A NEW

OF

ARTS and SCIENCES,

SHEWING THEIR

AND EXHIBITING

The *Invention*, *Structure*, *Improvement*, and *Uſes*,

Of the moſt conſiderable

WITH

Their *Nature*, *Power*, and *Operation*,

DECYPHERED IN

IN TWO VOLUMES.

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THE INTRODUCTION

CONCERNING

ACADEMIES, and ACADEMICAL LEARNING.

IT is a general Obſervation, that all Men retain a certain innate Affection for the Place of their Nativity. And ſhall it be ſaid that a Genius can forget the Place of his Improvement in Knowledge? Are not the Endowments of the Mind as valuable, as the Gratifications of Senſe in the Enjoyment of our natural Soil? Therefore it would be an unnatural Contempt of thoſe *Nurſeries of Learning*, ſhould we enter upon a Work of this Kind, without paying due Tribute to ACADEMIES, to which we are greatly indebted for moſt of the uſeful Improvements in the ſeveral ARTS and SCIENCES.

ACADEMY in its ſimple and primitive Senſe, was no other than the Houſe of a certain Nobleman, named *Academus*, ſituate without the Walls of the famous Univerſity of *Athens*; to which he invited all Men of Learning: And it was honoured by *Plato* and others, who reſorted thither to hold private Philoſophical Conferences; which perhaps, were preparatory for, or not allowable to be diſputed in, the *Areopagus*. — A Cuſtom, which afterwards prevailed in other Countries near the Seats of Learning, as we are informed by Hiſtory; till at laſt we have ſeen ſuch Societies of learned Men regularly inſtituted, under the Protection of Princes, for the Cultivation and Improvement of Arts and Sciences, under the Name of *Academies*, in memory of their Founder *Academus* the *Athenian*.

Cicero likewiſe had his *Academy*, or Country-houſe for the Entertainment of his Philoſophical Friends: to whoſe Conferences the World is indebted for his *Academical Queſtions*, and for his Books on *the Nature of the Gods*.

But the *Academies* in after Ages extended the Subjects of their Enquiry. For the Members of *that* inſtituted by *Charlemaigne* at *Paris*, under the Direction of *Alcuin* (an *Engliſh* Monk) and compoſed of the firſt Wits of the Court, were employed in making judicious and learned Reflections upon ſome ancient and claſſical Author in every Branch of Literature.

We have ſince found this Name appropriated to Places ſet apart for the Improvement of ſome particular Sciences.

In ENGLAND we have the *Royal Society*, whoſe Buſineſs is to make faithful Records of all the Works of *Nature* and *Art*, which come within their Reach. And how well they have executed this Plan is eaſily diſcovered by a Peruſal of their *Philoſophical Tranſactions*, containing a vaſt Collection of Experiments and Obſervations on moſt Parts of the Works of Nature; Hiſtories of Arts, Manufactures, Engines, *&c.* and Improvements in civil, military and naval Architecture; Navigation, Trade and Agriculture. Theſe Tranſactions, are in great Eſteem, and, with a few Intermiſſions, have been regularly publiſhed ſince 1665.

This

This Society seems to owe its Origin to the Necessity of the Times; when Party Zeal and civil Discord obstructed the free Intercourse of the Learned in our Universities. For, it began, like that in the House of *Academus*, in *Wadham College*, *Oxford*, where Dr. *Wilkins* entertained the brightest Genius's of his Time for the Promotion of natural and experimental Philosophy, in his private Apartment; till the Jealousy of *Oliver*'s Protectorate obliged them to discontinue their Meetings. However many of the Members taking up their Abode in *London*, we find them reviving at *Gresham College* in that Metropolis, about the Year 1658; where they acquired so much Reputation, that in the beginning of the Year 1663, King CHARLES II. incorporated this *Academical Society* by the Name and Stile of *The President, Council, and Fellows, for the promoting the Knowledge of natural Things and useful Experiments.*

This illustrious Body consists of Persons eminent for their Birth, and for their Knowledge in the Arts and Sciences they profess; amongst whom we find several Princes. Each of these Members at his Admission subscribes an Engagement, That he will endeavour to promote the Good of the Society: Which since its Incorporation is, by way of Eminence, distinguished by the Name of *The Royal Society*; King CHARLES himself designing to become a Member thereof.

The Reputation of this Establishment raised an Emulation in the Promoters of other Branches in the ARTS and SCIENCES; especially amongst the Masters of *Music* and *Painting*. For we find upon Record a *Royal Academy* for *Music*, and another for *Painting*, established by Letters Patents, and put under proper Directions; though at present they seem to have dwindled away.

Some Attempts have, of late Years, been made to form an *Academy* in LONDON for promoting *Sculpture*. And there is a flourishing SOCIETY for promoting ARTS *and* MANUFACTURES, which is supported by Gentlemen of great Eminence for Birth and Learning, and begun with a noble Design to encourage *Art* and *Industry*, and to discover the necessary Means to improve *Agriculture* and the *Manual Arts*, as well as other Branches of useful Knowledge: Tho' neither of these Societies, which are conducted upon *Academic* Principles, and for *public* Utility, have the Sanction of a Royal Charter.

The Society of *Antiquarians* in *London*, is an *Academy* or Meeting of Men learned in all curious Pieces, which are capable of giving any Light into the Lives, Actions, Customs, Manners, Buildings, *&c.* of the Ancients. It is said to have been founded by Mr. *Camden*, in Company with Sir *Robert Cotton*, *Stow*, and others; and we find that *R. Carew* was admitted a Member thereof in 1589. These Gentlemen applied to Queen *Elizabeth* for a Charter, and the Grant of a House for holding their Meetings, erecting a Library, *&c.* but her Death deprived them of their Expectations.

We hear no more of this excellent Institution till the Year 1717, when this Society was revived by a select Number of the Nobility, Gentry, Clergy and other learned and ingenious Men, whose Business is to discover the Antiquities of our own, as well as of other Nations. There has been no Interruption since its Revival; but it now flourishes under favour of a Royal Charter, dated 2 *November* 1751, by which the Number of its Members is limited to one Hundred and Fifty.

The College of *Physicians* in *London* is mentioned by the Author of *Mem. de Trev.* under the Name of *Academy*: And the Institution of *Gresham* College in the same Metropolis deserves the same Appellation: The former being established for the Improvement of *Physic*; the latter for Lectures in *Divinity*, *Civil Law*, *Astronomy*, *Geometry*, *Rhetoric*, *Physic* and *Music*; founded by Sir *Thomas Gresham* in 1581, with sufficient Salaries for the several Professors, and genteel Apartments for their Lodging.

In FRANCE we meet with *Academies* of various Kinds: The principal is the *Royal* ACADEMY *of Sciences* at *Paris*; which owes its Existence to *F. Mersenne* in the Beginning of the 17th Century, who entertained *Gassend*, *des Cartes*, *Hobbs*, *Robersal*, *Pascal*, *Blondel* and other eminent Philosophers, and proposed to each of them certain Problems to examine, or Experiments to be made. These private Meetings were followed by more public ones under the Direction of Mr. *Montfort* and M. *Thevenot*, the celebrated Traveller; till, in the Year 1666, it obtained the Royal Sanction, and was constituted a Society for the Improvement of *Physics*, *Mathematics* and *Chemistry*. But this Society was not honoured with the Name of *Royal* till the Year 1699; when his Majesty, by a Regulation, dated on 26 *January* of that Year, gave it a new Form, and placed it upon a more solemn Footing: By which it was ordained that the *Academy* should be composed of ten *Honorary* and ten *Eleves* Members, and of twenty *Pensionary* and twenty *Associate* Members. — That the *Honorary* Members should be all *Reciprocales*, and all the *Eleves* and *Pensionaries*, Inhabitants of *Paris*, and that eight *Associates* might be Foreigners: To be governed by a President, named yearly by the King out of the Honorary Members, and by a Secretary and Treasurer, who were to be perpetual.

It was also ordained that the Secretary and Treasurer should be chosen out of the *Pensionaries*, and that the remaining eighteen of that Class should be divided into three *Geometricians*, three *Astronomers*, three *Mechanics*, three *Anatomists*, three *Chemists* and three *Botanists*: — That two *Associates* should apply themselves to *Geometry*; two to *Botany*, and two to *Chemistry*: — That all the *Eleves* should apply themselves to some kind of Science; but never speak, except called up thereto by the President: — That no Regular nor Religious should be admitted, except an *Honorary* Member; nor any one admitted a *Pensionary* or *Associate*, who had not distinguished himself by some considerable Work in Print, or by some useful Machine or Discovery.

The *Academy* thus composed was allowed to meet twice a Week in the King's Library; and afterwards in a more convenient Apartment in the *Louvre*; where they transacted literary Business for two Hours at least: And every *Pensionary*, at the Beginning of the Year declared in Writing, what Work he intended to prosecute chiefly in that Year, with an Invitation for the Assistance of every Member.

His Majesty not only dignified them with his *Royal* Sanction; but to encourage them in the Pursuit of the Sciences, he gave besides their ordinary Pensions, some extraordinary Gratuities for Performances of superior Merit; bearing also the Expence of Experiments, Printing, Engraving, and of other Enquiries and Incidents necessary for improving the Subjects undertaken by the *Academists*; if approved and signed by the President.

But as this Regulation, in course of Time, was found too confined, and excluded many foreign Artificers and Mechanics, who excelled in Professions not yet brought to Perfection in *France*; the Duke of *Orleans*, Regent of the Kingdom, in the Year 1716, in order to invite over Foreigners, augmented the Number of *Honorary* Members and of *Associates* capable of being Foreigners: Admitted Regulars amongst such Associates: Suppressed the Class of *Eleves*, and in Lieu thereof, established twelve *Adjuncts* to the six several Sciences cultivated principally by the *Academy*. He also appointed a *Vice-president* to be chosen annually by the King out of the *Honorary* Class; and a *Director* and *Sub-director* from amongst the *Pensionaries*.

Their Motto is *Invenit & Perfecit*: and their Proceedings are published under the Title of *Histoire de l'Academie Royale*, &c. But no Member is allowed to make use of his Quality of *Academist*, in any private Work he shall publish, before it has been read to, and approved by, the *Academy*.

Before this Institution we meet with another under the Name of the *French Academy*, which was at first a private Assembly of the Learned in the House of M. *Courant* at *Paris*, *Anno* 1628. and afterwards established in 1635 by Cardinal *Richlieu*, under *Lewis* XIII. for refining and ascertaining the *French* Language and Style. The Number of its Members was confined to *Forty*; who have generally been Persons of the greatest Distinction in the Church, the Army, and at the Bar.

The primary Object of the Labours in this *Academy* was the compiling of a *Dictionary* for a Standard of the *French* Tongue: But that Performance was so long in *Embryo*, that the Public had almost lost all Hopes of ever seeing it: And when after Forty Years and upwards, these Forty Members were lampooned into the Necessity of publishing their Dictionary, the learned were extremely disappointed in their Expectations.

Its modern State may be gathered from a humorous Writer, who in the Year 1737 informs his Correspondent, "That the *French* Academy had then produced nothing but a System of Compliments, "and consisted of Forty Persons, who met three times a Week, and paid their Attendance very regu-"larly; because the King gives a Silver Medal to every one that attends, and permits the Medals of "the Absenters to be distributed to the Members present. Their Meetings for near fourscore Years "past, says he, have been spent in Harangues of Congratulation and Reception, and in commending "each other to the Skies. They applaud one another for their Merit and Talents, and then return "home. They sometimes are wholly employed in the spelling of a Word or accenting of a Syllable; "upon which Occasion the whole Academy labours, disputes and studies for about six Months, and "then pass Sentence of Death upon some insignificant Word or Syllable. This *Academy* was fifty "Years about a Dictionary, of which they were continually publishing Praises before hand; but when "it came out, it was universally despised. That which compleatly ruined its Character was another "Dictionary compiled by *M Furitiere* only, a Member of this Academy, which was published at the "same Time, and generally esteemed. The Academy was resolved to revenge their injured Honours "and to ruin the Man effectually: And therefore expelled him for no other Crime than for having "merited the Applause of the Learned World.

"In the Reign of *Lewis* XIV. all the great Men were Members of this Society, and were admitted "by the Royal Mandate: But since his Death they have been succeeded by a Rabble of Ecclesiastics, "Prelates and Fops: Nay they have admitted Stage-Players, *French Comedians*, and preferred two or "three Buffoons and Merry-Andrews to five or six Men of the first Class."

This Academy distributes two Prizes annually, one for an eloquent Discourse, whose Subject shall be proposed and taken out of the *New Testament* by the Academy. This is the Gift of Mr. *De Belzac*.

The

The other is given by the Academy, which is to be for the best Poem in Praise of the King, and proposed by the Academy also.

The Merit of these Pieces directed to the Secretary, and distinguished by some Motto, Letters, or Characters, is decided by a Committee of the Members delegated for that Purpose; who appoint the Day for distributing the Prizes, and for publickly reading and printing the Discourse and Piece of Poetry, which they judge to have deserved it.

The *Academy* of *Painting* and *Sculpture* established at *Paris* by Cardinal *Mazarin*, and the Chancellor *Seguier* is still in good Repute. It consists of a Director or President, a Chancellor, four Rectors, a Treasurer, twelve Professors, *Adjuncts* to the Rectors and Professors, Counsellors, a Secretary, a Professor for *Anatomy*, and another for *Geometry* and *Perspective*.

Members are admitted either as *Painters* or *Sculptors*. And Painters are to be admitted according to their several Branches: Some as Painters of History: Others, as Painters of Portraits: Others, as Painters of Landskips, Beasts, Fruits, Flowers, or in Miniature: Others, as only Designers, Engravers, Carvers, *&c.*

They expose their Works once a Year in the great Hall of the *Louvre*: The best Performances are rewarded with a Prize: And they, who shall be thus distinguished for their Works have a Right to Admission and Entertainment for three Years in an *Academy* of Painting, Sculpture, *&c.* established at *Rome* by *Lewis* XIV. for their further Improvement.

The *Academy of Medals and Inscriptions* at *Paris* is a Legacy to the Literary World by M. *Colbert*, who gave it Being in the Year 1663, and appropriated their Labours to the Study and Explanation of antient Monuments, and to the perpetuating of great and memorable Events, especially those of the *French* Monarchy, by Coins, Relievo's, Inscriptions, *&c.*

Its first Institution consisted only of *four* or *five* Members: But in 1701, they were encreased to *forty*, viz. Ten *Honoraries*; ten *Pensionaries*; ten *Associates*; ten *Novices* or *Eleves*, under the Direction of a President and Vice-President, who are annually appointed by the King. The Secretary and Treasurer are perpetual.

Their chief Employ has been upon the *Metallic History* of the Reign of *Lewis* XIV. But the Learned are indebted to this Academy for many Volumes of Essays on other Parts of History, published under the Title of *Memoirs*, &c. See the *Hist. de l'Acad. Roy. des Inscrip.* PARIS, 4*to*, & AMSTEL. 12*mo*.

The *Chirurgical Academy* in *Paris* is a modern Institution, erected by public Authority, for publishing their own and their Correspondents Observations and Improvements in *Surgery*; to give an Account of all that shall be published on *Surgery*, and to compile a complete History of this Art from the Works of all ancient and modern Authors on this Subject.

The *Academy of Dancing* seemed to be the most highly favoured by the late King of *France*. His Royal Privileges to this Society indicate a true Estimate of the Levity of the *French*. But

The *Royal Academy* of *Belles Lettres* at *Caen* in *Normandy*, by Letters Patent in 1707, does Honour to his Memory. This rises from the private Conferences held by the Learned in and about the City in the House of M. *de Brieux*, about fifty Years before M. *Foucault* procured their Incorporation into a perpetual *Academy*. Their Charter nominated M. *Foucault* Protector thereof for his Life, with Power for him to chuse *thirty* Members; after his Demise, the Choice of Protector and Members was left to the Society, with Leave to add *six* more Members to be elected out of the *Ecclesiastical Communities* in the City of *Caen*.

At *Lyons* in the same Kingdom is an *Academy* of the Learned. It consists of *twenty* Members, a Director and a Secretary; who have shewn themselves inferior to none of the *Royal Academies*, by their learned Dissertations; amongst which is one upon *Infinity* by *F. Lombard*, a *Jesuit*: See *Nouv. Liter. T.* 2. *p.* 82.

The *French* have also Academies at *Montpelier*, *Nismes*, *Arles*, *Angiers*, &c.

If we travel over the *Alps*, it will be seen that ITALY, the ancient Seat of Literature, has abounded most with *Academical Institutions*.

At BOLOGNA there was established an *Ecclesiastical Academy* in 1687, for the Examination of the Doctrine, Discipline, and History of each Age of the Church.

Here was the *Academy Degl' Inquieti*, which united with the *Academy Della Traccia*. They met in the House of the Abbot *Stut. Sampieri*, and were highly entertained with the Physical and Mathematical Discourses of *Geminiana Montanari*, one of the Members, published in 1667, under the Title *Pensieri Fisica Matematici*. The Members afterwards met in the House of *Eustachio Manfredi*; then in that of *Jacob Sandri*, but arrived at its greatest Lustre in the Palace of *Marsilli*.

In this City alſo is an *Academy of Arts and Sciences*, called *the Inſtitute of Bologna*, founded in 1712 by Count *Marſigli* for cultivating of *Phyſics*, *Mathematics*, *Medicine*, *Chemiſtry*, and *Natural* Hiſtory. Whoſe Hiſtory is publiſhed by M. *de Limiers* in 8vo. 1723, at *Amſterdam*.

To this add the *Sitientes* in the ſame City, who apply themſelves particularly to *Law*.

At VENICE is a *Coſmographical Academy*, called the *Argonauts*, inſtituted for the Improvement of *Geography* by the Intereſt of *F. Coronelli*. Their Plan was to make and publiſh exact Maps, both Geographical, Topographical, Hydrographical, and Ichnographical of the Celeſtial and Terreſtrial Globes, and the ſeveral Regions and Parts thereof, together with Geographical, Hiſtorical, and Aſtronomical Deſcriptions. Each Member in order to ſupport the Expence of ſuch a Society, is obliged to ſubſcribe a proportionate Sum towards raiſing the Money for publiſhing their Improvements. And for the more effectual Execution of this grand Deſign they eſtabliſhed two correſponding Societies, one at *Paris* and the other at *Rome*. In all three, the *Argonauts* number 196 Members; and their Device is the Terraqueous Globe with the Motto, *Plus ultra*.

Here are alſo three *Academies of Sciences*: One called *La Veneta*, founded by *Frederic Badoara*, a noble *Venetian*: Another, which acknowledges *Campegio*, Biſhop of *Feltro* for its Founder: And a third named *Conſenza* or *la Conſentina*; amongſt whoſe Members are numbered the celebrated Philoſophers *Teleſio*, *Quatromanni*, *Paulus Aquinas*, *Cavalcanti* and *Fabio Cicali*.

At NAPLES we read of the firſt *Academy of Sciences*. It was known by the Name of the *Academy Secretorum Naturæ*, firſt form'd for the Improvement of Natural and Mathematical Knowledge in the Houſe of *Baptiſta Porta*, about the Year 1560.

In the ſame Kingdom we meet with the *Academy* of *Roſſano*, called *La Societa Scientifica Roſſaneſe. Degl'Incurioſi*, which was founded about the Year 1540, by the Title *Naviganti*, and changed its Name to *Spenſierati* about the Year 1600, when it was renewed by *Camillo Tuſcano*.

This Academy underwent another Change in 1695, when *Don Giacinto Gimma*, its Preſident got it transformed from an *Academy of Belles Lettres* into an *Academy of Sciences*; at which Time he gave them a new Set of Regulations, and divided the Members into *Grammarians*, *Rhetoricians*, *Poets*, *Hiſtorians*, *Phyſicians*, *Mathematicians*, *Philoſophers*, *Lawyers*, and *Divines*; with a Proviſo for the Admiſſion of Cardinals and Perſons of Quality.

The *Academy of Arcadi* eſtabliſhed at *Rome* in 1690 for reviving the Study of *Poetry* and the *Belles Lettres*, has been honoured by many Princes, Cardinals, &c. and conſiſts of the moſt polite Wits of both Sexes in *Italy*; who to avoid Diſputes about Precedence, were obliged to come all maſked in Dreſſes reſembling the Shepherds of *Arcadia*: and at their firſt ſetting off, they uſed to meet ſeven Times in the Year in a Meadow or Grove; but now they are entertained in the Gardens of the Duke of *Salviati*; where they recite the Compoſitions of the Members. The ſix firſt Meetings are allotted for reciting the Poems and Verſes of the *Arcadi* reſiding at *Rome*; and every one reads his own Compoſition; except Ladies and Cardinals, who are allowed to depute another Shepherd in their ſtead: And at the ſeventh Meeting are read the Compoſitions of foreign or abſent Members. It does not appear how many Members this Academy comprehends; but we know that their Number amounted to 600 within ten Years from its firſt Eſtabliſhment.

At ROME ſeveral learned Men under the Name of *Lyncei* eſtabliſhed an *Academy* of *Sciences*, ſoon after that at *Naples*. Several of whoſe Members, amongſt whom was the celebrated *Galileo Galilei*, are famous for their Diſcoveries.

At FLORENCE is the *Academy* of *Umidi*, known alſo by the Name of *Florentina*, in Honour of the Grand Duke *Coſmo* I. its Protector in 1549. It is illuſtrious both for the Works it has produced and for its Members, who for more than two Ages have been Perſons of the moſt Eminence in all *Italy*.

Their chief Attention is bent to the *Italian Poetry*; ſo that they ſpend much Time in commenting, &c. on *Dante* and *Petrarch*, their chief Authors in that kind of Learning.

Neverthleſs this *Academy* has contributed greatly to the Progreſs of the Sciences by giving excellent *Italian* Tranſlations of the ancient *Greek* and *Latin* Hiſtorians.

In the ſame City and in the Year 1582 aroſe the *Academy della Cruſca*, which has eternized its Name by the famous Dictionary of the *Italian* Tongue. And the Diſcourſes delivered in this Academy by *Torricelli*, the celebrated Diſciple of *Galileo*, concerning Levity, Wind, Power of Percuſſion, in Mathematics and Military Architecture, convince that theſe Academiſts did not confine their Labours to Words only.

At FLORENCE also is the *Academy del Cimento* under the Protection of Prince *Leopold* Cardinal *de Medicis*. *Redi* was one of its chief Members; and the Studies pursued by the rest may be collected from those curious Experiments published by Count *Laurence Magulotti*, their Secretary in 1667, under the Title of *Saggi di naturali Esperienze*, presented to the *Royal Society* in *London*, and published in *English* by Mr. *Waller* in 4to.

I could tire your Patience in the Recital of the Number and Variety of *Academies* in *Italy*, which has more *Academies* than all the rest of the World: For the *Italians* are very vain of the Title of *Academists*, which to them seems an essential Part of a regular Constitution. At *Milan* only there are twenty-five *Academies*, and not less than Five Hundred and Fifty in all *Italy*; but none of them very famous, except those set apart for *Music*, *Painting* and *Sculpture*: And even these are much degenerated from the Skill of their Ancestors.

Let us give due Honour to the *Academy of Filarmonici* at *Verona*; whose Members, though they apply themselves to the *Belles Lettres*, don't neglect the *Sciences*. The *Academy of Ricovrati* at *Padua* exists with Reputation, as may be collected from the Discourse on the *Origin of Springs*, by *Ant. Vallisnieri* one of its Members; who also has given the learned World a Sample of the Studies of his Colleagues in the *Academy* of the *Monti de Reggio* at *Modena*, in his excellent Discourse on the *Scale of Created Beings*, inserted in his History of the Generation of Man and Animals, printed at *Venice* in 1723.

GERMANY is not destitute of *Academies*: And perhaps that called the *Leopoldine* differs from all others.

It is named also the *Academy* of *Naturæ Curiosi*, begun by private Conferences in the House of *Jo. Laur. Bauschius*, who invited all *Physicians* to communicate their Observations of extraordinary Cases. His Associates meeting with Encouragement, chose him President. But the Society was not fully established till the Presidentship of *Jo. Mich. Fehr*.

Their Works were originally published separately. But in 1670 it was agreed to publish their Observations periodically, by a Volume every Year. The first annual Volume did not make its Appearance till the Year 1684. It had the Title of *Ephemerides*. This Publication has been continued under some Interruptions, and under various Titles, *&c.*

In 1687 the Emperor *Leopold* granted this *Academy* several Privileges; particularly that their Presidents should be Counts Palatine of the Holy *Roman* Empire.

It consists of a President, two Adjuncts or Secretaries, Colleagues or Members without Restriction: Who at their Admission engage to handle some Subject in the Animal, Vegetable, or Mineral Kingdom, not treated of by any other College, and to furnish Materials for the Annual *Ephemerides*. Each Member also is to wear a Gold *Ring*, whereon instead of a Stone is a *Book open*, and on the Face thereof an *Eye*; and on the other Side the Motto, *Nunquam otiosus*.

The greatest Peculiarity in this *Academy* is its inconstant Situation. It has no fixt Residence or regular Assemblies. It is confined to a *Bureau* or Office first established at *Breslau*, and afterwards removed to *Nuremberg*; where Letters, &c. from its Members and Correspondents are acceptable, till it be necessary to remove to some other Place of Safety.

At BERLIN, *Frederic* I. the late King of *Prussia* in the Year 1700 founded a *Royal Society*, which besides the Improvement of natural Knowledge, is engaged in the promotion of the *Belles Lettres*. By the Charter, which was amended in the Year 1710, it is granted, that the President shall be nominated by the King, and be one of the Counsellors of State.

The Members are divided into four Classes: I. For *Physic*, *Medicine* and *Chemistry*; II. For *Mathematics*, *Astronomy* and *Mechanics*: III. For the *German Language* and the *History of the Country*; and the IVth. For the *Oriental Learning*, particularly as it may concern the Propagation of the Gospel amongst Infidels.

Each Class elects a Director for themselves, who is continued for Life. They meet once a Week alternately by their Classes in the Castle called the *New Marshal*. The Members of any of the Classes have free admission into the Assemblies of any of the rest.

The great Promoter of this Foundation was the celebrated *M. Leibnitz*, who was made the first Director.

The present King, *Frederic* II. is said to be a Member thereof; and has thereby occasioned many to give it the Name of the *Academy of Princes*. By his Countenance and Influence many learned Men from all Nations have raised its Reputation throughout the Literary World.

Before

Before we leave the Northern Climes let us travel to RUSSIA, and we ſhall find an Academy of a particular and excellent Inſtitution, founded by Czar PETER *the Great*, at *Peterſburg*, who modelled it upon the Plan of the *Academy of Sciences* at *Paris*, but did not live to finiſh his Deſign: which was carried into Execution and completed by *Catherine* his Relict and Succeſſor upon the Throne.

This Academy held its firſt Public Meeting in *December* 1725, and was favoured with the Preſence of the Duke of *Holſtein*, and a large Number of other noble Perſonages.

The Czar invited hither the Learned from all Parts of *Europe*, and eſtabliſhed regular Profeſſors with good Salaries to read ſtated Lectures in the ſeveral Faculties.

The ordinary Meetings are twice a Week, in a very ſumptuous Building, furniſhed with a good Library, and an Obſervatory, *&c.* and thrice in the Year there is a public or ſolemn Meeting, in which is rendered an Accout of what has been done in the common Aſſemblies.

Their Buſineſs is not only to promote the Study of the *Arts* and *Sciences*; but they are employed in Compiling a RUSSIAN *Dictionary*, *Grammar*, &c.

JOHN V. King of PORTUGAL founded a *Royal Academy* for the collecting and aſcertaining the *Hiſtory* of his own Kingdoms and Dominions. It was inſtituted in the Year 1720, and the Marquis *de Allegrette* was appointed Secretary thereof.

This Inſtitution was honoured by a Medal with the Effigy of King JOHN V. on one Side, with the Legend JOANNES V. LUSITANORUM: and on the Reverſe is the ſame Prince ſtanding, ſupporting and raiſing HISTORY almoſt proſtrate before him, with the Legend HISTORIA RESURGES: and below is this Inſcription REG. ACAD. HIST. LUSIT. INSTIT. VI. Idus Decembris MDCCXX.

This Academy conſiſts of fifty Members, a Director, four Cenſors, and a Secretary.

None are admitted to be Members, who have not given great and public Examples of their Abilities, and after Admiſſion every Member is obliged to treat of ſuch part of the Eccleſiaſtical or Civil Hiſtory of the Nation, as ſhall be preſcribed by the Director.

The Method obſerved in compiling *Church Hiſtory*, the Hiſtoriographer is to relate diſtinctly in twelve Chapters, an Account of the Prelates, Synods, Councils, Churches, Monaſteries, Academies, Perſons illuſtrious for Sanctity or Learning, Places famous for Miracles or Relicks, to be found in each Dioceſe. And in the purſuit of the *Civil Hiſtory*, he is to relate the Tranſactions of the *Romans*, *Goths*, and *Moors* during their Government in this Country: the Genealogies of the Kings; the Wars and Acquiſitions in *Aſia*, *Africa*, and *America*, and to give the ſeveral Treaties, and other Matters relating to the Political and Military State of the Kingdom.

The Meetings for carrying on this uſeful Inſtitution, are to be held once in fifteen Days. And thoſe Members, who are diſperſed in the Country, are enjoined to employ their Time in making Extracts and Collections of all the Regiſters *&c.* within the particular Diſtricts, where they reſide.

This Foundation was, in the next Year, followed by a ſimilar Inſtitution of an Academy for *Suabian Hiſtory* at TUBINGEN; where ſeveral Gentlemen eminent for Letters aſſociated with an Intention to Publiſh the beſt Hiſtorical Writings, the Lives of the chief Hiſtorians, and for Compiling new Memoirs, on the ſeveral Points and Periods thereof.

SPAIN alſo boaſts of her *Royal Academy* at *Madrid*. This Foundation was laid by Don *Joan Emanuel Fernandes Pacheco*, Duke *d'Eſcalona*, in his own Palace, with ſeven Aſſociates; who held their firſt Meeting in *July* 1713.

Their Number was preſently increaſed to Twenty-two *Academiſts*; and the Founder being choſe Preſident or Director, and Don *Vincent Squarcafigo* Secretary, they petitioned for, and obtained the King's Confirmation and Protection in 1714.

In this Charter they are enjoined to cultivate and improve the *National Language*. In order to which, they are to begin with chuſing carefully ſuch Words and Phraſes, as have been uſed by the beſt *Spaniſh* Writers; noting the low, barbarous or obſolete ones, and compiling a *Dictionary* in which theſe may be diſtinguiſhed from the former, *&c.* by which Method, adds that Prince, it will clearly appear that the *Caſtilian* Tongue is inferior to none of thoſe moſt eſteemed in the World; and may be employed with Advantage either in teaching the *Arts* and *Sciences*, or in expreſſing the moſt perfect *Latin* or *Greek* Originals in exact Tranſlations, when the Dictionary ſhall be finiſhed, they are to compile a Grammar, and Hiſtory of the *Spaniſh* Tongue.

The Duke *d'Eſcalona* was conſtituted Director for Life: But it was ordained that, after his Deceaſe, the Members, who were confined to Twenty-four in Number, ſhould chuſe a Director annually.

For greater Encouragement the *Academists* are favoured with the Privileges and Immunities enjoyed by the Domestic Officers, who are actually in the King's Service, and in the Royal Palace. The Secretary is for Life; and their Motto is *Limpia, Fija, y da Esplendor*, i. e. *It purifies, fixes, and gives Brightness.*

ACADEMIA, in an exalted Degree, has been commonly used to signify a UNIVERSITY, as *Academia Oxoniensis*, the *University of Oxford*; and *Academia Cantabrigiensis*, the *University of Cambridge*; because in each University are usually taught *Theology*, *Medicine*, *Law*, *Arts* and *Sciences*. But these Repositories of Learning ought rather to be considered as *Universal Schools*, not only because they improve the whole Compass of Literature; but on Account of their being an Assemblage of several Colleges or *Academical* Societies established under one form of Government, and partaking of the same Privileges and Immunities; wherein Students in the several Sciences are trained up by established Professors; and *Academical* Degrees or Certificates of Study, in the divers Faculties, are granted on certain Conditions: though, it is certain, this Institution, in the *Literary World*, took its rise from a Custom, in or about the *eighth* Century, set a foot by the *Monastic Orders*, of erecting *Seminaries* or *Public Schools* in some pleasant and happy Situation for training up not only their own Novices, but for the Instruction of the Children of the Nobility and Gentry.

In this State they continued till almost the *thirteenth* Century. For, though the University of *Paris* endeavours to carry its Origin up to the Year of CHRIST 814, when four *Englishmen* Disciples of Venerable *Bede*, read public Lectures on the *Sciences* in certain Places assigned to them by *Charlemaign*; it can be proved beyond all Dispute, that it was not considered under the Acceptation of an *University*, till about the middle of the *twelfth* Century, when *Peter Lombard* Bishop of *Paris*, is supposed to have obtained the Incorporation of all the public Schools or Colleges under the single Denomination of an UNIVERSITY: For which Benefaction his Anniversary is kept in that University to this Day.

The most celebrated Colleges in this University for *Theological* Learning are the *Sorbonne* and *Navarre*.

The College of *Sorbonne* takes its Name from *Robert de Sorbonne*, who dedicated his own House to the Study of Divinity in 1254; which owes the present Magnificence of its Building, great Halls for Disputations, &c. and of its Church, to the Magnificence of Cardinal *Richelieu*.

There are six Residentiary Doctors or Professors in the *Sorbonne*, who each give a Lecture of half an Hour every Day; three in the Morning, and three others in the Afternoon.

The College of *Navarre* was founded by *Jane* of *Navarre*, Countess Palatine of *Champagne* and *Brie*, Wife of *Philip the Fair*, King of *France* in 1304, with an Obligation upon the Professors to read two Lectures in *Divinity*, Morning and Evening daily.

In this City are found *fifty three* other Colleges, many of which *Philip the Fourth* in 1295, and *Lewis Hutin* his Son, and *Philip de Valois* in 1340, incorporated into one Body, and honoured with very great Privileges and Immunities. These are confined to the study of Divinity.

But there are other Colleges for the Study of the *Canonical* and *Civil Law*, and for *Medicine*.

In the Street of St. *John de Beauvois* are six Professors, who read public Lectures, each of them once a Day, besides a Professorship for the *French Law* in particular, founded in this College by *Lewis* XIV.

In the Street *de Bucherie* is a College for the study of *Medicine*, founded in 1469, in which is a large *Anatomical* Theatre, and it is famous for the Education of several eminent Physicians, amongst whom the Faculty mentions the learned *Ferrel*, with Respect, who was Physician to *Henry* II. of *France*.

However, the *Faculty of Arts* is the Mother of all the other Colleges. From this Foundation is always taken the *Rector*, who is an elective Dignitary, that seldom continues more than *three*, and never yond *nine* Months.

The *Rector* is the highest Post or Office in the University of *Paris*; whose Privilege is to take Place of all Personages, except the Princes of the Blood. In public Arts he has a Right to precede the Pope's Nuncio, and Foreign Ambassadors, as well as the Dukes and Peers of *France*; and at the King's Funeral he walks a-breast with the Archbishop of *Paris*. His Robes are, a Violet Gown tied with a Violet Sash, adorned at both Ends with Gold Glands; at his Side hangs the *Escarcelle*, an old fashioned Violet coloured Velvet Purse trimmed with Gold Lace and Buttons. Over all flows a Mantelet of white Ermine, which reaches to the middle of his Arms.

The *Faculty of Arts* is divided into four Nations: I. The Nation of *France*: II. The Nation of *Picardy*: III. The Nation of *Normandy*: IV. The Nation of *Germany*; which includes *English*, *Irish*, *Scotch*, *Italians*, &c. and is divided into very large Provinces.

The *Provost of Paris*, for the Time being, is Conservator or Chancellor of this University; and it is worthy of Notice, that almost all these Colleges have been founded for poor Students both Natives and Foreigners;

Foreigners; and that none can be admitted to enjoy the Benefits of their Foundation, but ſuch as are not in a Capacity to pay the Expences of an Univerſity Education: All others who ſtudy in thoſe Colleges being obliged to pay for their Board, Lodging, *&c.* except Learning, which is given to every Body without Diſtinction, that are deſirous to attend the public Lectures.

FRANCE has alſo its Univerſities.

		A. D.
At *Toulouſe* founded by	Pope *Gregory* XI.	1233
Bourdeaux,	King *Lewis* XI.	1473
Poictiers,	*Charles* VII.	1431
Orleans,	Pope *Clement* V.	1305
Bourges,	King *Lewis* XI.	1465
Angiers,		1346
Caën in *Normandy*,	*Charles* VII.	1452
Montpellier,	Pope *Nicholas* IV.	1289
Cahors,	Pope *John* XXII.	1332
Nantes,		1460
Rheims,	*Charles* Cardinal of *Lorrain*.	1548
Valence,	King *Lewis* XI. when Dauphin.	1458
Aix,	Pope *Alexander* V.	1409
Perpignan,	King *Peter* of *Arragon*.	1349
Beſancon,	Emperor *Ferdinand* I.	1564
Orange,		1365
Arles,		
Avignon,	Pope *Boniface* VIII.	1303
Douay,		
Louvain.	*John* Duke of *Brabant*	1426
Dole,	*Philip* Duke of *Burgundy*	1426
Fleche,	King *Henry* IV.	
Mountaban and *Soiſſons*,		
Pont-a-Mouſſon,	*Charles* Cardinal of *Lorrain*.	1573
Richelieu,	King *Lewis* XIII.	1640
Tournon,	*Francis* Cardinal *de Tournon*.	

At *Montpelier* is ſtudied the Faculty of *Medicine* with greater Applauſe than in any Place throughout all *Europe*: inſomuch that not only the King of *France*, but ſeveral other Potentates have granted the Graduates of this Univerſity the Privilege to practiſe *Medicine* in their Dominions without any Interruption.

At *Orleans* the Univerſity is founded on the Model of that at *Paris*. It enjoys the ſame Dignities. There is an Eſtabliſhment of four Profeſſors to teach the Civil and Imperial Law; to the Study of which *Philip the Fair*, in 1312, annexed many Privileges in favour of the Students, which were confirmed by the Bull of Pope *Clement* V. in 1367, who was a Native of *Bourdeaux*, and had ſtudied at *Orleans*.

By this Means here was a very great Conflux of Scholars from all Nations; who by certain Regulations, were compriſed under *ten* Nations: But theſe in 1538, were by an Arret of the Parliament of *Paris*, in the Reign of *Francis the Firſt*, reduced to *four*, viz. The FRENCH, which includes the *Bourgenois*, *Gaſcons*, and *Tourangeaux*: The GERMAN which includes *Lorrain*: PICARDY, which includes the *Champanois*: and NORMANDY, which includes the *Scotch*. But

The *German* Nation enjoy the greateſt Privileges granted by former Kings, and confirmed by the Letters Patent of *Henry* IV. dated *July* 15, 1608, and in *June* 1616, at *Paris*.

At *Angiers*, *Louis* II. Duke of *Anjou*, founded an Univerſity in 1348, and obtained for it ſeveral Privileges and Immunities both from the King and the Pope. Its firſt Inſtitution was for the Study of Law only; but *Henry* Duke of *Anjou*, and Brother to King *Charles* IX. added the Faculty of *Medicine*, and procured for it new Privileges. The famous *Rover*, Chancellor of *France*, *John Bodin* and other eminent Lawyers were Members of this Univerſity, which now has three Colleges in great Eſteem.

The other Univerſities diſperſed through the *French* Dominions are in great Reputation for their good Diſcipline and Care of their Students; but as they are all modelled on the *Pariſian* Plan, it will be excuſable cufable to pafs them over; I fhall only remark, That the *English Secular Priefts* have a very flourifhing College in the Univerfity of *Douay*, founded by Cardinal *Allen*, immediately after the Reformation took Place in *England*, for the fugitive Students and Profeffors that retired beyond Seas from the *Englifh* Univerfities. The Learning in this College is in great Reputation amongft the *Roman Catholicks*: But it is confined too much to *Claffical* Knowledge, *Ariftotelian* Philofophy, *Metaphyficks*, and *Polemical* Divinity; which laft feems to be the greateft Object of its Inftitution, Namely, to make the Members thereof expert Controvertifts in defence of the Church of *Rome*, and to breed up *Miffionaries* for drawing *Proteftants* into their Communion.

Here was written and printed the *Douay Bible* by the felf-fame Men, who had juft before publifhed their *Annotations* on the *New Teftament* at *Rheims*: neverthelefs, thefe *Collegians* have not for many Years been able to preferve themfelves from a Sufpicion and Charge of *Janfenifm*; becaufe in the grand Difpute amongft the *French* Clergy and Laity, they would not implicitly run into all the Extremes of the Fautors of the *Bull Unigenitus*; as the *Englifh Jefuits* feated at *Liege* and St. *Omers* have done.

The Advantages of *Univerfal Schools* or *Academical Societies* uniting under one Government becoming very obvious to other Nations, they began prefently to multiply throughout *Europe*. So that at prefent there is not to be found fcarce any one fovereign State, where this Inftitution has not taken Root, and become almoft an effential Part of its Exiftence; fo far as *Univerfities* are defigned to finifh the Education of fuch, as are devoted to the Church and State, or to any Branch of Literature. For, in *England* in particular the *Statute Law* has made the *Academical Degrees* of her own *Univerfities* a Condition (*fine qua non*) for the Tenure of certain Church Benefices, &c.

In the UNITED PROVINCES are the *Univerfities* of

Leyden founded by the *States* in the Year	1575
Utrecht —— —	1616
Franeker —— —	1585
Groeninghen —— —	1684
Harderwick —— —	1648

SPAIN in EUROPE has the *Univerfities* of

Salamanca founded by *Alphonfus* IX. King of *Leon* in the Year	1239
Alcala or *Complutum* by Cardinal *Ximenes*	1517
Granada, by the Emperor *Charles* V.	1537
Palencia —— —	1200
Baeza —— —	1538
Onate —— —	1543
Lerida, by Pope *Califtus* III.	
Offuna —— —	1549
Oviedo, by *Ferdinando Valdes*.	1536
Pampelon, —— —	1608
Saragoça, by the Emperor *Charles* V.	
Signenza, by Cardinal *Ximenes*.	
Taragona, by King *Philip* II.	
Valladolid, by Pope *Clement* VI.	1346

Sevill, *Toledo*, *Avila*, *Compoftella*, *Gandia*, *Huefca*, *Valencia*, *Tudela*, and *Murcia*, whofe Dates of Inftitution and Founders are not come to our Knowledge.

SPAIN in AMERICA has the *Univerfities* of

Mexico, founded by the Emperor *Charles* V. in the Year.	1551
Guatimales, by King *Philip* IV.	1628
Lima in *Peru*, by King *Philip* III.	1614
Quito, by King *Philip* II.	1586
St. *Domingo* in *Hifpaniola*, by King *Philip* II.	1558

PORTUGAL rivals her Neighbours with the *Univerfities* of *Evora*, *Coimbra* and *Lifbon*.

The Commentaries on *Ariftotle*'s Philofophy by the *Conimbricenfes* have done their Nation great Honour; and were formerly a Tutor's Book recommended to the perufal of the Under-graduates in *Oxford*.

At *Lifbon* is an *Univerfity* founded by Pope *Nicholas* IV. A. D. 1290, and before the late Earthquake laid that City in Ruins it had many Colleges, but none in greater efteem for Learning and Difcipline than the *Englifh* College of *Secular Priefts* dedicated to the Apoftles St. *Peter* and St. *Paul*.

This College by particular Privilege is exempt from the Jurifdiction of the *Univerfity* of *Lifbon*, which till lately was under the Government or Direction of the *Society of Jefus*.

This Inftitution is a Branch of the *Secular Englifh Clergy* detached from *Douay*, who were invited to *Lifbon* and fixed in a convenient Situation, in *Bairo Alto*, by *Don Lewis d'Acunha*, to be a *Seminary* for *Miffionaries* to be fent to obftruct the Progrefs of the Reformation in *England*.

The Founder did little more than find them a Houfe and fpacious Gardens in the moft confpicuous and pleafanteft Part of the City. But what by private Donations and Subfcriptions both in *Portugal* and in *England*, they foon improved their Habitations with a Church and proper Offices.

At the Time of the Earthquake most of the old decayed Buildings had been replaced with a capacious Stone Dormitory, agreeable Apartments for the President and other Officers; towards which the late King *John* V. had contributed by a large annual Pension for many Years.

There are none admitted into this College but such as are Natives of *England* or *Wales*, or born of *English* or *Welch* Parents; except they pay for their Board, Lodging, *&c.*

The Number of *Scholarships* are no more than twenty-five, all founded (except two or three) by *Roman Catholic* Families, and paid out of their Estates in *England*. So that as these Scholarships depend upon a Variety of Accidents, it sometimes happens that they are not regularly paid, and sometimes drop; as in the Case of two *Scholarships* founded in this College by the *Ratcliff* Family; which are lost in the Forfeiture of the *Derwentwater* Estates.

The Government of this College is by a President, Vice-President, Confessor, Procurator, a Prefect of Studies, two Professors in *Divinity*, one in *Philosophy*, and one in *Humanity*; who are subject to a *Chapter* of secular Clergy established in *London*, and are under the Protection of the *Inquisitor-General* at *Lisbon* for the Time being. The President of this College was buried in the Ruins occasioned by the late Earthquake.

These *Seminarists* are distinguished from all other Students in that University by a Piece of Cloth, *Coloris Leonini*, of a kind of Brick colour, which, cut in the shape of an *Oar*, doubles on the Breast and hangs over the Shoulders with each End as low as the bend of the Knee behind, upon a black Serge Gown without Sleeves, with a Cassock of the same Stuff underneath; the Collar whereof is made of stiff Pasteboard covered, and edged with a Piece of Cambrick, which they call a Band.

In this Dress they pretend to preserve the old Fashion of the Students of *Oxford*: and they also tell you that they are governed by the Statutes brought by their first Professors from the same University.

In ITALY are the *Universities* of

Rome,
Bologna,
Padua, founded by the Emperor *Frederic* II. 1222
Ferrara, by the Emperor *Frederic*. 1316
Florence, by *Cosmo de Medicis*.
Pavia,
Siena — — 1387
Pisa, — — 1339
Turin, by Pope *Benedict* XII. 1405
Naples, *Salerno*, } by *Frederic* II.
Venice,
Verona,
Mantua,
Milan,
Perugia, by Pope *Clement* V.
Macerata, by Pope *Paul* III.
Catania, in *Sicily*,
Cagliari, in *Sardinia*,

In SWITZERLAND are the *Universities* of

Basil, — — 1459
Geneva or *Colonia Allobrogum*, founded by the Emperor *Charles* IV. } 1365

In GERMANY are the *Universities* of

Cologne or *Colonia Agrippina*, founded by Pope *Urban* VI. } 1388
Leipsick, by Elector *Frederic* I. 1408
Francfort upon Oder, by *Joachim* Elector of *Brandenburgh*. } 1506
Strasburg, — — 1538
Erfurt, — — 1391
Heidelberg, by *Rupert* II. Elector Palatine. 1346
Jena, by *John Frederick* Elector of *Saxony*. 1558
Ingolstad, by *Lewis*, Duke of *Bavaria* 1472
Liege before — — 1129
Tubingen, by *Eberhard* Count of *Wurtemburg*. } 1477
Vienna, by *Albert* III. Arch Duke of *Austria*. 1365
Wittemberg, by *Frederic* III. Elector of *Saxony*. 1502
Mentz, — — 1482
Triers or *Treves*, — — 1558
Friburg in *Brisgaw*, by *Albert* Duke of *Austria*. } 1463
Rostock, — — 1490
Marpurgh, by *Philip*, Landgrave.
Gissen, by *Lewis* Landgrave of *Hesse* 1607
Gripswald by *Philip* Duke of *Pomeren*. 1547
Dillingken, by *Otho* Cardinal *Truchses*
Kiel, by *Albert* Duke of *Holstein*. 1669
Altorf, by Emperor *Ferdinand* II. 1622
Helmstad, by *Julius* Duke of *Brunswick*. 1576
Paderborn, — — 1502
Sigen, by *John* Count of *Nassau*, 1589
Lawengen, by *Wolfgangus* Count Palatine.
Gratz.
Wurtzburgh.
Duisburg.

In BOHEMIA is the *University* of

Prague, founded by the Emperor *Charles* V. 1358

In POLAND are the *Universities* of

Cracow — — 1364
Wilna in *Lithuania* — 1579

Koningsberg and Elbing in Prussia, by Albert Duke of Prussia. 1544

In SWEDELAND are the Universities of

Upsal

Lunden or Londinum Scanorum founded by King Charles IX.

Abo, by Queen Christina, 1640

Dorpt, by Gustavus Adolphus in Livonia, 1632

In DENMARK is the University of Copenhagen, founded in the Year 1497

In TRANSILVANIA is the University of Alba Julia or Waisemburg, founded by Prince Ragotzi.

In ASIA is the University of Goa, founded by a King of Portugal in the sixteenth Century.

But let us look now at home. No Nation goes before our own either in the point of the Antiquity, Magnificence, or Learning of our Universities of Oxford and Cambridge. For, whatever France may boast of her Parisian Foundations, we find it more certain and eminent in these.

As to their Antiquity, it is beyond Contradiction, that the Foundation of University, Baliol and Merton Colleges in Oxford, and St. Peter's in Cambridge, were all made such in the thirteenth Century; and therefore claim their Title amongst the first regular Endowments of the Kind in Europe.

We might contend for a Priority in favour of University College, which was a Place for Students in the Year 872; and some Authors insist upon King Alfred's Foundation thereof. Yet as these Students did not live in Society, but at their own Charge at private Houses, their Places of meeting for Improvement in Learning were not called Colleges, but Inns and Halls; and are not to be accounted Universities till those Inns and Halls were endowed and made Collegiate for the Reception, Diet, Apparel, &c. of the Students, and with Salaries for Professors.

Dr. Newton's Account of the Original of this University is this, "That in ancient Times, certain learned "Men resided in the City of Oxford, and there taught those Arts and Sciences, which are called liberal to "such as were disposed to learn them. The Reputation of their Skill, and the fine Situation of the Place, "invited such a general Resort of Scholars to it from all Parts, that it soon obtained the Name of an "University. The Citizens for the better Accommodation of the Students, from whose Residence "amongst them they received great Benefit, let out such of their Houses, as they did not themselves in-"habit, to the Teachers of these Arts; who again let out the several Rooms thereof to their respec-"tive Scholars, as to Under-Tenants. Such Houses, from the Time they were applied to the Pur-"poses of liberal Education, were called Halls; and the several Governors of these voluntary Socie-"ties, Principals of Halls. Long before any of these Halls were converted into Colleges, the Uni-"versity, by Prescription, used a public Seal, received Lands, was possessed of Customs, and made "Laws for the Government of its own Body, as a Corporation." The Schools established at Oxford were entirely burnt and destroyed by the Danes about the Year 1000, and all Learning banished from thence for many Years. Edward the Confessor restored the Students to their Seats and Privileges about the Year 1050, according to some Writers; while others assure us, that the Universities lay in a miserable Condition, almost expiring, till the Time of the Conquest Anno 1066.

It is not a Point to be debated here whether Oxford or Cambridge is the eldest University. But we will begin with Oxford, as Custom always gives it the Precedence, when those two Universities are mentioned together.

The University of OXFORD is governed by a Chancellor; whose Office is to superintend the Government of the whole University; to maintain the Privileges and Liberties thereof; to call Assemblies; to hear and determine Controversies where Scholars are concerned; to summon Courts; punish Delinquents; to prove Wills; to grant Administration, &c.

He is always a Person of the first Rank, and holds his Office for Life, into which he is elected by a Majority of Fellows or Regents, and Non-Regents in Convocation.

The present Chancellor was elected on the fourth Day of January 1759.

The next Office in Dignity is the High Steward; whose Office enjoins him to assist the Chancellor, Vice-Chancellor, and the Proctors in the due Execution of their respective Offices; and also to hear and determine capital Causes, where a Scholar, or privileged Person is the Offender, when required so to do by the Chancellor, who also may appoint him to keep the Court-Leet. He is nominated by the Chancellor: but must be approved by the University in Convocation. This Office also is for Life.

There is also a Vice-Chancellor, nominated annually, but commonly continued for three Years, by the Chancellor, from amongst the Heads of Colleges.

This Officer may be said to bear the greatest Burden in the Government of the University. He is obliged to reside at Oxford, so that he may be always at hand to supply the Place of the Chancellor, who

who never attends but upon some very special Occasion. He licenses Books printed at the University-Press. He is particularly to take Care that Sermons, Lectures, Disputations, and other Exercises be performed; that Hereticks, Fanaticks, Non-Conformists, Panders, Bawds, Whores, &c. be expelled from the University, and kept from the Conversation of the Students: To license Taverns, Ale-houses, Coachmen, Carriers, &c. To see that the *Proctors* and *other* Officers, and public Servants of the University perform their respective Duties; that Courts be called, and Law-Suits be determined without Delay.

N. B. The Chancellor of the University, and in his Absence, the *Vice-Chancellor* is superior to the *Mayor* of the City in Affairs of Moment; even where they concern the City itself. And the *Mayor* and Burgesses, and the High-Sheriff of *Oxfordshire* take an Oath in a solemn Manner before the *Vice-Chancellor* to observe and preserve the Rights, Privileges, and Rights of the *University of Oxford.*

The other Officers concerned in the Government of the University are,

Two *Proctors*, chosen by all the Doctors and Masters of Arts in College, out of the several Colleges by Turns: They must be Masters of Arts, whose particular Duty is to assist in what regards Scholastic Exercises and taking of Degrees: To punish all that break the Statutes: To examine Weights and Measures, and to punish common Strumpets, &c. to inspect the Publicans, &c.

The Public *Orator* is next in Office. His Business is to write Letters by Order of the Convocation, and to make public Speeches on solemn Occasions. He must be a Master of Arts or Batchelor of Law. His Election is for Life, and made in Convocation.

There is a *Keeper of Records*, chosen in Convocation, who keeps the Charters, and other public Papers belonging to the University; and is to be ready to plead those Rights and Privileges when called in Question.

Next to him is the *Registerer*, who is chosen (as all other Officers of the University) are by Scrutiny in Convocation; and ought to be a Master of Arts, or a Batchelor of Law, and a Public Notary at the Time of Election; his Business being to register all Acts and Deeds, which pass under the public Seal of the Universiy; and all Acts in judicial Causes before the Delegates of Appeal.

For the better Regulation of *Provisions* the *University* has a Right to chuse two Clerks to inspect the *Markets.* They must be of the Degree of a Master of Arts, or Batchelor of *Divinity*, *Law*, or *Physic*, and are nominated, one by the Chancellor; the other by the Vice-Chancellor, yearly.

These Clerks are to take care of the Assize of Bread, Beer and Wine, of Weights and Measures, the Prices and Qualities of Victuals and other Provisions: For which End, they are often obliged to weigh the Bread, and once a Year (at least) to gauge all Brewers Vessels, and to break or burn the same, if wanting of the Statutable Measure; besides an arbitrary Mulct to be inflicted on the Brewer by the Vice-Chancellor: Their Business is also to take care of Hay, and all kind of Horses Provender, of the just Measure of Faggots and Coals, and if defective, to distribute them among the Poor; and lastly, to see that all Things belonging to the Market be exposed to Sale therein; to amerce Regrators, Forestallers, &c.

For the better Execution of the Laws of the University there are six public Servants called *Beadles*, *Cryers*, and *Foot* Messengers. Three of these are called Squire Beadles; the other three *Yeomen Beadles.*

Every College has its Visitor also, who takes Cognizance of such Matters as particularly relate to Breaches of the distinct Statutes of each House or Society: This Officer is nominated by the Will of the Founder, and is empowered to deprive or suspend any Member under his local Jurisdiction for Contumacy, or any Crime of a high Nature, committed against the Laws of God or the Statutes of the College; provided he always governs himself by the Rules and Order of his Founder: Where he exceeds his Power the injured Party has a Right of Appeal to the Crown.

Under this Government there are *nineteen Colleges* and *five Halls.*

1. *University* College claims the Precedence in Point of Antiquity; it being commonly said to derive its Foundation from the Munificence of King *Alfred*, the first Monarch of *England*; and has by various Revolutions and Benefactions arrived to its present flourishing Condition. Amongst these Benefactors we find *William* Archdeacon of *Durham*, who soon after the *Norman* Conquest endowed it so largely, that he is numbered amongst its Founders.

In this College is one Master, twelve Fellows, and seventeen Scholars. Dr *Ratcliff* has established two travelling Fellowships at the Charge of 600 *l. per Annum*, in this College.

2. *Baliol* College was founded by *John Baliol* Father to *John Baliol*, King of *Scotland*, about the Year 1263, and by numerous Benefactions it is now provided with Estates for the Support of a Master, twelve Fellows, fourteen Scholars and eighteen Exhibitioners.

3. *Merton* College so called from *Walter de Merton*, its Founder, Lord Chancellor of *England* and Bishop of *Rochester*, was founded, endowed and chartered in 127 . It has been favoured with many Benefactions; and is governed by a Warden. Here are twenty-four Fellows and fourteen Exhibitioners called Post-masters, and two Clerks.

4. *Exeter* College is a Foundation so early as 1316, by *Walter Stapledon*, Bishop of *Exeter*. It for many Years passed under the Name of *Stapledon-Hall*, till there rose up another Bishop of *Exeter*, *Edmond Stafford*, who became a second Founder, and changed its Name, by Authority, to *Exeter* College.

The Government of this College is in a Rector, and twenty-three Fellows Here is a Beadle Clerk and three Exhibitioners.

5. *Oriel* College founded in 1323, by *Adam de Broome*, takes its Name from a large Messuage named *Le Oriel*, granted to this College by King *Edward* III. It has had many great and royal Benefactions; and at present maintains a Provost, eighteen Fellows, and fourteen Exhibitioners.

6 *Queen's* College was founded and endowed in the Year 1340, by *Robert Englisfield*, by Direction from Queen *Philippa*, Consort to *Edward* III. *Robert* was then Chaplain, and gave this Foundation the Name *Aula Scholarium Reginæ de* Oxon, or *Queen Scholars Hall of* Oxford.

By the Charter of Incorporation of this College it appears, that the Founder had made Provision for a Provost and twelve Fellows to be chosen out of seventy poor Children or Scholars, to be also maintained and educated here. It also appoints, that the Society should be called together at their Meals by the Sound of a Horn; and that when the Fellows in their Purple Gowns had placed themselves on the further Side of the Table, with the Provost in the Middle thereof, the poor Scholars should kneel before them on the opposite Side, and answer such Questions in Philosophy, as should be put to them by the Fellows, before Dinner began.

The Number of Members upon the Books of this College at a late public Act, were one Provost, sixteen Fellows, eight Chaplains, nine Taberders, sixteen poor Scholars, two Clerks and twenty Exhibitioners, besides Gentlemen Commoners.

7. *New* College is a Monument of the Munificence of that great Prelate and Statesman *William Long*, born at *Wickham* in *Hampshire*, by which Name he is most generally known: Who before he erected this College, in 1379, maintained for seven Years, seventy Students in several Halls in *Oxford*. The Foundation was laid on the 5th of *March* 1379, and the Building being completed in the beginning of 1380, his Warden and Fellows took Possession of it by a solemn Procession.

This Foundation was made for a Warden, seventy Scholars, ten Chaplains, three Clerks and sixteen Choiristers with handsome Stipends; on Condition that fifty of the Scholars should apply themselves to *Arts* and *Divinity*, ten to the Study of the *Civil Law*, and ten to the Study of the *Canon Law*.

The present Members of this Society are one Warden, seventy Fellows, ten Chaplains, three Clerks, and one Sexton.

8. *Lincoln* College, this Foundation was begun in 1430, by *Richard Flemming* Bishop of *Lincoln*, who obtained a Charter for its Establishment, and left a Sufficiency to complete his Design not finished at his Death.

It has had a Succession of valuable Benefactors; amongst whom is *Thomas Rotheram*, Bishop of *Lincoln* also, afterwards Archbishop of *York* and Chancellor of *England*. Who by his Donations, and his Body of Laws for their better Regulation, is esteemed a second Founder.

The present Members are a Rector, twelve Fellows, nine Scholars, and twenty Exhibitioners.

9. *All-Souls* College was founded and endowed by Archbishop *Chicheley* in 1437, for forty Fellows; of whom twenty-four were ordained to study *Divinity* and *Philosophy*, and the other sixteen the *Canon*, and *Civil Law*. But *Henry* VI. was so largious in his Royal Favours to this Foundation, that he has been supposed to be the real Founder of the Fellowships, though the Archbishop expended near 5000 *l.* in the Buildings, &c.

Colonel *Codrington*, some time Fellow of this College, and Governor of the *Leward Islands*, in the beginning of this Century bequeathed 6000 *l.* for building a Library, and not only left his own valuable Study of Books to be deposited therein; but gave 4000 *l.* more to purchase new ones.

The present Members are one Warden, forty Fellows, two Chaplains and nine Scholarships.

10. *Magdalen* College was another Foundation in the Reign of *Henry* VI. *An. Dom.* 1456, erected and endowed by *William Patten* of *Wainfleet*, usually called *William of Wainfleet*. He was Bishop of *Winchester* and Lord High-Chancellor of *England*.

This College is founded on the Site of the dissolved Hospital of *St. John*, and endowed with the Revenues of those Hospitallers; which were settled by Charter for a perpetual Maintenance of poor and indigent Clerks in the University of *Oxford*, studying *Arts* and *Sciences*; and the said Charter ordains

that

that there ſhould be forty Fellows, thirty Scholars, called Demies or Semi-Commoners, four Chaplains, eight Clerks and ſixteen Choriſters, beſides Servants. Since which Inſtitution it has been augmented by ſeveral large Benefactions. And at preſent it conſiſts of a Preſident, forty Fellows, four Chaplains, thirty Demies, and twenty Exhibitioners, beſides a Number of Gentlemen Commoners.

11. *Brazen-Noſe* was founded by *William Smith* Biſhop of *Lincoln* in 1511, who obtained for it a Charter of Incorporation from *Henry* VII. by the Name and Stile of the Principal and Scholars of *King's-Hall* and *Brazen-Noſe* College, with Power to purchaſe Lands of the yearly Value of 300 *l.* excluſive of all Taxes and Repriſals.

In this College are a Principal, twenty Fellows, thirty Scholarſhips and four Exhibitioners, who enjoy the Advowſons of the great Pariſhes of *Chriſt-Church* in *Spittle-Fields*, of *St. Matthew Bethnal Green*, of *St. Mary Stratford-Bow*, of *St. Ann Lime-Houſe*, of *St. George Ratcliff Highway*, or *St. George's* in the *Eaſt*, together with the Mother-Church of *St. Dunſtan* at *Stepney*, in the County of *Middleſex*, by a cheap Purchaſe of the Impropriation and Advowſon of the old Pariſh and Pariſh Church of *St. Dunſtan* at *Stepney*, a little before it was by Act of Parliament divided into thoſe ſeveral Pariſhes, as they now are; the leaſt of which being of the yearly Value of 200 *l.*

12. *Corpus Chriſti* College was founded in the Year 1516, by Dr. *Richard Fox*, Biſhop of *Wincheſter*, for the Study of *Divinity*, *Philoſophy*, and the *Liberal Arts*; who endowed it for the Support of a Preſident, twenty Fellows or Scholars, two Chaplains, two Clerks and two Choriſters. He alſo ſettled a *Humanity* Lecture, a *Greek* Lecture, and a *Divinity* Lecture.

The preſent Members are a Preſident, twenty Fellows, two Chaplains, twenty Scholars, and four Exhibitioners.

13. *Trinity* College ſprung out of the ancient *Monaſtic* College belonging to the Monks of the Cathedral of *Durham*, which was diſſolved with other religious Houſes by King *Henry* VIII.

This diſſolved Houſe being afterwards conveyed to Sir *Thomas Pope* of *Tittenhanger* in *Hertfordſhire*, he obtained a Charter from Queen *Mary* in 1554, to convert it into a College, and improved it, and endowed it for a Preſident and twelve Fellows, to be educated in the Studies of *Philoſophy* and *Divinity*, and eight Students in *Logic*, *Rhetoric* and other *Arts*.

The Members now are a Preſident, twelve Fellows, twelve Scholars and two Exhibitioners; beſides Gentlemen Commoners.

14. St. *John's* College, a noble Foundation by Sir *Thomas White*, an Alderman and Merchant-Taylor of the City of *London*: but greatly enriched by the Favours and Benefactions of Archbiſhop *Laud* and Dr. *Juxon*, Biſhop of *London*, which laſt alone gave 6000 *l.* to it. This College is ſupplied with Scholars from *Merchant-Taylor's* School in *London*; and its Members are one Preſident, thirty-nine Fellows, and eleven Scholars, who are all elected on St. *Barnaby's* Day from *Merchant-Taylors* School.

15. *Wadham* College, a modern Foundation; was begun by *Nicholas Wadham*, Eſq; of *Marefield* in *Somerſetſhire*, and finiſhed purſuant to her Huſband's Will, by *Dorothy* his Relict, in the Year 1613. It was endowed by them for a Warden, fifteen Fellows, fifteen Scholars, two Chaplains, two Clerks, one Manciple, two Cooks, two Butlers, and a Porter; with theſe Reſtrictions; That the Warden ſhould be a Native of *Great-Britain*, and to quit this College upon Marriage or Advancement to a Biſhopric; and that the Fellows to quit their Fellowſhips after having completed eighteen Years from their Regency.

The preſent Members are a Warden, fifteen Fellows, two Chaplains, fifteen Scholars, two Clerks and eight Exhibitioners, beſides many Gentlemen Commoners.

16. *Pembroke* College, was founded on the Site of *Broadgate-Hall* in 1624, by *Thomas Tiſdale* and *Richard Wightwick*, S. T. B. for the Study of *Divinity*, *Phyſic*, *Civil* and *Canon-Law*, &c.

The Members are a Maſter, ten Fellows and ten Scholars. Four Fellows to be choſen out of Mr. *Tiſdale's* Relations; the others from *Abingdon* School: and two Fellows and two Scholars to be of the Name and Kindred of Mr. *Wightwick*.

King *Charles* I. became a Benefactor to this infant Foundation. His Majeſty founded a Fellowſhip to be filled from *Guernſey* or *Jerſey*; and Dr. *Morley* Biſhop of *Wincheſter* augmented it with five Scholarſhips for Natives of the ſame Iſland.

The Members are a Maſter, thirteen Fellows and twenty-three Scholars.

17. *Worceſter* College is riſen from the Remains of *Gloceſter-Hall*, anciently the Seminary for educating the Novices of the *Benedictine* Monks of *Gloceſter*. Which being ſuppreſſed at the Diſſolution of the Monaſteries, under *Henry* VIII. fell, in Proceſs of Time, into the Hands of St. *John's* Collegians, who erected it into a Seminary by the Name of St. *John Baptiſt's* Hall, and made one of their Fellows Principal thereof. But in the Year 1714, Sir *Thomas Cookſey*, Bart. obtained a Charter from Queen

Ann to erect it into a College, and to endow it for a Provost, six Fellows, and six Scholars: Since which Time many considerable Benefactions have been given to this Society.

18. *Hartford* College was converted into its present Institution from *Hart* Hall, by the Rev. Dr. *Newton*, in the Year 1740: Who has expended great Sums in its Building and Endowment.

19. *Christ-Church* College I have reserved to the last, as it may be said to excel them all in its Dimensions, Revenues, and Number of Students.

This College is indebted to Cardinal *Wolsey* for its first Foundation. To which he persuaded King *Henry* VIII. in the Year 1524; and it was then named *Cardinal-College*. But the Design of that Great Prelate dropt with his Disgrace: And though the King in the Year 1532, at the Instance of Lord *Cromwell*, *&c.* was prevailed upon to grant Letters Patent to continue the Foundation under the Name of King *Henry* VIII's College, with an Endowment of 2000 *l.* *per Annum*, in Lands, for the Maintenance of a Dean and twelve Canons, we find in the Year 1545, that it was suppressed, surrendered into the King's Hands, and the Dean and five Canons reduced to the greatest Necessity.

However in 1546 the King transferred the Episcopal See of *Ousney* to this College, and constituted the Church of St. *Frideswide* to be the Cathedral Church, by the Name of *Christ Church, founded by King* Henry VIII. and endowed it with Lands to the Value of 2000 *l.* *per Annum*, for the Maintenance of a Dean, seven Canons, eight Petty Canons, one Postillator, eight Clerks, or Chaplains, a Master and eight Choristers, and an Organist; reserving out of the same 40 *l.* *per Annum* each, to a Professor in *Divinity*, a Professor of *Greek*, and another of *Hebrew*: 8 *l.* *per Annum* each, to sixty Students or Scholars. 20 *l.* *per Annum* to a Schoolmaster, and 10 *l.* *per Annum* to an Usher.

Queen *Elizabeth* added forty Scholars to be chosen from *Westminster-School*, with an Exhibition of 6 *l.* *per Annum* each, and *William Thurston*'s Legacy of 800 *l.* for the Education of one Scholar, makes the Number of its Students 101.

Here also are two Lectures, one for the *Oriental Languages*; the other for *Mathematicks*, founded and handsomely endowed, by Doctor *Busby*, S. T. P. Master of *Westminster* School.

The *Five* HALLS are known by the Names of

1. St. *Alban* Hall.
2. St. *Edmund* Hall.
3. St. *Mary* Hall.
4. *New-Inn* Hall.
5. *Maudlin* or St. *Mary Magdalen Hall.*

These Seminaries are mere *Hostels* or *Inns*, where the Students hire their Chambers of the *Principal*, and pay for their Diet. Whereas every College consists of a Head, Fellows and Scholars incorporated by Royal Charter, and endowed with Lands, *&c.* which yield the Fellows and Scholars a certain Revenue, and defray all Expences of their Commons; and every College has its Statutes, which the Members are obliged to obey by their Oaths, at their Admittance, under Pain of Expulsion.

The Principals of these Halls are in the Nomination of the Chancellor and University; except the Principal of *Edmund* Hall, who is appointed by *Queen*'s College.

The Colleges have all Libraries within themselves. But we must not leave this Seat of Learning, till we have taken a Survey of that Foundation, which is particularly known by the Name of

The *University Library*, otherwise the *Bodleian Library*, so called from Sir *Thomas Bodley* its principal Founder. It is built in the Form of a *Roman* H, and said to contain the greatest Number of Books, except the *Vatican* and *Parisian* Libraries.

Sir *Thomas Bodley* found upon this Spot an old Library called the Library of *Humphrey* Duke of *Glocester*, which he enlarged and furnished with the best Books he could procure from all Parts of the World; and left a considerable Estate for Salaries to the Officers, and for keeping the Library in Repair.

The Earl of *Pembroke* afterwards enriched it with his valuable Collection of *Greek* MSS. To which Sir *Thomas Roe* added another choice Parcel of *Greek* MSS. as did also Sir *Kenelm Digby*.

Here was deposited the most excellent Study of the learned *John Selden*: Which with several great Purchases as well as Donations, have made it the largest *University* in the World.

Besides this, *Oxford* enjoys the Benefit of another great public Library; which if it does not exceed the former in Number and Value of Books and MSS. is allowed to excel in the Magnificence of its Structure; it having cost 40,000 *l.* in building one Room, the Legacy of the celebrated Physician Doctor *John Radcliff*.

This

This is called the *New Library*, or *Radcliffe Mausolæum*; the Keeper whereof is intitled to 150 *l. per Annum*, by the Doctor's Will.

Ashmole's Musæum, a handsome Edifice, is another Repository of learned Pieces, so called from the great Antiquarian, *Elias Ashmole*, Esq; whose valuable Collection of *Antiquities* and foreign Curiosities and MSS. given to this University, are preserved under this Inscription, *Musæum Ashmoleanum Schola Naturalis Historiæ Officina Chymica.* To which have been added some *Egyptian* Hieroglyphicks, an entire Mummy, a large Collection of Natural Curiosities, several *Roman* Urns, Medals, Altars, *&c.* many Collections of Plants and Animals preserved in Spirits; and other Curiosities, which have made it the richest Repository of such Matters in *Europe*.

Here are public Schools, and a Theatre of curious Structure, for public Lectures and Academical Exercises.

Every Person, who is willing to become a Member of this University, in any College or Hall, is to appear within fifteen Days after his Arrival before the Chancellor or his Commissary, to be matriculated or registered in a Book, kept by one of the Beadles for that Purpose. At which Time the Scholar being sixteen Years old, is to subscribe the thirty-nine Articles of Religion, and to take the Oaths of Allegiance and Abjuration.

He must have a Tutor, a Graduate of some Faculty, and approved of by the Head of the House, in which he is admitted, till he himself shall be promoted to a Degree: Nor shall he change his House for another, without Leave from the Head thereof, or from the Vice-Chancellor.

ALL *Scholars* (except *Noblemen*) must keep *sixteen* Terms before they can take a BACHELOR'S *Degree:* They ought also to attend public Lectures, and perform all other statutable Exercises, such as *Generals*, *Juraments*, *Answering*, *Under-bachelors*, &c.

GENERALS, are Disputations on three *Logical* Questions from one in the Afternoon, till three, and are held every *Monday*, *Wednesday* and *Friday* in full Term, in the public Schools of ARTS, under the Moderatorship of some Senior *Sophist* or *Bachelor of Arts*; the Respondent giving out his Questions to be disputed on, a Week before the Disputation.

THIS Exercise is not to be performed, until the Student is *two* Years standing in the *University*, and *three* Terms at least before he supplicates for a *Bachelor*'s Degree; and he is created *General* or *Senior Sophist*, immediately after these Disputations, by one of the *Masters*, who presides at them: These *Senior Sophists* are obliged every Term afterwards, till they take their Degree, to dispute once, at least, under Pain of the former Disputation's not going *pro forma*, which is stil'd *Juraments* from the Oath taken at the Time of proceeding *Bachelor*, that they have done all the Statutable Exercises.

FROM the Time of Admission to a *Bachelor's Degree*, the ARTIST is obliged to wait *twelve* Terms before he can sue for his Grace, to have a *Master's Degree:* As to the Exercise for a *Master's Degree*, every *Bachelor of Arts*, after Admission to his Degree, shall solemnly determine in *Lent*; and these *Lent* Disputations are called *Determinations*, because they do determine and finish the Conditions of a *Bachelor's Degree*, and truly compleat the same; and also for the *Degree of Master*, he must answer at *Quodlibet* Disputations, so called; because he must answer on three Questions to be propounded by any *Master* at Pleasure, after he has finished his *Lent* Determinations. Besides these *Determinations* and *Quodlibets*, such *Bachelor* must either, as a Respondent, or Opponent, dispute in *Austin*'s, speak *two* Declamations, and read *six* solemn Lectures before he can be promoted to a *Master's Degree*.

On *Ashwednesday*, immediately after the *Latin* Sermon, a Bell rings out, calling the Presentator or Dean of every College and Hall, with his *determining Bachelors* of that *Lent* attending him in their proper Habits, to the Schools, which they chuse, according to the Seniority of every Dean or Presentator; and having made Choice of their several Schools, the Dean or Presentator mounts the Pew, and has three Questions propounded to him in *Natural Philosophy*, with *Verses* read, briefly explaining the Sense thereof, by each of the Determiners: Which *Questions* and *Verses*, as soon as propounded and read, one of the Senior *Bachelors* takes upon him to answer the Dean, who is always Opponent; after the Dean has propounded a *Syllogism* or two to his *Determiner*, who thereupon prays his *Aristotle* (for so is the *Senior Responding Bachelor* called) to answer for him as long as the Dean shall think fit; and these Disputations last from One o'Clock till Five in the Afternoon.

On *Mondays*, *Tuesdays*, *Wednesdays* and *Thursdays*, these *Determiners* dispute on *Logical* Questions, which they are obliged to defend according to the Authority of their great Master *Aristotle*, and on *Fridays* on *Grammatical*, *Rhetorical*, *Political*, and *Moral* Problems; in *Grammar* they are to follow the ancient and received Authors, and in *Rhetorick*, *Politicks* and *Moral* Philosophy, they are likewise bound to defend *Aristotle*, and the whole Doctrine of the *Peripateticks*, under Pain, that if any one should do otherwise, his Answer shall not be taken *pro forma*, and he shall also be mulcted five Shillings, *toties quoties*.

Every *Bachelor of Arts*, after his full Determination, ought once every Year to anſwer or oppoſe at *Auſtin* Diſputations, every *Saturday* in Full Term, from one o'Clock, till three, in the *Natural Philoſophy* School, if he be required.

There is a *general Commencement* once every Year in all the Faculties of Learning, which is called, the Act at *Oxford:* This *Act* is opened on *Friday*, following the ſeventh of *July*, and Exerciſes performed in the Schools on *Saturday* and *Monday* following, and alſo in the publick Theatre. On *Saturday* all the Profeſſors and Lecturers read in the ſeveral Arts and Sciences, cloathed in their proper Habits.

The *Inceptors in Arts* diſpute on three *Philoſophical* Queſtions, and one of theſe Inceptors (for ſo are the *Maſters* called, who ſtand for their Regency in this *ſolemn Act)* to be appointed by the *Senior Proctor*, has the Place of the Reſpondent; and firſt the *Senior Proctor* oppoſes on all the Queſtions, and confirms an Argument on the firſt, then the *Pro-Proctor* and *Terræ-Filius* diſpute on the ſecond; and laſtly, the *Junior Proctor* on the third Queſtion; and all the Inceptors are obliged to attend theſe Diſputations from the Beginning to the End, under Pain of three Shillings and four Pence. At the equal Expence of all the Inceptors, there is an elegant Supper at the College or Hall of the Senior of each Faculty, for the Entertainment of the *Doctors*, called the *Act Supper:* On *Sunday*, between the *Veſpers* and the *Comitia* (for ſo are Exerciſes of *Saturday* and *Monday* ſtiled) there are two Sermons in the *Engliſh* Tongue at St. *Mary*'s Church, preach'd by any one of the Inceptors, as the *Vice-chancellor* ſhall appoint, being *Doctors of Divinity*, in this *Act*. On *Monday*, at nine o'Clock, all the Inceptors go with the *Beadles* of their ſeveral Faculties to St. *Mary*'s, and there after Prayers at the Communion Table make Oblations; and if any Perſon ſhall abſent himſelf, or be irreverently preſent, he ſhall be mulcted Five Shillings; and moreover puniſhed at the *Vice-chancellor*'s Pleaſure. Then the *Comitial Exerciſes* beginning, the *Senior Proctor* mounts the Pew on the Weſt Side of the Theatre, and the *Junior Proctor* the Pew oppoſite to him on the Eaſt Side. The *Profeſſor of Phyſick*, with his Inceptors, on the Weſt; and the *Law Profeſſors*, with his Inceptors, on the Eaſt Side thereof; and the *Divinity Profeſſor*, with his Inceptors, on the North Side, under the *Vice-chancellor*; and the Inceptors in *Muſick*, with *their Profeſſor* in the Muſick Gallery, on the South; and at theſe *Comitial* Diſputations, the ſame Method is uſed in Reſpect of the Agents, as at Veſpers, *viz.* firſt the *Senior Proctors*; then the *Terræ Filius* and *Pro-Proctor*; and laſtly, the *Junior Proctor*; and he who was Reſpondent the Year before, is the *Magiſter Replicans* this Year. The firſt Opponent, among the Inceptors, has a Book given him at the End of the Diſputations by the *Senior Proctor* (who in Reſpect of the *Artiſts* Inceptors is called *Father of the Comitia)* and is alſo created *Maſter* by a *Kiſs*, and putting on his Cap.

After the *Comitial Exerciſes in Arts* are ended, if there be any Perſon taking a *Muſick Degree*, he is to perform a *Song* of ſix or eight Parts on *vocal* and *inſtrumental* Muſick, and then he ſhall have his Creation from the *Savilian* Profeſſors, *&c.* After the performing of the Exerciſes, and the Creation of *Doctors*, according to a Preſcript Form in each Faculty, the *Vice-chancellor* cloſes the *Act* with a ſolemn Speech; wherein it is uſual for him to commemorate the Tranſactions of the Year paſt, and eſpecially ſuch Benefactions as have been given to the Univerſity: And after the End of the *Act*, the *Vice-chancellor*, with the *Regents* of the foregoing Year, immediately aſſemble in the Congregation Houſe, where, at the Supplication of the *Doctors* and *Maſters*, newly created, they diſpence with the Wearing of *Boots* and *Slop Shoes*, to which the *Doctors* and *Maſters* of the Act are obliged during the Comitia.

On *Tueſday*, after the Comitia, a *Latin* Sermon is preached to the Clergy, at eight in the Morning, in St. *Mary*'s Church, the Preacher to be either ſome Doctor or Bachelor in Divinity, and of the Vice-chancellor's Appointment, with a Pre-monition, for this End, from the Vice-chancellor for three Months beforehand.

The Queſtions to be diſputed on in each Faculty are to be approved by the Congregation of Maſters ſome time before the Act; and becauſe that *Civilians* ought to know the Difference between the *Civil* and *Municipal* Laws, one of the Law Queſtions ought to have ſome Affinity with the *Common Law* of *England*; wherein the Profeſſor, by a ſhort Speech, ought to ſhew, what the one, and what the other Law maintains.

If any contumelious, reproachful, or defamatory Language, be given in any Speech or Arguments at Diſputations, the Vice-chancellor may convene the Perſon before him, and command a Copy of his Speech, and if he pretends, that he has no Copy, he may convict him by Oath, and puniſh him according to the Heinouſneſs of the Offence, in Reſpect of Perſons and other Circumſtances, either by publick Recantation, Impriſonment, or Baniſhment from the Univerſity, as a Diſturber of the publick Peace; beſides the Satisfaction he is obliged to make to the Party injur'd.

In the Faculties of *Divinity*, *Law* and *Phyſick*, every one takes Place according to the Order of his Preſentation or Admiſſion, to be an Inceptor in theſe Sciences, and ſhall keep the ſame for ever afterwards; only *grand Compounders* have the Precedence of all others of the ſame Year: But *Inceptors in*

Arts have their *Seniority* according to the Proctor's Discretion; unless they be grand Compounders, who have Precedence, as aforesaid. Yet it is provided,' that this Disposition shall not prejudice Fellows of Colleges, in Respect of their Seniority; but that the same be governed and disposed according to the Seniority which they bear in their respective Colleges, according to the local Statutes thereof.

THE ordinary Disputations in *Divinity* shall be had *ten* times a Year in the Divinity School, *viz.* on the first and last *Thursdays* in every Full Term, on the *Thursday* before the first *Sunday* in *Advent*, and also the *Thursday* immediately preceding Lent, which Day, if a Holiday, then Disputations shall be had the Day following; and all the *Bachelors in Divinity*, of what Standing soever, as well as *Masters of Arts* (unless Proctors of the University, or publick Professors of Arts) are obliged to perform these Disputations, as soon as they have compleated four Years from the Time of their Regency, whether they live in Colleges or Halls, unless it does notoriously appear, that they are obliged to the Studies of *Law* or *Physick* by the local Statutes of their College for a Year (at least) before they have received any Monition to answer or oppose at these Disputations, which may evidently appear by their entering their Names in the *Beadle*'s Book.

At these Disputations, the *Senior Bachelor*, or *Master*, is Respondent, and the two next downwards in Degree after the *Regius Professor* (who is Moderator here) are Opponents, and so on till they have all had their Turns; and then they revert to the Seniors. The two Questions to be here disputed on, from one o'Clock, till three in the Afternoon, are to be approved by the next Congregation ensuing the Date of the Monition; and all *Bachelors of Divinity*, and *Masters of Arts*, of two Years Standing from their Regency, who have not applied their Studies to any other Faculty, are bound to be present.

THE ordinary Disputations are only had *twice* every Year in *Physick*, viz. on the first *Tuesday* in Trinity and Hilary Term; at which Disputations, all *Bachelors*, and *other Students in Physick*, on the *Physick Line*, and *privileged* Persons, are Agents, except the Proctors of the University, and the publick Professors of Arts; and the Senior of these is the Respondent, and the other two are Opponents, according to the Course and Method of *Divinity* Disputations; whereat all *Bachelors* and *Students* in *Physick* are obliged to attend.

THE ordinary Disputations in the *Civil Law* (called Disputations *pro Termino)* are also had but *twice* a Year, *viz.* on the last *Tuesday* of *Easter* and *Michaelmas* Term; at which Disputations, all Bachelors of Law, and Persons of Bachelors standing, being Students in the Law, are to bear their Turns in the same Course and Manner, as at *Physick* Disputations, the Proctors and Professors excepted, as aforesaid; and at these Disputations, all Bachelors of Law and Students in that Faculty, are to attend, and frequent the same.

Graces or Supplications for Degrees are proposed and granted in the *Congregation of Regent Masters*, except it be for the Fellows of *New* College, who have their Graces given them in their own House by a certain Privilege: And here are all Dispensations ask'd in Matters dispensable by the Congregation, that fit Persons may be admitted to *Scholastical Degrees*, and also that Men recommended by other Universities, may be incorporated, and, according to Custom, be licensed in each Faculty. This Congregation now, as antiently, consists of the *Chancellor*, or *Vice-chancellor*, the *two Proctors*, or their Deputies, and of such *Masters* as are necessary, or Regents *ad placitum.* And nothing can be decreed in this Assembly, to which the *Chancellor*, or his *Vice-chancellor*, *both Proctors*, or their Deputies, or the *major Part* of the *Masters* present (whose Number ought not to be less than nine) do not consent; but ought to be taken for not granted, if either the Chancellor, or his Deputy, or the two Proctors, or their Deputies, or the major Part of the Masters dissent; unless it be in Elections, which are to be made freely, according to ancient Custom, by the major Part of the Voters.

BY a received Custom immediately after the End of the *Act*, every Year, the *Masters of Arts*, and *Doctors in Divinity*, *Law* and *Physick*, on the solemn Day of their Creation, supplicate to be admitted into the *Congregation House*, and to their *Regency* in each Faculty, *i. e.* to all and every Act of their necessary Regency before the third Congregation, unless some grievous Crime be objected to them, which may draw a Scandal on the University; and if they be deferred any longer, the Chancellor, or his *Locum-tenent*, may summon and admit them thereunto by his own proper Authority: Which *Doctors* and *Masters* are necessarily Regents for *two* Years; unless they be dispensed with for the second Year's Regency (as usual) after the Creation of other Doctors and Masters the next *Act*, and admitted to their Regency in the like manner, in the Congregation: Then the Doctors and Masters admitted to their Regency, take an Oath not to reveal the Secrets of that House, and also swear, that they will not promote unfit Persons, nor hinder those, who are fit, from proceeding to their Degrees, &c. Every Master, for this Admission, pays 12 *d.* to the Register, and 4 *d.* to the Beadle of his Faculty, and a Doctor gives 12 *d.* to be distributed among the Poor, at the Pleasure of the Vice-chancellor and Proctors.

All

All publick Professors and Lecturers, Royal, as well as others, are accounted Regents *ad placitum*; so are all Resident Doctors, of what Faculty soever, and all Heads of Colleges and Halls, who have been for some time Regents in Arts, and (in their Absence) their Deputies, all Masters of Schools, and Deans and Censors of Colleges, together with all Masters during the second Year of their Regency, if they are dispensed with for the second Year of their necessary Regency, as aforesaid.

The Scholars are obliged to be in their respective Colleges by *nine of the Clock* at Night, immediately after the Tolling of the great Bell at *Christ-Church*, and if any Person shall be found in the Streets, or in any House in the Town; unless on his lawful and necessary Occasions, he is mulcted in the Sum of 40 *s.* being a Graduate; which Sum the Vice-chancellor demands, if he be a Master of Arts, or a Batchelor of Law; otherwise the Proctors may do it, and imprison him for Contumacy, Suspicion of Flight, or any rebellious Behaviour: If the Person offending be an Under-graduate, he is left to the discretionary Punishment of the Vice-chancellor.

All *Plays* and *Gaming* (especially *for Money*) are prohibited, under the Pain of 6 *s.* 8 *d.* if a Graduate, and if not, then he is punished according to the Vice-chancellor's Pleasure, besides Restitution of Money so won; and 20 *s.* inflicted on all *Gaming Houses*, and Imprisonment, till they find Sureties not to receive any Scholars upon the like Account.

Scholars are also forbid to carry *Guns*, *Bows*, *&c.* to keep *Dogs*, *Ferrets*, *Nets*, *&c.* under the Pain of 6 *s.* 8 *d.* *toties quoties*, and to forfeit and lose the same.

Rope Dancers, *Stage-Players* and *Sword Fighters* are also prohibited the *University*, unless they get the Vice-chancellor's Leave to come, under Pain of Imprisonment; and all Graduate Scholars, attending them, are punished 6 *s.* 8 *d.* and Under-graduates are corrected as aforesaid.

The Habits at *Oxford* are all black, except the *Sons of Noblemen*, having Voices in the House of Lords, who may wear colour'd Gowns of any kind, how rich soever; and on certain Days, on some Occasions, all Doctors here are honoured with *Scarlet Robes*. The Scarlet Days are *Circumcision* or *New Year's Day*, *Epiphany* or *Twelfth Day*, *Purification* or *Candlemas-Day*, *Annunciation* or *Lady-Day*; when the Sermon is at *New* College; *Easter-Day*, *Ascension* or *Holy Thursday*, the 29th of *May*, *Whitsunday*, *Trinity Sunday*, when the Sermon is again at *New* College; *Friday*, *Saturday*, *Sunday* and *Tuesday* Morning in *Act* Time, at Sermon and Congregation; *All Saints* Day, the 5th of *November*, *Christmas* Day, and all publick Thanksgivings. The *Habit-Days* are, the Day the Judges come to Town; when the Vice-chancellor, Doctors and Proctors assemble at St. *Mary's*, and from thence go to wait on the Judges in their Formalities; at all *Latin* Sermons, Morning Sermons in Term Time, and at all Sermons at St. *Peter's* in *Lent*, on Congregation Days, and on *Scholastica* Day; and the Day after *Michaelmas*, when the Mayor is sworn in St. *Mary's* Church in the Morning by the Senior Proctor. All Scholars whatsoever in Term Time ought to come to Church in their proper Habits.

Baronets are esteemed *Noblemen* in this *University*, and their Habit is black, trim'd with Gold Lace.

In this University are sixteen *Publick Professors*, two in *Divinity*, and one each in *History*, *moral Philosophy*, *Geometry*, *Astronomy*, *Anatomy*, *natural Philosophy*, *Music*, *Law*, *Physic*, *Laws of England*, *Botany*, *Hebrew*, *Greek*, and *Arabic*.

One of the Divinity Professorships was founded by the Countess of *Richmond* and Mother to King *Henry* VII. and endowed with 20 Marks *per Annum*.

This is called the *Magaret* Professorship, and is to give a Lecture on the first Day of every Term, and on certain other Days in the Divinity School.

The other is an Institution by King *Henry* VIII. who endowed it with 40 *l.* *per Annum*, with a Canonry of *Christ Church* and the Rectory of *Eweline* annexed thereunto.

This is by way of Eminence called the *Regius Professor* in *Divinity*, and is enjoin'd to read Lectures on *Mondays* and *Fridays* at *Nine* in the Morning to Masters of Arts of a Year's standing, until they commence Doctors.

The *History* Lecture is the Gift of the learned Antiquary and Historian *William Cambden*, Esq; who endowed it with the Manor of *Boxley* in *Kent*, worth, as some say, 400 *l.* *per Annum*, with an Obligation on the Professor to read a Lecture on *Mondays* and *Fridays* weekly in the History School to the Batchelors of Arts and Students in Law.

The moral Philosophy Lecture is a Foundation by Doctor *Thomas White*, Canon of *Christ Church*, *&c.* who endowed it with 100 *l.* *per Annum*.

Sir *Henry Savile*, a great Patron of Learning and Learned Men, founded two Lectures, one in *Geometry*, the other in *Astronomy*, *Anno Domini* 1619, endowed them both with suitable Revenues, and left the Professors a Library of Mathematical Books, Tables, Maps and Instruments proper for such Studies. But he debarred them from accepting of any Ecclesiastical Preferment whatever.

The

The *Anatomical* Lecture was founded by Mr. *Richard Tomlins*, who settled 25 *l.* *per Annum*, on the *Regius* Professor *in Physick* for reading the same at stated Times.

The natural Philosophy Professorship was founded and endowed with 120 *l.* *per Annum* in Land. *Anno Domini* 1618.

The *Musick* Lecture was founded by *William Heyther*, Doctor of *Music* in 1626, who endowed it with sixteen Pounds six Shillings and Eight-pence *per Annum* Salary; thirteen Pounds Six and Eight-pence for a House and repairing Instruments, and three Pounds *per Annum* for teaching the Theory of Music, once every Term.

The Lectures in *Law* and *Physic* were founded by King *Henry* VIII. with a Salary of 40 *l.* *per Annum* each, and a Prebend in the Church of *Sarum* annexed to the *Law* Professorship, and the Government of the Hospital of *Eweline* to the *Physic* Professorship.

The *Botanic* Lecture was founded in 1643 by *Henry Danvers* Earl of *Danby*; who purchased the *Physic* Garden at *Oxford* for the Uses thereof, and appropriated the Rectory of *Kirkdale* in *Yorkshire* to maintain a Gardener to encrease and propagate the Plants, and to explain the Nature and Virtue of them.

The Professorship of the Laws of *England* was lately founded by *Charles Viner*, Esq; who by his last Will and Testament, bearing Date 29 *December* 1755, divised *(inter alia)* to the Chancellor, Masters, and Scholars of the University of *Oxford*, whom he also appointed his Executors, all the printed Copies of his ABRIDGMENT of the Laws of *England*, and the Residue of his real and personal Estate not otherwise disposed of by his Will, " to be applied, by and with the Approbation of a Majority of the Mem- " bers there in Convocation to be assembled for that Purpose, (on public Notice given) for the nominating, " appointing and establishing a Professorship of the Common Law in the said University; and to put it " upon a proper Foot, that young Gentlemen, who shall be Students there, and shall intend to apply " themselves to the Study of the common Laws of *England*, may be instructed and enabled to pursue " their Studies to their best Advantage afterwards, when they shall attend the Courts at *Westminster*; " and not to trifle away their Time there in hearing what they understand nothing of, and thereupon " perhaps divert their Thoughts from the Law to their Pleasures: That a certain, annual, handsome " Allowance be fixed upon to be made to such Professor and his Successors, to be chosen from Time to " Time by the said University in Convocation assembled;" and then directed that a competent Fund be raised from the Surplus to continue his ABRIDGMENT at proper Intervals. He also willed and desired, " that such Professor so to be elected should be at least a Master of Arts or a Bachelor of the Civil Law " in the said University, and likewise a Barrister at the common Law; and should read a solemn Lecture " and Lectures when and so often as such Convocation should think proper and direct, so as such Time " of Reading shall not interfere or be within the Time of the Law Terms." And his Will farther was, " that after an ample Provision, according to the Judgment and Approbation of the said Convocation, " shall be made and secured for such Professor as aforesaid, the remaining Part of the Monies to arise from " the Sale of the Residue of his said *Abridgment*, &c. shall be disposed of, by and with the Direction " and Approbation of such Convocation assembled or to be assembled as aforesaid, for the constituting, " establishing, and endowing one or more Fellowship or Fellowships, and Scholarship or Scholarships, " in any College or Hall in the said University as to such Convocation shall be thought most proper for " Students of the common Law; such Fellow or Fellows to be Master or Masters of Arts, or Bachelor " or Bachelors of Civil Law, and such Scholar or Scholars to be of two Years standing at least at the " Time of Election, and that one at least of such Fellows should be proposed as a Tutor to such Students " in the said University as shall be intended for such Study; and that as often as a Fellow or Fellows " die, or such Fellowship or Fellowships shall otherwise become vacant, the said Scholar or Scholars may " from Time to Time succeed to such Fellowship or Fellowships, if approved of by the said Convo- " cation; otherwise some other to be chosen or nominated by them, whom they shall think more proper. " And in case such Professorship as is before mentioned shall at any Time or Times become vacant, his " Will was that such Convocation shall from Time to Time nominate and appoint a proper Successor " or Successors; but in such Case he would recommend it to them to appoint such Fellow, or one of " such Fellows as aforesaid, in case he or either of them shall be really deserving to succeed to such " Vacancy."

Mr. VINER's Estate and Effects were found to consist, on the 27th of *January* 1758, of upwards of 8000 *l.* in Money; of a Freehold Estate of 9 *l.* *per Annum* in Possession of a certain Reversion (after one very antient Life) of a Copyhold Estate of 30 *l.* *per Annum*; of a Reversion depending on a Contingency) of another Freehold Estate of 51 *l.* *per Annum*; and of a Number of Books, then unsold, which on a moderate Calculation may produce about 3000 *l.* but, if all sold at their present Prices, will amount to 500 *l.* more.

In the Execution of this Truſt the Univerſity has ordained and decreed in Subſtance as follows;

1. That the Accounts of this Benefaction be ſeparately kept, and annually audited by the Delegates of Accounts and Profeſſor, and afterwards reported to Convocation.

2. That a Profeſſorſhip of the Laws of *England* be immediately eſtabliſhed, with a Salary of 200 *l.* *per Annum*; the Profeſſor to be elected by Convocation, and to be at the Time of his Election at leaſt a Maſter of Arts or Bachelor of Civil Law in the Univerſity of *Oxford*, of ten Years ſtanding from his Matriculation; and alſo a Barriſter at Law of four Years ſtanding at the Bar.

3. That ſuch Profeſſor (by himſelf, or by Deputy to be previouſly approved by Convocation) ſhall read one ſolemn public Lecture on the Laws of *England* and in the *Engliſh* Language, in every academical Term, at certain ſtated Times previous to the Commencement of the common Law Term; or forfeit 20 *l.* for every Omiſſion to Mr. Viner's general Fund: And alſo (by himſelf, or by Deputy to be approved, if occaſional, by the Vice-chancellor and Proctors; or, if permanent, both the Cauſe and the Deputy to be annually approved by Convocation) ſhall yearly read one compleat Courſe of Lectures on the Laws of *England* and in the *Engliſh* Language; conſiſting of ſixty Lectures at the leaſt, to be read during the Univerſity Term Time, with ſuch proper Intervals that not more than four Lectures may fall within any ſingle Week. That the Profeſſor ſhall give a Month's Notice of the Time when the Courſe is to begin, and ſhall read gratis to the Scholars of Mr. Viner's Foundation, but may demand of other Auditors ſuch Gratuity as ſhall be ſettled from Time to Time by Decree of Convocation: (which Gratuity is at preſent ſettled to be four Guineas for the firſt Courſe, and two for the Second; but nothing for any future Attendance) and that for every of the ſaid ſixty Lectures omitted, the Profeſſor, on Complaint made to the Vice-chancellor within the Year, ſhall forfeit 40 *s.* to Mr. Viner's general Fund; the Proof of having performed his Duty to lie upon the ſaid Profeſſor.

4. That every Profeſſor ſhall continue in his Office during Life, unleſs in Caſe of ſuch Miſbehaviour as ſhall amount to Bannition by the Univerſity Statutes; or unleſs he deſerts the Profeſſion of the Law by betaking himſelf to another Profeſſion; or unleſs, after one Admonition by the Vice-chancellor and Proctors for notorious Neglect, he is guilty of another flagrant Omiſſion; in any of which Caſes he ſhall be deprived by the Vice-chancellor, with Conſent of the Houſe of Convocation.

5. That out of the Reſidue of the ſaid Effects ſuch a Number of Fellowſhips with a Stipend of 50 *l.* *per Annum* and Scholarſhips with a Stipend of 30 *l.* be eſtabliſhed, as the Convocation ſhall from Time to Time ordain, according to the State of Mr. Viner's Revenues: And that at preſent two Scholarſhips be eſtabliſhed, and one Fellowſhip next afterwards, as ſoon as the Revenues will permit.

6. That every Fellow be elected by Convocation and at the Time of Election be unmarried, and at leaſt a Maſter of Arts or Bachelor of civil Law, and a Member of ſome College or Hall in the Univerſity of *Oxford*; the Scholars of this Foundation or ſuch as have been Scholars (if qualified and approved of by Convocation) to have the Preference: That, if not a Barriſter when choſen, he ſhall be called to the Bar within one Year after his Election, but ſhall reſide in the Univerſity two Months in every Year, or in caſe of Non-Reſidence ſhall forfeit the Stipend of that Year to Mr. Viner's general Fund.

7. That every Scholar be elected by Convocation, and at the Time of Election be unmarried, and a Member of ſome College or Hall in the Univerſity of *Oxford*, and ſhall have been matriculated twenty four Calendar Months at the leaſt: That he proceed to the Degree of Bachelor of civil Law with all convenient Speed; (either proceeding in Arts or otherwiſe) and previous to his taking the ſame, between the ſecond and eighth Year from his Matriculation, ſhall be bound to attend two Courſes of the Profeſſor's Lectures, to be certified under his Hand; and within one Year after taking the ſame ſhall be called to the Bar: That he ſhall annually reſide ſix Months till he is of four Years Standing, and four Months from that Time till he is Maſter of Arts or Bachelor of civil Law; after which he ſhall be bound to reſide two Months in every Year; or, in Caſe of Non-reſidence, ſhall forfeit the Stipend of that Year to Mr. Viner's general Fund.

8. That the Scholarſhips ſhall become void in caſe of Non-attendance on the Profeſſor, or not taking the Degree of Bachelor of civil Law, being duly admoniſhed ſo to do by the Vice-chancellor and Proctors. And both Fellowſhips and Scholarſhips ſhall expire at the End of ten Years after each reſpective Election; and ſhall become void in caſe of groſs Miſbehaviour, Non-reſidence for two Years together, Marriage, not being called to the Bar within the Time before limited, (being duly admoniſhed ſo to be by the Vice-chancellor and Proctors) or deſerting the Profeſſion of the Law by following any other Profeſſion. In any of which Caſes the Vice-chancellor, with Conſent of Convocation, ſhall declare the Place actually void.

9. That in Caſe of any Vacancy of the Profeſſorſhip, Fellowſhips, or Scholarſhips, the Profits of the current Year be ratably divided between the Predeceſſor or his Repreſentatives, and the Succeſſor; and

and that a new Election be had within one Month afterwards, unless by that Means the Time of Election shall fall within any Vacation, in which Case it shall be deferred to the first Week in the next full Term. And that before any Convocation shall be held for such Election, or for any other Matter relating to Mr. *Viner*'s Benefaction, ten Days public Notice be given to each College and Hall of the Convocation itself and the Cause of convoking it.

King *Henry* VIII. did also found two Lectureships for *Hebrew* and *Greek*, and endowed them with 40 *l. per Annum* each; and annexed to the *Hebrew* Lecture a Canonry in *Christ Church*.

Archbishop *Laud*, in 1636, distinguished his Taste for Oriental Learning by founding another Lectureship, with an Endowment of 40 *l. per Annum* for the Study of the *Arabic* Tongue.

The moral Discipline in this University is worthy of Imitation, and is not to be parallelled in any foreign Seats of Literature.

The Governors here try in the first Place, if the Offender is capable of being reclaimed by Advice; and if this has no Effect, they proceed to punish him by requiring extraordinary Exercises, withdrawing his Commons, or imposing a Fine upon him: And if these will not reform him, he is rusticated (sent home to his Friends) till it may be supposed he has reflected on the Deformity of his Conduct, and the fatal Consequences attending it: and if this does not prevail, he is finally expelled the University: But it must be acknowledged, it is scarce possible to exercise this Discipline equally on all. There are Gentlemen of Quality and Fortune that think themselves privileged to play the Fool in these Seats of Learning, and to be as irregular as they please. They neither rise to Chapel, or perform Exercises; but are entirely devoted to Pleasure, whose Example is of mischievous Consequence to their Inferiors, as well as Equals, who sometimes endeavour to imitate them in every fashionable Failing: However, it is very certain the Youth are generally improved both in Learning and good Manners by their Residence in the University. Those that are guilty of any Excesses are usually Freshmen and Under-graduates; and if ever these become Candidates for a Degree, they find it necessary to alter their Conduct: They must learn to behave with Decency at least, and apply themselves diligently to their Studies, or they are pretty sure to be stopped, when they come for a Degree. A notorious Defect either in Learning or Morals is fatal to them.

The Governors and Tutors are Men generally eminent for their Learning and Prudence, and polite Behaviour; and their Example seems to influence both the University and Town. The People of the Place are more civilized than the Inhabitants of any other Town in *Great-Britain*. Strangers admire their Hospitality. There is a Foible however that some of them are subject to, and that is a pardonable one, *viz.* a partial Fondness for the Place of their Education: They will scare admit there can be any Defects in the Situation or Buildings of *Oxford*. They look upon the City as a perfect Paradise, and seem offended, that all Men cannot think as they do: And it must be admitted, that *Oxford* is a very desirable Place; their Streets are spacious; their public Buildings magnificent; and their Situation in one of the most fruitful Countries of *England*: But will Philosophers be proud of these Advantages. Do they condemn the Vanity of Dress, and prohibit young Students wearing Gold or Silver, and whatever has the Appearance of Finery in their Habits; and are they at the same time proud of fine Structures, and lay out Money in elegant, but superfluous, Buildings, which might be more usefully employed in the Encouragement of Learning, and the Support of poor Scholars: The Reputation of abounding in virtuous and learned Men, and the supporting and encouraging them in their Studies, will contribute more to the Honour of the University, and perpetuate their Fame more than the most magnificent Fabricks. [This is the Opinion of Mr. SALMON.]

The Discipline of the University, as has been observed already, is in a great Measure committed to the Proctors, who are impowered to punish Scholars for ordinary Irregularities; and where they prove immoral or refractory, their Names are entered in a black Book, as it is called, whereby they are rendered incapable of their Degrees, unless their future Behaviour recommends them to the Favour of the University. There is a Book also kept in every College of the like Nature, where Scholars are marked, who have been notorious for keeping ill Hours, absenting from Chapel, Idleness, Immorality, *&c.* And they may be stopped of their Degree by the Governors of the respective Colleges, and rusticated or expelled, which, if they be, no other House can entertain them; and though such irregular Gentlemen sometimes remove to the other University, they will not be easily received there, if they have been formally expelled this: Nor does it lie in the Power only of every particular College, and the Proctors, to stop a Lad of his Degree, but every Member of the Convocation may deny any Candidate for a Degree his Grace twice, without giving any Reason for it.

And here it may be proper to obſerve the Manner of calling and holding their Convocations in this Univerſity, and the Buſineſs tranſacted there.

The Beadle having given Notice of a CONVOCATION: All *Doctors*, *Regent* and *Non-Regent Maſters*, are obliged to reſort to the *Convocation-Houſe* at the Time appointed in their proper Habits; where having taken the Places aſſigned them, the *Vice-Chancellor* enters, preceded by the *Beadles*, and having ſeated himſelf declares the Cauſe of their Meeting.

Here nothing is decreed or granted without the Conſent of the *Vice-chancellor*, or *both the Proctors*, and a *Majority* of the *Regent* and *Non-regent Maſters*: But Elections are all made by the major Part of all the Suffragans, either by a private Scrutiny in Writing, or publickly by dividing in the Houſe, or otherwiſe by a publick Scrutiny in Writing.

The Buſineſs of this Houſe is to make, abrogate, interpret, and moderate all Laws and Statutes of the Univerſity, to grant Diſpenſations and Preſentations to Benefices, to examine and paſs Accounts, demiſe Lands, write Letters to great Perſons, to degrade Criminals, &c. But this Houſe can neither abrogate or interpret Statutes made or confirmed by Royal Authority without ſpecial Licenſe from the Crown.

Before a new Law is made, or a Statute altered or explained, the Vice-chancellor lays it before the Heads of Houſes at their *hebdomedal Meeting*; and as ſoon as they have prepared and ſettled the Draught, the Proctors report it to the Congregation in the Terms agreed on by the Heads of Houſes, and in the following Convocation it is publickly read by the Regiſter, and put to the Vote, whether it ſhall paſs or not.

The Convocation may diſpenſe with many Things; as, where Students, who have formerly been of the Univerſity, have applied themſelves to the Study of Divinity fifteen or ſixteen Years from the Time of their Regency, they may take their further Degrees by Accumulation, after doing exerciſe for them. The Convocation alſo may give Degrees to Biſhops and Noblemen (*honoris gratiâ*) without Performance of Exerciſe for them.

All Elections (except for Members of Parliament) are made by private Scrutiny in Writing, wherein the Vice-chancellor is Preſident, and the two Proctors Scrutators: But before they proceed to Election for any Lecturer, Officer, or Servant, the Candidate ſwears, that he has neither directly or indirectly by himſelf or others, made a Contract with any one, or given, or promiſed to give, any Thing for the ſame; and the Proctors are ſworn to make a faithful Scrutiny; and that they will not induce any one to give a Vote contrary to his Inclination, but pronounce the Perſon elected, who hath the Majority: The Electors alſo are ſworn, that they will vote but once in this Scrutiny, that they will name none but thoſe they know or believe duly qualified for the Office, Benefice, &c. and that without any Reward or Expectation thereof. The Poll being caſt up by the Proctors, it is burnt; after which the Election is pronounced; if two have an equal Number, the Senior is preferred, if they are Graduates; and if not, the Vice-chancellor determines the Election.

For the ſpeedier Diſpatch of Buſineſs, the Convocation and Congregation often chuſe Delegates, who are a ſelect Number of Men, who have ſometimes a Power of acting without making Report to the Houſes, and ſometimes are obliged to make a Report for their Approbation: Theſe Delegates conſiſting of Doctors, Regent and Non-regent Maſters, ſwear to act according to the Statutes.

All Speeches are made in *Latin* in the Congregation and Convocation, unleſs the Vice-chancellor diſpenſes with their being ſpoken in *Engliſh*, and all opprobrious and indecent Language is prohibited on Pain of Excluſion.

For the better Government of the Univerſity, the Vice-chancellor, Proctors and Heads of all the Colleges and Halls, aſſemble every *Monday* in the Year, except Holidays, at one in the Afternoon, and here they conſider the State of the Univerſity, what Invaſions have been made on their Rights and Privileges, and how to remedy their Grievances. There is a large elegant Room in the *Clarendon* Printing-Houſe, where the Heads aſſemble on theſe Occaſions.

Having already treated of the ſeveral Degrees taken in the Univerſity, and the Qualifications required by thoſe who are Candidates for them, it may be proper to ſay ſomething of the Condition of Under-graduates, conſiſting of Noblemen, Gentlemen-Commoners, Commoners, Scholars of the Foundation, Exhibitioners, Battlers and Servitors.

Of theſe the *Noblemen* only are permitted to wear Gold and Silver Lace, or Net-work in their Habits. Theſe Common with the Fellows, and have private Tutors uſually, but do not ſeem to be ſubject to the Rules of the Univerſity any further than they pleaſe.

The

The *Gentlemen Commoners* live at their own Expence, and either eat with the Fellows, or have a Table to themſelves (as in *Queen's*) and have every one his Battler (as a Fellow has) who is entitled to ſome ſmall Perquſities.

The *Commoners* I preſume are ſo called from their *commoning together*, and having a certain Portion of Meat and Drink provided for them, denominated Commons. Of theſe ſeveral are Scholars of the Foundation, and obliged to wait in the Hall on the Fellows, by Turns.

The Battlers are entitled to no Commons, but purchaſe their Meat and Drink of the Cook and Butler, unleſs they ſerve a Fellow or Gentleman Commoner, and then they have the Diſhes, which come from their Tables, with ſome other ſmall Perquiſites.

Of theſe *Battlers*, ſome are *Servitors*, who attend the Batchelors and Commoners in the Hall, for which they have an Allowance.

The Education of all theſe is the ſame, but they pay for their Tuition and other Articles differently; if a Commoner pays 1 *l.* 10 *s.* a Quarter for Tuition, a Gentleman Commoner pays double, and a Battler pays leſs than a Commoner; and the different Reſpect given to each of theſe in the Univerſity, according to the Claſs they enter, is very remarkable, though it is not material, when they go out into the World, of what Claſs they were. There have been Inſtances of Battlers and Servitors that have arrived at eminent Poſts in the Eccleſiaſtical and Civil Government: Neither is it any Diſadvantage to the taking a Degree. A Battler, when he is four Years ſtanding, becomes a Candidate for a Batchelor's Degree, as well as a Commoner, and perhaps there is no Place where pure Merit is more conſidered, and countenanced than in this Univerſity, when Students become Candidates for Degrees.

One Advantage all of them have in an Academical Education, which is not to be met with elſewhere, is the coming up in the Schools, and diſputing publickly. There are ſome Lads, who are not to be moved by other Arguments, to apply themſelves to Study, who will take true Pains to qualify themſelves for theſe Encounters, leſt they ſhould be recorded *Blockheads*, *hiſſed* and *deſpiſed* in all Companies. Gentlemen, who are deaf to the Advice of their Superiors on other Occaſions, will beg their Aſſiſtance, when they are to come upon this Stage, and uſe uncommon Diligence to acquit themſelves with Applauſe in the Eyes of the Univerſity; and here Gentlemen learn to ſpeak in Publick without Heſitation or Diſorder, when they meet with Oppoſition, which are Advantages that cannot be had in private Education.

It having been intimated by ſome Gentlemen, that a Degree at *Oxford* may at preſent be obtained by performing a very ſlight Exerciſe: A Member of that Univerſity obſerves, that there is as much Exerciſe performed every Year, and that as ſtrictly too, as ever was in former Times, and perhaps more than in any other Univerſity in the World. All the ſeveral Exerciſes that the Statutes of the Univerſity require, except the *Terræ Filius's*, and Muſick, and a few other Speeches at the Act, are as rightly, and duly, and laudably performed in theſe modern, as ever they were in antient Times, except the Times of *courſing* as they called them, which were, in plain *Engliſh*, Times of fighting, very unbecoming Scholars; for after they had been ſharply diſputing College againſt College in the Schools, they fell to fighting it out in the Streets.

It is well known, that beſides private Exerciſes of one Sort or other every Day in all Colleges and Halls, there are publick Exerciſes, ſuch as Diſputations, Lectures, Declamations and Examinations performed in the publick Schools almoſt every Day in Term Time, which every individual Scholar is obliged by the Statutes of the Univerſity to perform before he can be promoted to any Degree in the Univerſity. At ſome of which Exerciſes (eſpecially at the more ſolemn Times for Exerciſe, as Lent and Act Time) the Vice-chancellor himſelf is often preſent: Nay, ſome of thoſe Exerciſes cannot be performed, unleſs he or the Pro-vice-chancellor be there: And at ſome other Exerciſes, one of the Proctors is always preſent; and thoſe Exerciſes cannot be performed, and paſs *pro forma*, unleſs it be ſo. Beſides this, there is no publick Scholaſtick Exerciſe at any Time performed, but either one of the Magiſtrates of the Univerſity is actually preſent at the Performance of it, or at leaſt the Performers run the Riſque of having one of the Magiſtrates preſent at the Performance, and conſequently take all poſſible Care before-hand in providing for the due Performance of their reſpective Exerciſes, as not knowing, but that ſome Magiſtrate may be preſent at the Performance of them. And this ſome Scholars do to gain Applauſe, others to avoid the Diſgrace of being *plucked*, as they call it, that is commanded to deſiſt from the Performance of their Exerciſe for that Time, and ſo to provide themſelves better againſt ſome other Time. Which Thing of being plucked is what ſeldom happens, ſcarce once in a Year; but when it does happen, it is ſcarce ever wiped off as long as a Man lives.

I ſhall conclude this Hiſtory of the *Univerſity* of *Oxford* with Doctor *Newton*'s Account of the Expences a Scholar is at in the Houſe, of which he is a Member.

A particular Account of a Commoner's *Expences in* Hart-Hall, *for* Michaelmas *Quarter*, 1723.

	l.	s.	d.
Chamber-Rent — — —	1	0	0
(*a*) Tuition and Officers Stipends — —	2	5	0
(*b*) Univerfity Dues — — —	0	1	3
(*c*) Charter — — —	0	0	6
Bedmaker's Wages — — —	0	6	6
Domus — — —	0	0	3
(*d*) Decrements — — —	0	4	2
Servitor — — —	0	2	6
Commons and Battels, Cook and Butler's Salaries, (*e*) included	3	16	11
	7	17	1

A View of each Week's Expence, for *Commons* and *Battels* in the faid Quarter, exclufive of the Cook and Butler's Salaries.

		l.	s.	d.
June	28. — — —	0	4	4 ½
July	5. — — —	0	4	5 ½
	12. — — —	0	4	6 ½
	19. — — —	0	4	5 ½
	26. — — —	0	4	8
Auguft	2. — — —	0	4	5 ½
	9. — — —	0	5	9
	16. — — —	0	5	3
	23. — — —	0	4	11
	30. — — —	0	4	10 ½
Septem.	6. — — —	0	5	1 ½
	13. — — —	0	4	11 ½
	20. — — —	0	4	9 ½
	27. — — —	0	4	11 ½
		3	7	7

	l.	s.	d.
The Doctor obferves, that this was a Quarter, in which were fourteen Weeks, and of which the *Commoner* was not abfent from the Hall one Day, and that the pure Commons and Battels of the whole Quarter amount to no more than — —	3	7	7
Add to this, the Cook and Butler's Salaries for 14 Weeks. —	0	9	4
Decrements — — —	0	4	2
	4	1	1

(*a*) To the *Tutor*, 1*l.* 10*s.* To the *Publick Lecturer*, 5*s.* To the *Principal, Chaplain, Catechift* and *Moderator*, 2*s.* 6*d.* each.

(*b*) To the *Readers* of the *Un-endowed Lectures*, 6*d.* To the *Bedell of Arts*, 2*d.* called *Culet*, i. e. *Collecta*. To the Keeper of the Galleries at St. *Mary*'s, 6*d.* To the Clerk of St. *Mary*'s, 1*d.*

(*c*) Paid to the Univerfity at *Michaelmas* and *Lady-Day*, only for the Defence of their Privileges.

(*d*) Each Scholar's Proportion for Fuel, Candles, Salt, and other common Neceffaries, originally fo called, as fo much did on thefe Accounts *decrefcere*, or was difcounted from a Scholar's Endowment.

(*e*) Four-pence a Week to each of thofe Servants, from every Commoner of the Society, in lieu of all Fees and Perquifites before received by them.

Allowance

	l.	s.	d.
Brought over	4	1	1
Allowance to Domus ——— ——— ———	0	0	3
Allowance to the Servitor for waiting ——— ———	0	2	6
The whole Expence of Eating and Drinking, and of the Accommodations and Attendance and Service relating thereto, comes but to	4	3	10

Which is 5 *s.* 11 *d.* ¾. *per* Week, or 10 *d.* ¼. each Day, (only three Halfpence over)

From hence it appears, that the ordinary Expences of a College Life, including Chamber-Rent, Tuition and Officer's Stipends, does not amount to eight Pounds a Quarter, or thirty-two Pounds *per Annum*; and if it ſhould be admitted, that the Expences are ſomething more in other Colleges, and we add forty Shillings a Quarter, or eight Pounds *per Annum* to the Account; then the whole Expences will amount to but forty Pounds *per Annum*; and yet there is ſcarce a Commoner in the Univerſity that ſpends leſs than ſixty Pounds *per Annum*, and many of them upwards of fourſcore by an extraordinary way of Living: and excluſive of the Expences at his Entrance into the Univerſity.

	l.	s.	d.
For the Furniture of a Room ——— ———	15	0	0
— A Gown, Surplice and Cap ——— ———	7	0	0
— Cautionary Money ——— ——— ———	10	0	0
	32	0	0

Let us now take a Survey of the Univerſity of CAMBRIDGE.

Should I adopt the Opinion of ſome *Antiquarians*, it would lead me to aſſert that *Cambridge* is the moſt ancient *Academical* Foundation in *Europe*; the Univerſity of *Oxford* only excepted. For, from this Seat of Learning were ſent certain Diſciples of Venerable *Bede* to be the firſt Profeſſors in the Univerſity of *Paris*; and *Bede* (in the Year of Chriſt 689) by conſent of the Clergy and Prelates of the Kingdom, was, for his many learned Diſputations againſt the *Heathens*, raiſed to the Chair of the *Elders*, with the Mantle of Honour, and Cap of Dignity, after the Manner of the *Athenians*, in the Univerſity of *Cambridge*.

If the Letter, which goes under the Name of *Alcuin* to the Scholars of *Cambridge*, be genuine, there can be no doubt of its being in a flouriſhing Condition in his Time, himſelf having commenced Doctor in this Univerſity under Venerable *Bede* in the Year of Chriſt 692. But let the Fate of that Letter, and the State of this *Univerſity* in the Reign of King *Alfred*, the *Solomon* of the *Saxon* Line in *Britain*, be what they will, I can, with great Certainty, affirm, that the *Norman* Conqueror committed the Education of *Henry Beauclerk*, his youngeſt Son, and afterwards King of *England*, to the Care of the Governors of this learned Body.

But it cannot be preſumed that the Univerſity, in thoſe early Ages, could be under the ſame Regulation, or ſo endowed, and ſettled as now we ſee it.

It might, and probably was here, as at *Oxford*, the Cuſtom to erect public Schools for private Emolument: the Scholars at firſt boarded in private Houſes, as is ſtill the Cuſtom at *Leyden*, *&c.* in *Holland*: Some Encouragers of Learning did in length of Time, and for the better Improvement of Youth built *Hoſtels* or *Inns* for the Students to live in Society, at their own Charges, under certain Rules or Regulations, as now practiſed at the *Inns of Court* in *London*; and which in courſe of Time obtained the Name of *Halls*; and at length the *Monks* and *Friars* taking it in their Heads to plant ſome of their young Branches in this learned Soil, they introduced Foundations for the full Maintenance of the Students and Fellows in *their Halls*, which proved ſo great an Encouragement to Learning, that we find their Example imitated, ſoon after, by all the other *Halls*.

Theſe Endowments were attended with another alteration in the Circumſtances of the Houſes for the Reception of Students: for, many of the *Halls*, from the Time of their Endowment took the Names of *Colleges*.

The

The diligent Searchers into Antiquity have given the following Lift of the *Inns* and *Hoftels* at *Cambridge*, in which the Students originally lived and ftudied at their own Charges, and under the Government of a Prefident.

1 *Auguftine Hoftel.*
2 *Barnard's Hoftel.*
3 *Bolton's Place.*
4 *Boden's Hoftel.*
5 *St. Botolph's Hoftel.*
6 *St. Clement's Hoftel.*
7 *Coufin's Place.*
8 *St. Croffe's Hoftel.*
9 *St. Edward's Hoftel.*
10 *Ely-Convent* for Monks belonging to *Ely-Monaftery.*
11 *Gerrard's Hoftel.*
12 *God's Houfe.* }
13 *God's Houfe.* } Three feveral Foundations.
14 *God's Houfe.* }
15 *St. Gregory's Hoftel.*
16 *Jefus* and *St. John's Hoftel.*
17 *St. John's Hoftel.*
18 *St. Katharine's Hofpital.*
19 *Knapton's Place.*
20 *St. Margaret's Hoftel.*
21 *St. Mary's Hoftel.*
22 *St. Michael's Hoftel.*
23 *Ovin's Inn.*
24 *St. Paul's Inn.*
25 *Phifwick's Hoftel.*
26 *Rud's Hoftel.*
27 *St. Thomas's Hoftel.*
28 *Tiled Hoftel.*
29 *Trinity Hoftel.*
30 *Univerfity Hoftel.*
31 *A Dominican Convent.*
32 *A Francifcan* or *Minorite Convent.*
33 *An Auguftine-Friars Convent.*
34 *A Carmelite Convent.*
35 *A Houfe of White Canons.*

I don't infift upon the tradition of *Pythagoras's Houfe*, (where, it has been faid, that antient Philofopher lived and read Lectures to the Youth of this Univerfity) fituated on the North Weft Side of St. *John's College*, now a Farm to *Merton College*, *Oxon.*

The *Colleges* and *Halls*, as now eftablifhed, differ only in Name. They entertain three forts of Scholars: Ift, *Great Penfioners* or *Fellow Commoners*, who are Gentlemen of *Quality* or of large Fortunes: IIdly, Leffer *Penfioners* or *Commoners*, who are dieted as Scholars, but both live at their own Expences: IIIdly, *Sizars* or *Servitors*, who are fuch Scholars, as are maintained on the Revenues of the Foundations, Exhibitions, *&c.*

But this Diftinction is no Impediment or Bar to the Advancement of them to the *Academical* Degrees conferred upon the Students of this Univerfity.

The Degrees conferred by this Univerfity are *Batchelor* and *Mafter of Arts*, *Batchelor* and *Doctor* in *Divinity*, *Phyfic*, and *Law*: to which all Students, according to their ftanding and proficiency in Learning, are intitled, *viz.* To the Degree of a *Batchelor* of *Arts* at the end of four Years from Admiffion: To the Degree of a *Mafter* of *Arts*, an the end of three Years more: To the Degree of a *Batchelor* of *Divinity*, feven Years after that: And to the Degree of *Doctor* in *Divinity* not till feven Years more fhall expire; which make twenty-one Years from the Student's firft admiffion upon the Books of this Univerfity.

The Degrees in *Law* and *Phyfic* are fooner conferred. In either of thefe the Student may commence *Batchelor* at the end of *five* Years; and *Doctor* at the end of five Years more.

The Times for conferring Degrees are called the *Commencement*; and for *Bachelors* of *Arts*, it begins on *Afh-wednefday*, and continues the whole Time of Lent: for *Mafters* of *Arts* and *Doctors* of all Faculties, on the firft *Tuefday* in *July*.

The Graduates are diftinguifhed by their *Dreffes*; and are intitled to certain *Privileges*, *&c.*

It is moft probable that the Habits ufed in this Seat of Learning have undergone as many Alterations and Changes, as we have feen Forms of the Houfes or Habitations; for, though the prefent Gown of the *Undergraduate* refembles the Garb of a *Novice* of the *Friars Preachers*: That of a *Mafter* of *Arts*, the Habit of a *Canon Regular* of the Order of St. *Auguftine*: and that of a *Doctor* in Divinity nearly approaching the Drefs of a *Benedictine* Monk; and though the *Cap* is exactly borrowed from the faid Canons; and the *Hood* is a near Reprefentation of the large Couls ftill worn by fome of the Monaftic Orders, more for Ornament than Ufe; yet it cannot be imagined that a Place of fuch Antiquity and Fame for its Studies could be without *Academical Habits* before thefe *Monaftic* Inventions had any Exiftence in the Ifland of *Britain*: neither can the retaining of the prefent Forms be fubject to Cenfure, let their Origin be what they will; becaufe fome Habits are neceffary to convey an immediate Idea of a Students ftanding

and

and Degree in the Univerſity, at ſight; and as theſe, delivered down from former Times, contain nothing indecent nor irreligious, they cannot be conſidered any otherwiſe than as Badges of Honour and Ornament, and not as Relicks of Popiſh Superſtition.

The Government of this *Univerſity* is in a *Chancellor*, *High Steward*, *Vice-Chancellor*, two *Proctors*, and ſeveral other inferior Officers, who are all choſen and empowered much in the ſame Manner as thoſe already mentioned in the Hiſtory of the Univerſity of *Oxford*.

This Univerſity is not only incorporated; but it ſends two Repreſentatives to Parliament.

Here are only three Terms kept, *viz.*

Lent Term, which always begins on the 13th of *January*, except it falls on a *Sunday*; then on the 14th.

Eaſter Term, which begins *Wedneſday* ſennight after *Eaſter*, and ends on *Friday* after the *Commencement*.

October Term, which begins on 10th of *October*, divides *November* 13th, and ends *December* 16th.

The *Colleges*, *Houſes* and *Halls* incorporated by the Name and Stile of the Univerſity of *Cambridge* at this Time are

1. *Peter Houſe*, which takes its Name from being built on the Burial Place belonging to St. *Peter*'s *Church*, now St. *Mary*'s. This College was founded by *Hugh de Balſham* about the Year 1257 or 1280, for fourteen Fellows, two Students in Divinity, and eight poor Fellows. He alſo gave them 300 Marks at his Death to make Additions to the College, and a large Collection of *Manuſcripts*.

The Lands, Revenues, &c. of this College have been very much encreaſed by a numerous Liſt of Benefactors from Time to Time; which has put it into a moſt flouriſhing Condition. For there are now a Maſter, fourteen Foundation Fellows, and forty-three Scholars.

From this College we can enumerate, two Archbiſhops of *Canterbury*, one Archbiſhop of *Armagh* in *Ireland*, one Cardinal, twelve *Biſhops* in *England* and *Wales*, and one *Iriſh* Biſhop.

Its State of Learning from the very Commencement of the Reformation is very conſpicuous in the Works of *George Joye*, a *Proteſtant* Fellow of this College in 1547, who tranſlated Part of the Old Bible: ---Of Archbiſhop *Whitgift*, who diſtinguiſhed himſelf by his learned Diſcourſes againſt the Church of *Rome*:---Of *Andrew Perne*, Maſter; one of the Tranſlators of Biſhop *Parker*'s Bible:--- Doctor *John Richardſon*, Maſter, and Doctor *Andrew Bing*, two of the Tranſlators of King *James* the *Firſt*'s Bible:---*John Holbroke*, Maſter; the great Mathematician:---*Chriſtopher Cartwright*, a noted Linguiſt and Author of Annotations on *Geneſis* and *Exodus*:---Biſhop *Coſyns* Author of the *Scholaſtical Hiſtory of the Canon of Scripture*:---Biſhop *Walton* Author of the *Polyglott Bible*:---Doctor *William Sherlock*, Author of many Diſcourſes againſt *Papiſts*, &c.---Sir *Samuel Garth*, Knt. M. D. Phyſician and Poet, Author of the *Diſpenſary*.

2. *Clare Hall*; which was founded in the Year 1326, by *Richard Baden*, then Chancellor of the Univerſity, by the Name of *Univerſity Hall*, without any Foundation Revenues. But this being deſtroyed by Fire about 16 Years after, he prevailed with Lady *Elizabeth Burgo*, alias *Burk*, Counteſs of *Clare* in *Suffolk*, to join with him in rebuilding and endowing the ſame. And ſhe accordingly rebuilt and endowed it by the Name of *Clare Hall*, for the Maintenance of one Provoſt, ten Fellows, and ten Scholars: and from the additional Benefactions the Revenues now maintain a Maſter, ten Senior and ſeventeen Junior Fellows, and three Bye-Fellows, and a numerous Train of Scholars and others to the Amount of 100, or thereabout.

This *Hall* has given to the Church one Archbiſhop of *Canterbury*, one Archbiſhop of *York*, one Lord High Chancellor; four Biſhops in *England*, and one *Iriſh Biſhop*.

The Learned World is indebted to it for the Education of *Ralph Cudworth*, Maſter of this Hall, and Author of *the Intellectual Syſtem*:---Of *Richard Thompſon* the Philoſopher:---Of *Thomas Philpot*, the celebrated *Antiquarian*:---Of Archbiſhop *Tillotſon*, admired for his Preaching and learned Sermons: ---Of Doctor *Thomas Burnet*, Maſter of the *Charter-Houſe*, and Author of *the Theory of the Earth*, &c.

The College as it now appears is a great Curioſity, and was built in that elegant Manner, *Anno Domini* 1638.

3. *Pembroke Hall*; which was founded by Lady *Mary de Valentine* Counteſs of *Pembroke*, *Anno Domini* 1347, was endowed under a Charter from King *Edward* III. for ſix Fellows and two Scholars, leaving it to the Diſcretion of the Maſter and Fellows to increaſe the Number in Proportion to the Revenues ſhe ſhould ſettle.

This Foundation was ſoon enlarged, by extending its Buildings over the Site of *Univerſity Hoſtel*, &c.

King *Henry* VI. became its magnificent Benefactor, which, with the many Privileges and Benefactions that followed, both from Popes, Kings, Queens, and Subjects, procured it the Character, which was given under the great Seal of *England* by King *Edward* IV. of *The noble and renowned and most precious College, which does and always did shine wonderfully, among all Places in the University.*

In this College were educated two Archbishops of *Canterbury*; four Archbishops of *York*; two Archbishops of *Tuam* in *Ireland*; twenty-four Bishops in *England* and *Wales*, and one *Irish* Bishop.

N. B. From this Number of Bishops, this College was, of old, called *Collegium Episcopale.*

But what has made it more renowned is the Catalogue of Learned Men produced from its Foundation. Here we find *William de Bottlesham*, the eloquent Preacher in King *Richard* II. Reign: --- *William Lyndwood* Author of the *Provincial*: --- *William Somerset*, M. D. Physician to *Henry* VI. --- *John Rogers*, who translated the Bible, and was the first Protestant *Martyr* under Queen *Mary* I. --- Bishop *Ridley* the most learned of the *Martyrs* in that Reign, and one of the Compilers of our *Liturgy*: --- Doctor *William Turner* an eminent Physician, Divine and Preacher. He was Domestic Physician to the Protector Duke of *Somerset*: Wrote divers Treatises against Popery; was Dean of *Wells*; and Author of the first *English Herbal*, *Anno Domini* 1568. --- *John Bradford* another Martyr: --- Bishop *Christopherson*, eminent for his Skill in the *Greek* Tongue: --- Doctor *Fulk*, the learned Confuter of the *Rheims Testament*: --- *Gabriel Harvey*, an elegant Prelate and Orator: --- The celebrated Poet *Edmund Spencer*: --- *William Rowley*, a great Wit and Theatrical Poet: --- Bishop *Brownrigge*, an eminent Preacher: --- *Thomas Stanley*, Author of the *History of Philosophy*: --- Doctor *Thomas Wharton*, M. D. who discovered the *Ducts* in the *Glandulæ Maxillares*: --- Doctor *William Holder*, who first discovered the Method to teach a dumb Man to speak, and an eminent Virtuoso: --- *Henry Hawson*, the Chronologer: --- Doctor *George Folbury*, Poet Laureat, and a famous *Rhetorician*, celebrated for his *Epigrams* and *Orations*.

4. *Bennet-College* was founded by the joint Endeavours of the *Gild* of *Corpus Christi* and the *Gild* of the *Blessed Virgin Mary* by the Name of both their Gilds, in the Year 1344. But they about four Years after consented to change its Name to *Benedict* or *Benet College*, because it was situated near St. *Benet*'s Church.

Its first Revenues were inconsiderable; and though it was put under the Protection of *Henry Plantagenet* the brave and good Duke of *Lancaster*, the Income would hardly support the Master avd Fellows with Necessaries. However in Process of Time the Benefactions enabled this Society to encrease the Number of Students very much. So that at present here are 12 Fellows and 45 Scholarships and Exhibitions.

From hence have proceeded three Archbishops of *Canterbury*; two Archbishops of *York*; two Archbishops in *Ireland*; eleven Bishops in *England* and *Wales*, and three *Irish* Bishops.

Also the learned Author of *Antiquitates Britannicæ*: --- *Richard Cavendish* the celebrated Physician and Mathematician: --- *Thomas Markunt* the Antiquarian: --- *John Crump* the great Divine: --- *William Briggs*, M. D. the Anatomist and Author of the *Anatomy of the Eye* and *Theory of Vision*: --- *John Pulgrave*, S. T. P. the Grammarian and Linguist: --- *John Spencer* Author of the learned Treatise *de Legibus Hebreorum*: --- *John Thorp* the *Logician*, Author of the *Labyrinth* of *Logic*: --- *Thomas Allen*, Author of *Scripture Chronology*: --- *John Johnson*, Author of *the bloody Sacrifice* and Altar *unveiled*, &c. --- Doctor *Robert Mosse*, a celebrated Preacher, *&c. &c. &c.*

In this College is a Library over the Chapel consisting of *Manuscripts* only; the Gift of Archbishop *Parker*. They were collected by himself and deposited in this College under this Condition, that should any one of the Records or Manuscripts left by him, be secreted or missing from that Collection, the College shall loose the whole; as by his Grace's Will doth more fully appear. Therefore such Care is taken to preserve this valuable Deposit, celebrated all over the learned World, that even a Fellow of the House is not permitted to enter the Library, without an Inspector with him, to attend him during his stay there; and the Manuscripts are carefully examined and numbered once a Year by two Persons of another College.

5. *Trinity-Hall* is indebted to the Generosity of divers Benefactors, who brought it out of its ancient Mediocrity of a poor *Hôtel* or *House of Study*, and added to it many Enlargements; which being all purchased by Doctor *William Bateman*, Bishop of *Norwich*, was taken down, and at his own Expence was built and erected into a College, he endowing it with a considerable Estate; and is therefore generally reputed the Founder thereof, in the Year 1351.

The Founder appointed a Master, two Fellows, and three Scholars of this House to be Students in the *Canon* and *Civil Law*, and one Fellow to the Study of Divinity. He afterwards enereased his Favours, and procured many Advantages and Additions to their Revenues from the Pope. We find also

many

many other Benefactions both for founding Scholarships, rebuilding the Premisses, *&c.* But the greatest Sum was left to this College lately by *John Andrews*, L. L. D. sometime Fellow, Master of the *Faculties*, and Chancellor of the Diocese of *London*. This Gentleman, who died in 1747, gave to this Hall 20,000*l.* for six Fellowships, and six Scholarships for the Study of the *Civil Law*, which he appropriates to *Merchant Taylor's School* in *London*; and the Residue for finishing the new Buildings.

The present Members of this *Hall* are a Master, twelve Fellows, two of which are Divines, fourteen Scholars, and one Exhibitioner. Who enjoy the Advantages of a Library replenished with a fine Collection of choice and valuable Books, and an entire Study of Civil and Common Law Books.

Amongst the dignified Clergy we find eight Bishops; and amongst the Learned we can mention Doctor *Haddo*, Master of the Requests to Queen *Elizabeth*, and one of the Restorers of Learning in *Britain*: --- Bishop *Thirleby*, one of the Compilers of the *Liturgy*: --- *Thomas Tuper*, who has wrote well for his Time, on Husbandry: --- Doctor *Cowel* Author of the Interpreter and of the *Institutiones Juris Anglicanæ*: --- Bishop *Barlow* one of the Translators of the *Bible*: --- Sir *Robert Naunton*, Knt. Public *Orator*, Secretary of State and Author of *Fragmenta Regalia*.

6. *Gonville* and *Caius College* takes its Name from a double Foundation. It was originally the Foundation of Mr. *Edmund Gonville* Minister of *Tarrington* in *Norfolk*, who in the 22d of *Edward* III. obtained a Charter for building of a College to maintain a Master and thirty Scholars. To which the Chancellor and Masters of the University, and the Master and Brethren of St. *John*'s Hospital in *Cambridge*, about four Years after, became Benefactors. Mr. *Gonville* did not live to complete this Institution: But having prevailed with Doctor *Bateman* Bishop of *Norwich* to finish the Work after his Death, that Prelate executed his Will, and gave it the Name of *Gonville Hall*: However the Revenues fell far short of the Maintenance intended by the Founder; for it does not appear that this Bishop endowed this Hall for more than a Master and three Fellows. It was afterwards endowed with the Augmentation of three more Fellows; which, with the Favour shewn by Pope *Sixtus* IV. *Anno Domini* 1481, who obliged all *Benedictine Monks* of the Diocese of *Norwich*, intending to follow their Studies at *Cambridge*, to study in no other Hall than this.

This brought the Society into great Reputation; and Benefactions tumbled in a-pace, insomuch that soon after we find seven Fellowships and eleven Scholarships added to the former Number.

In 1557 *John Caius*, M. D. who had been Master of this College, enlarged the House and encreased its Revenues so much, that his Benefaction was deemed a new Foundation: So that from thenceforward it is called *Gonville* and *Caius* College.

John Caius, alias *Keys*, after he had taken his Doctor's Degree in *Physic*, left *Gonville* College, and travelling into foreign Parts for Experience, entered himself in the University of *Padua*, at that Time much in Vogue for the Study of *Physic*, under *John Baptist Montanus de Verona*, the greatest Physician of the Age: And having acquired great Reputation there by his public Lectures and Writings, Mr. *Caius* returned to his native Country, and then made the Foundation abovementioned.

He obtained a Charter of Incorporation for this united Foundation, which gave him Power to found two or more Fellows, and twelve or more Scholars; to be incorporated by the Name of the Master, Fellows and Scholars of *Gonville* and *Caius* College, founded to the *Honour* of the ANNUNCIATION of the Blessed Virgin MARY.

The Doctor soon after built *Caius Court* at his own Charge; and inscribed the Gate next to St. *Michael*'s Church, HUMILITATIS, or the Gate of HUMILITY: the next VIRTUTIS, *i. e.* the Gate of VIRTUE: On the other Side of this *Portico* are these Words *Jo. Caius posuit Sapientiæ* 1567, i. e. *John Caius erected this in Honour of Wisdom*: the other Gate next the public Schools, commended much for its Architecture is inscribed HONORIS, i. e. *The Gate of Honour*, upon a Supposition that none should venture to pass through it to take their Degrees, who have not honourably acquitted themselves in their Studies, *&c.* Those Buildings, exclusive of his Settlements, cost him 1834*l.*

Amongst other Privileges the Doctor obtained a Licence in the 6th *Elizabeth*, that this College might for ever yearly take the Bodies of two Malefactors at their Discretion, and dissect them without the Controul of any Person, and without paying any thing for them; and settled the annual Sum of 1*l.* 6*s.* 8*d.* for the Expence of dissecting the Bodies.

By his Will he settled 100*l.* *per Annum* more upon this College; and appropriated his *Fellowships* and *Scholarships* to the Diocese and City of *Norwich*.

There have been many other good Benefactions made to this College. Mr. *Robert Trapp* settled four Scholarships. Mrs. *Jocosa Frankland* gave enough to maintain six Fellows, twelve Scholars, a Chaplain and a *Hebrew* Professor. Doctor *Thomas Legge* left Money to build the Side of the new Court next St.

Michael's Church. Mr. *William Branthwait*, S. T. B. gave a most valuable Library to this College, and 26 *l.* 13 *s.* 4 *d.* for founding four Scholarships, Mr. *Stephen Perse*, M. D. left 10 *l. per Annum* each to six Fellows: 4 *l. per Annum* each to six Scholars, and 500 *l.* to build the *North* Side of the new Court. *John Griffin*, M. D. gave 40 *l. per Annum* for ever to be employed for *four* Scholars at 5 *l.* each *per Annum*, and other Purposes. Mr. *Matthew Stokys* gave 5 *l.* 10 *s. per Annum* each to three Scholars, and 16 *l. per Annum* to one Fellow, who is a Divine, and applies himself to Study. Mr. *John Goslin* augmented his Great Uncle Doctor *Goslin*'s Scholarships, with the Interest of 500 *l.* for ever. Archbishop *Parker* founded one *Physic* Scholar.

This College has the Guardianship and Direction of a *School* and *Alms-house* for six poor Women; both founded by Doctor *Stephen Perse*: The *School-House* so large as to contain 100 Boys; with Apartments adjoining for the Master and Usher: Endowed with 40 *l.* for the Master and with 20 *l.* for the Usher. The *Alms-house* for six single Women forty Years old, and upwards, to be paid 20 *s.* every Quarter.

Amongst the Regulations and Orders of this College, we find one, which obliges those Scholars, who intend to offer themselves for College Preferments, to reside four Calendar Months in each Year; and that such as shall not so reside the first Year after they are *Bachelors*, if they be possessed of any of the more valuable Scholarships, must quit the College or change their Scholarships.

The dignified Clergy, educated in this united Society, are one Archbishop of *Canterbury*, one Archbishop of *Armagh*, eleven Bishops in *England* and *Wales*, and two *Irish* Bishops.

Amongst the learned Members of this Society are noted the celebrated *Astronomer Walter de Aveden*, Author of an *Astronomical Table*: — Bishop *Skyppe*, a noted Preacher and one of the Compilers of the Liturgy: — Doctor *John Caius* the Founder, and Author of many excellent Books not only in *Physic*, but of the *Antiquities* of *Cambridge*: — Bishop *White*, who wrote learnedly against *Popery*: — Mr. *Fletcher*, M. D. famous for his Book *de Urinis*: — Doctor *William Harvey*, who discovered the Circulation *of the Blood*, and wrote *de Generatione Animalium*: — Doctor *Jeremy Taylor*, Author of the *Holy Living and Dying*, and many other Books in great Esteem for their Piety and Learning: — Doctor *Robert Sherringham* an excellent *Antiquarian*, and *Orientalist*, Author of *Liber de Anglorum Gentis origine*; and of two Sermons entitled *The King*'s *Supremacy asserted*, &c. and Translator of *Joma*, a *Talmudical* Book, with his own Annotations: — Sir *Charles Scarborough*, M. D, an eminent *Mathematician* and Anatomist, the Author of the *Anatomy of the Muscles*: — Doctor *Henry Wharton* a celebrated Antiquarian, as appears by his *Anglia Sacra*, &c. — *Sir William Neve*, *Clarencieux* King at Arms, also esteemed for his Knowledge of, and Researches into Antiquity: - - - Doctor *Brady* Author of the History of *England*: — *Robert Hare*, Esq; noted in *Heraldry*: — *Thomas Shadwell*, Esq; a *Theatrical Poet* and *Poet Laureat*: — Mr. *Jeremy Collyer*, the learned Author of an *Historical Dictionary*, &c. — Doctor *Samuel Clarke*, whose *Sermons*, *Philosophical* and *Critical* Works are to be rated with the best Works of his Predecessors in Learning and Eloquence.

The Library of this College is not large, but well stocked with useful Books both in Print and Manuscript: amongst which is a large Collection of such as treat of *Physic* and *Heraldry*.

7. *Kings College*, begun by King *Henry* VI. in the Year of Christ 1441, was dedicated to the *Virgin Mary* and St. *Nicholas*, and intended for the Support of a Rector and twelve Scholars: But in 1443 his Majesty changed its Form and Name; placed in it a Provost (instead of a Rector,) seventy Fellows and Scholars, ten Priests, six Clerks, a Music Master or Organist, sixteen Choristers, sixteen Officers of the Foundation, twelve Servitors for the senior Fellows, and six poor Scholars; in all 140; and dedicated this new Conception to the *Blessed Virgin Mary*, and to the *glorious Confessor St. Nicholas*. However this grand Design was cut short by the Troubles, which he met with, from the *House of York*.

King *Edward* IV. diminished its Revenues, and gave Part of its Estate, called *Pythagoras*'s-*House* to *Merton College* in *Oxford*, which enjoys it to this Day.

Henry VII. was the first that cast his Eyes upon this Royal Foundation with Favour: And he extended the Chaple 188 Feet in Length; and finished the outside Shell. The Inside, as we now see it, was the Work of his Son and Successor *Henry* VIII.

The College at *Eaton* was founded by King *Henry* VI. for a Provost, seven Fellows, and seventy Grammar Scholars to be maintained on the Foundation, for a Nursery to this College at *Cambridge*.

The succeeding Benefactions to this College have been chiefly made to the Library.

The present Members of this College are a Provost, seventy Members, two Conducts, six poor Scholars, an Organist, six Singing men, and sixteen Choristers, all upon the Foundation; and are not obliged to keep their Exercise in the public Schools, as those belonging to other Colleges do.

This College has produced two Archbishops of *York*; one Archbishop of *Dublin*; one Archbishop of *Armagh*; twenty-two Bishops in *England* and *Wales*, and two *Irish* Bishops.

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It has educated feveral Statefmen, many of whom are celebrated for their learned Works; as Doctor *Hartlyffe*, M. D. who was chief Phyfician to King *Henry* VI. eminent in his Faculty, and Secretary of State to King *Edward* IV: — Lord Chief Juftice *Coningfby* in the King's Bench, temp. *Henry* VIII. — Doctor *Thomas Wilfon* Principal Secretary to Queen *Elizabeth*, and Author of two Difcourfes on the Art of *Rhetoric* and *Logic*: — Doctor *Giles Fletcher*, Author of *the Hiftory of Ruffia*, Mafter of the Requefts, and Embaffador into *Ruffia*: — Sir *Thomas Ridley*, Knt. Vicar General, and the learned Author of the *View of the Civil and Ecclefiaftical Law*: — Sir *Robert Morton* Principal Secretary of State to King *James* I. — Sir *Francis Walfingham*. Knt. Principal Secretary of State to Queen *Elizabeth*.

The Number of its learned Members would be too long to enumerate. Thefe may ferve for a Specimen.

At the Foundation we find *Thomas Stacey* and *William Sutton*, both famous for *Aftrology*: — Doctor *Richard Croke* Public Orator and *Greek* Profeffor, in which Language he greatly excelled: *William Buckley*, an eminent Mathematician and Author of *Arithmetica Memor.* — Doctor *Alley*, Author of a *Hebrew Grammar*, and one of the Tranflators of Queen *Elizabeth*'s Bible: — *Richard Muncaster*, an eminent *Grecian* and *Grammarian*. — *Anthony Wotton*, firft Profeffor of *Divinity* in *Grefham College*. *William Oughtred*, B. D. Author of *Clavis Mathematicæ*, and moft renowned for *Mathematical* Learning: — *Edmund Waller*, Efq; that admirable Poet, who firft refined *Englifh* Verfe: — Bifhop *Montague* a great *Antiquary*, and Author of *Apello Cæfarem*, &c. for which he underwent great Perfecution from the *Fanatics* and *Republicans*. He alfo wrote againft *Selden*'s *Hiftory of Tythes*, and a *new Gage for the Old Gofpel*; and he publifhed *Photius*'s *Epiftles* and *Nazianzen*'s *Invective againft Julian*: — Doctor *Whichott* a celebrated and pious Preacher: — Doctor *Pearfon*, Bifhop of *Chefter*, well known for his elaborate Writings both in *Hiftory* and *Divinity*: — Doctor *Caftel*, the laborious and moft learned Author of the *Lexicon Heptaglot*: — Doctor *Stanhope* Dean of *Canterbury*, and Author of the Paraphrafe on the *Epiftles* and *Gofpels*: — Bifhop *Hare*, Editor of *Terence*: — Doctor *King*, Editor of *Eurypides*, and Doctor *Battie*, Editor of *Ifocrates*.

The Chapel is one of the moft fumptuous *Gothic* Edifices in the whole World; it meafures 304 Feet from *Eaft* to *Weft*, 73 from *North* to *South*, and from the Ground to the Top of the Battlements 91; carrying an Octogon Tower at every Corner, each of which terminates in a Dome, with winding Stairs leading into the fame. The whole is built of Free-ftone, and is thought to be the largeft Room in the World, whofe Roof is not fupported by Pillars. It is covered with a Stone Arch; above which is another made of Timber well leaded, with Space enough between the two Arches, as to permit a tall Man to walk upright between them. On the *North* and *South* Side is a Porch and nine fmall Chapels, each of which had its Altar, before the *Reformation*; but they now are ufed as burial Places, except thofe on the *South* Side, where one is converted into a *Library*, another into a *Veftry*, &c.

Doctor *Fuller* tells us, that the Stone-work, Wood-work and Glafs-work in this Chapel, contend, which moft deferves Admiration.

Here Prayers are read three Times a Day; at half an Hour paft fix in the Morning, and again at ten, and then at five in the Afternoon.

8. *Queen's College* is another Royal Foundation by *Margaret* of *Anjou*, Queen Confort to *Henry* VI. of *England*, in the Year of Chrift 1448. Her Majefty dedicated this College to *St. Margaret* and *St. Bernard*, and endowed it with 20 *l. per Annum*. And though this Work received fome Interruption by the Troubles brought upon her Hufband and Family by the *Lancaftrian* Party; it was finifhed *Anno Domini* 1465, by her Succeffor on the Throne, *Elizabeth* Wife to *Edward* IV. moved thereunto by her Confeffor *Andrew Ducket*, a Minorite Friar: Whofe Care for this College, and his Intereft amongft the Great, obtained many large Donations from other Hands for its Support. Amongft the numerous Benefactions (in all 150) we find *Richard* III. who having feized upon the great Poffeffions of *John Vere* the thirteenth Earl of *Oxford*, gave them all to this Foundation. But King *Henry* VII. reftored them again to the Earl.

At prefent it maintains a Mafter, twenty Fellows, forty-five Scholars, and eight Exhibitioners.

From hence the Church has received one Archbifhop of *Canterbury*; one Archbifhop of *York*, feventeen Bifhops in *England* and *Wales*, and one Bifhop in *Ireland*.

The Learned World have received from hence alfo, the learned Bifhop *Fifher*, the firft Lady *Margaret*'s Profeffor in *Divinity*: — *Erafmus Rotterodamus*, an Author of the greateft Repute in *Critical*, *Theological* and *Grammatical* Learning: — Doctor *Haynes* and Doctor *May*, Compilers of the *Liturgy*: — Sir *Thomas Smith*, Knt. Secretary of State, and *Greek* Profeffor, &c. and the firft Introducer of the new way of pronouncing that Language: — Bifhop *Davenant*, Reprefentative for the *Anglican* Church at the Synod of *Dort*, and Author of Annotations, &c. — The famous Antiquarian *John Weever*, Author

Author of the *Funeral Monuments*: — The Historian Doctor *John Fuller*, Author of the Church History and Worthies of *England*, &c. — The great *Mathematician* Doctor *John Wallis*: — Bishop *Sparrow*, Author of the *Rationale on the Common Prayer*, and other Pieces: — Bishop *Patrick*, Author of the very learned Commentary on great Part of the Old Testament; — Doctor *James Windlett*, M. D. an ingenious *Latin* Poet, an excellent *Linguist*, and a sacred *Critic*: — Doctor *Davyes*, Editor of several Classics, and of *Minutius Felix*, and *Lactantius*: — And Doctor *Thomas Brett*, the learned Author of the Discourse on *Church Government*, and of a Dissertation on *Liturgies*.

9. *Katharine Hall* is the Monument of a private Charity; being the Foundation of Doctor *Robert Woodlark* or *Wodelarke*, Chancellor of this University. He began this Work in 1457, but did not obtain a Licence for its Endowment with Revenues to support a Master and three Fellows, till the Year 1475.

Many Benefactions have since enabled this *Hall* to support a Master, six Fellows, one Fellow-Chaplain, one Bye-Fellow, thirty five Scholarships, and about forty Exhibitioners.

Amongst the Benefactions none appears with a better Grace than a Gentlewoman, named *Mary Ramsden* of *Norton* in *Yorkshire*, who a few Years ago appropriated an ample Donation for maintaining six Fellowships and ten Scholarships, to be Natives of *Yorkshire*, and to be named *Skyrne*'s Fellows and Scholars, in Memory of Mr. *Robert Skyrne* her Relation, and a former Benefactor to this Hall.

This Hall has produced two Archbishops of *York* and one of *Armagh*; nine Bishops in *England*, one Bishop of *Sodor* and *Man*, and one Bishop in *Ireland*.

Amongst the Men of distinguished Learning in this Hall, we read of the eminent Preacher Archbishop *Sandys*, who was one of the Translators of Queen *Elizabeth*'s *Bible*: Of Bishop *Overall*, a Translator of King *James*'s *Bible*, and Author of the *Convocation-Book*: — Of *John Strype*, the noted *Antiquarian*: — Of the celebrated Naturalist *John Ray*, Author of *the Wisdom of God in the Creation*, &c. — Of Doctor *Benjamin Calamy*, a celebrated Preacher: — Of Doctor *Lightfoot*, eminent for his Skill in *Hebrew* and the other *Orientals*, and Author of the *Harmony of the Bible*, *Horæ Hebraicæ*, &c. — Of Bishop *Blackhall*, a celebrated Preacher, and Author of many learned Sermons: — And of Doctor *Wotton*, an excellent *Critic*, Author of *Reflections on antient and modern Learning*, and Editor of the *Welch Laws*.

10. *Jesus College*, was founded on the Site of a *Benedictine* Nunnery dedicated to St. *Rhadegund*. To which Nunnery *Malcolm* IV. King of *Scotland* added a Church dedicated to the Name of *Jesus*. — The Nuns flourished here many Years; but at last degenerated into such a debauched way of Life, that, for Shame, says my Author, they all but two left the House; and one of the two that staid was with Child, and the other but a Child.

John Alcock, Bishop of *Ely*, and then Lord Chancellor of *England*, being informed of this Dissertion, obtained the Licence of *Henry* VII. and of Pope *Alexander* VI. to convert the abandoned Monastery into a College. In which (*An. Dom.* 1496) he placed a Master, six Fellows, and six Scholars; and dedicated the Premisses to the Blessed *Virgin Mary*, to St. *John the Evangelist*, and to the *Glorious Virgin St. Rhadegund*.

This Alteration for the Advancement of Piety and Learning was presently succeeded by several large Benefactions; so that at present here are Foundations sufficient to support a Master, sixteen Fellows, and fifteen Scholars; besides twenty-five Exhibitions.

From this College we can produce four Archbishops of *Canterbury*, and three Archbishops of *York*: Ten Bishops in *England* and *Wales*; and two Bishops in *Ireland*. *N. B.* Both the present and the late Archbishops of *Canterbury* were Scholars of this Foundation.

Here also was educated the great Light of our Church, Archbishop *Cranmer*, who was burnt at *Oxford* for adhering to the *Protestant Faith*: — Bishop *Bale*, Author of *Libri de scriptoribus Britannicis*. &c. — Sir *Thomas Elliot*, Knt. who wrote a *Dictionary*, &c. --- Doctor *Duport* and Doctor *Andrews*, concerned in the Translation of the *Bible*: — Sir *William Boswille*, Knt. Embassador in *Holland*: — Sir *Richard Hutton*, Knt. Judge of the Common Pleas, and Writer of Reports: — Sir *Richard Fenshaw*, an elegant Poet, Master of the Requests, and Embassador to *Spain*: — The celebrated *Astronomer* Doctor *John Flamstead*, Royal Professor of *Astronomy*, &c. &c.

Here is a tolerable large Library well furnished with useful Books.

11. *Christ-College* was another Foundation by King *Henry* VI. for the Reception of the Scholars, &c. whom he removed hither from *the House of God*, which he intended to include within the Bounds of *King's-College*, He placed here a Provost and four Fellows and Scholars, intending to increase the Scholars to sixty, had not the fatal War that followed obstructed his pious Design.

However *Margaret* Countess of *Richmond*, and Mother to King *Henry* VII. arose like a tutelar Deity to this House, and got Leave of her Son to complete the Project of the Royal Founder *Henry* VI.

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And she accordingly endowed it with Revenues for the Maintenance of a Master, twelve Fellows, and forty-seven Scholars; which Number have since encreased by other Benefactions. So that the present Members are a Master, fifteen Fellows, and fifty-four Scholars.

The Regard paid to the Credit of this Society by the State, cannot be more properly indicated than by the Number of Bishops taken from thence; they being no less than twenty four, *viz.* two Archbishops of *Canterbury*; three Archbishops of *York*; one Primate of *Ireland*; one Archbishop of *Dublin*; fourteen Bishops in *England* and *Wales*, and three Bishops in *Ireland*.

Here was educated *John Leland*, whose Memory is highly revered amongst the *Antiquarians*: — *Hugh Broughton* the *Orientalist*: — Doctor *Andrew Willet*, Author of *Synopsis Papismi*, &c. — Doctor *Richard Clarke* and *Francis Dillingham*, B. D. both Translators of the *Bible*, and learned in the Eastern Tongues: --- Doctor *Henry More* a deep Divine and Philosopher: --- Doctor *Laurence Echard*, an eminent Historian and Author of the History of *England*.

12. *St. John's College*, as it now stands, is another Foundation begun by the said Lady *Margaret*. She erected this House of Learning, upon the Ruins of a very antient *Hôtel* or Monastery of *Regular Canons*, founded by *Nigellus*, Bishop of *Ely*, and Treasurer to King *Henry* I. in 1134, and afterwards divided between those *Regulars* and a certain Number of Scholars, by *Norwold*, or *Northwood*, Bishop of *Ely*, in the Year 1280. But the Regulars at last dwindled away to two Members only: When Lady *Margaret* obtained Leave from King *Henry* VIII. to rebuild it to dedicate it to *St. John the Evangelist*, and to endow it with her own Lands for the Maintenance of a Master and fifty Scholars.

Lady *Margaret* not living to see it finished, committed the Execution of that Part of her Will to *Richard Fox*, Bishop of *Winchester*, *John Fisher*, Bishop of *Rochester*, and others, who faithfully discharged their Trust in 1508, but not without great Difficulties.

For, the Foundress having trusted to a Codicil in her last Will and Testament for the Settlements intended to be made for this College, and dying before she had signed that Codicil, King *Henry* VIII. her Grandson, cast his Eye upon the Estates to be alienated from his Family for this Foundation, and neither his Majesty nor the Bishop of *Ely*, who had Pretensions to the former House, on which this College was to be grafted, could be prevailed upon to submit to the Will of the deceased Foundress; till the Executors with great Expence and Trouble obtained a Bull from the Pope, dated *Octavo Calend. Jul. Anno Domini* 1510, which decreed the utter Subversion of the old House, and confirmed the Foundation of a new College, and the Revenues designed for the Maintenance of a Master and fifty Clerks in it; set aside the Right of the Bishop of *Ely*, the Diocesan, and empowered the Bishops of *Lincoln* and *Norwich*, or either of them, to execute his Decree, and to excommunicate all Opposers thereunto. The King immediately granted his Licence to carry the Lady, his Grandmother's Will into Execution, so far as regarded the old House to be suppressed and its Revenues, but he kept back above 400 *l. per Ann.* Estate given by the Foundress.

By the King's Charter this College is incorporated by the Name of St. *John*'s College, for one Master and fifty Fellows and Scholars, more or less, to study the *Liberal Sciences*, the *Civil* and *Canon Law*, and *Divinity*.

The Benefactions to this College have been very liberal. Insomuch that here are one Master, fifty-nine Fellows, and one hundred Scholars upon the Foundation; and the whole Number upon the Books is seldom less than 300.

From hence have been taken thirty-nine Bishops, *viz.* Three Archbishops of *York*: Thirty-four Bishops in *England*, and two Bishops in *Ireland*.

In this House were famous for their Learning *Roger Ascham*, Preceptor to Queen *Elizabeth*: --- Doctor *Richard Bayne*, Professor of *Hebrew* at *Paris*, and a Commentator on *Proverbs*: --- Doctor *Bullock*, Author of the *Concordance*: --- Sir *John Cheke*, Preceptor to King *Edward* VI. -- Sir *Thomas Wyat*, Knt the Poet: --- *William Cecil* Lord *Burgley*, Lord Treasurer: --- Doctor *John Dee*, a noted Philosopher and Mathematician: --- *Thomas Gataere*, B. D. well esteemed for his *Opera Critica*, and *Annotations on the Bible*: --- Bishop *Morgan*, who first translated the Bible into *Welsh*: --- *John Hall*, a celebrated *Poet*, *Historian*, &c --- *John Cleveland*, a renowned Poet: --- *Henry Brigges* the noted *Mathematician*, the first *Savilian* Lecturer in *Geometry* at *Oxon*; *Geometry* Professor at *Gresham College*; and Author of many curious *Mathematical*, *Logorithmetical* and *Geometrical Tables*; and of a Treatise concerning the *North-West* Passage to the *South Seas* through the Continent of *Virginia*: --- *John Serjeant* and Doctor *Thomas Godden*, two of the most able *Controvertists* on the Popish Side; who left this College and entered themselves in St. *Peter* and *Paul*'s College for the *English* Nation at *Lisbon*, of which they both became Presidents: --- *Thomas Wentworth*, Earl of *Strafford*, Prime Minister to King

King *Charles* I. --- *Lucius Carey*, Lord Viscount *Faulkland*, Secretary of State to the said King: --- *Ambrose Philips*, Esq; a celebrated Poet, and Author of the *Pastorals* under his Name: --- Doctor *William Cave*, Author of *Historica Literaria*, the Lives of the Apostles, and of other Works in the Service of Religion and Learning: --- Bishop *Stillingfleet*, that eminent and learned Author and Prelate: --- Doctor *Peter Berwick* the celebrated *Physician*: --- *Martyn Lyster* the famous *Naturalist* and President of the College of *Physicians*: --- Doctor *John Smith*, eminent for his Knowledge in Divinity and History: --- Bishop *Beveridge*, who at 20 Years of Age published a *Latin* Treatise on the Use of the *Oriental* Languages: Then his *Chronological Institutions* in the same Language: The *Pandex of the Canons of the Apostles*: The *Code of the Canons of the primitive Church vindicated and illustrated*, also in *Latin*: His *Private Thoughts*: An *Exposition of the thirty-nine Articles*: Two Volumes of Sermons, &c. --- Doctor *Thomas Bennet*, Author of an *Hebrew Grammar*: Of a *Paraphrase on the Common Prayer*, and of several Tracts against the *Dissenters*: --- *Matthew Prior*, Esq; the celebrated Poet; Minister in Queen *Ann*'s Reign; and Author of several *Poetical*, *Historical* and *Political* Pieces: --- Doctor *Jenkyns*, Author of the *Reasonableness and Certainty of the Christian Religion*: --- Doctor *Richard Bentley*, accounted the most learned Writer and Critic of his Age, as may be collected from the Variety and Correctness of his Works: --- *Thomas Baker*, B. D. a celebrated *Antiquarian*, and the Author of *Reflections on Learning*: --- *William Lee*, A. M. the ingenious Inventor of the Stocking Weavers Loom or Engine: --- Doctor *Samuel Croxal*, an ingenious Poet, and Author of Fables, lately printed under his Name.

There is a very good Library: It is spacious and well supplied with Books, and decorated with original Pictures of the Benefactors.

13. *Mary Magdalen*'s *College* is the Foundation of *Thomas* Lord *Audley* of *Walden*, Lord Chancellor of *England*, Knight of the Garter, and Privy Counsellor to *Henry* VIII. upon the Site of an antient House, known in the Year 1092, by the Name of *St. Giles*'s Priory, for six Canons. But these Canons being removed, the *Hôstel* or *Priory* was purchased by certain Monasteries for a *Hôtel* to accommodate their young Broods sent to study at *Cambridge*. From which Incident it gained the Name of *Monks-College*; till *Edward Stafford* Duke of *Buckingham*, having purchased the Premisses, built thereon a new College and called it *Buckingham*-College, *Anno Domini* 1519: And in 1521 this Duke being attainted of High Treason, before the Foundation thereof was perfected, this College, as Part of his Estates, fell to the Crown; and as such was granted by *Henry* VIII. to Lord *Audley* aforesaid, in 1542; who refounded the same by the Name of *St. Mary Magdalen*'s *College*, endowed it with Parcels of the Priory of *Holy Trinity* near *Algate* in *London*, for a Master and four Fellows; reserving to himself and Successors the Patronage of the Mastership and visitorial Power over the College. But such have been the good Will of the Opulent towards this poor Foundation; that it has now a Master, sixteen Fellows, and twenty-five Scholarships and Exhibitions; with a very grand new Library, well filled with Books neatly classed. Amongst which is the valuable Collection made by *Samuel Pepys*, Esq; Secretary to the *Admiralty*, and President of the *Royal Society*, valued at 4000 *l.* many of which are Manuscripts, relating to Maritime Affairs in several Reigns.

Here also is a curious and extensive Collection of Prints and Drawings by the most celebrated Masters and Artists in *Europe*, placed by themselves.

From hence have sprung one Archbishop of *Canterbury*, and seven other Bishops; besides a great Number of eminent Scholars in different Branches of Literature; amongst whom we find *Henry* Lord *Stafford* who was an ingenious *Latin* Poet: --- Sir *Orlando Bridgeman*, Lord Chief Justice of the Common Pleas and Lord Privy Seal; --- Sir *Robert Sawyer* Attorney General; --- Doctor *William Howel* the *Historian*; --- Bishop *Cumberland*, who wrote *de Legibus Naturæ*, &c. and published the *Phœnician History*; --- *Samuel Pepys*, Esq; one of the greatest Ornaments of the Age, and Secretary of the Admiralty under King *Charles* II. and *James* II. He wrote the History of the *Navy*; --- Dr. *Waterland* well known as an eloquent and powerful Preacher and Defender of the Catholic Doctrine of the Trinity against the *Arian Heresy*.

14. *Trinity College* is the Work of King *Henry* VIII. who built it upon the Site of St. *Michael's House*, *King's Hall* and *Phiswick's Hostel*, and the six antient *Hostels* or *Inns* of *Gregory*, *Ovings*, *Margaret*, *Gerard*'s, *Katherine*'s and *Tyler*'s.

Michael's House had been founded in the Year 1324 and well endowed, so as to be accounted as complete a College, as any in the University, about that Time; and before its Dissolution, became famous for the Education of three Bishops, and several Men of Learning, among whom was Doctor *Mullet*, who translated *Erasmus*'s *Paraphrase* on St. *John*.

King's Hall was founded by King *Edward* III. at the Desire of his Father deceased, for a Master and thirty-two Scholars. On whom his Majesty's Charter dated *October* 27, 1337, settled 40*l. per Annum*, to be paid out of the Exchequer.

From hence proceeded five Bishops in *England*; and an Archbishop of *Dublin*, and a Lord Chancellor; also that elegant *Latin* Orator *John Gunthorpe*, and Bishop *Tonstal*, a great Divine and Mathematician.

King *Henry* VIII. out of all these Nurseries of Learning composed the stately College dedicated to the *Holy and undivided Trinity*; and by his Charter of *December* 19, 1546, endowed it with 1300*l. per Annum*, to maintain a Master, sixty Fellows, forty Scholars, and ten Almoner Orators or Beadsmen; reserving the Right of nominating a Master.

Queen *Mary* his Daughter began a most grand Chapel for its Use, and augmented its Revenue with 338*l. per Annum*, for the Maintenance of twenty Scholars, ten Choristers, a Master for them; four Chaplains, thirteen Poor Scholars, and two under Sizars. But this Queen dying before the Chapel was finished; her Sister and Successor *Elizabeth* took Measures for completing both the Chapel and a Library.

There have been many and most liberal Donations to this College; which now maintain a Master, Vice-Master, sixty Fellows, (including the Vice-Master) and seventy-one Scholars. But we have an Account that in the Year 1641, the State of this College was much more flourishing, when there belonged thereunto a Master, sixty Fellows, sixty-two Scholars, thirteen Poor Scholars, four Chaplains, ten Choristers with their Masters, six Singing-Men, twenty-four Alms Orators; besides as many Officers and Servants as in all amounted to about 440. And there is annually paid out of the Treasury of this House the Sum of 120*l.* to three Public and Royal Professors founded by King *Henry* VIII. at 40*l.* each.

The Advantages of this Foundation, and of the Numbers educated therein, have given it the Preference both in the Favour of the Court and in a Variety of eminent Scholars. For,

Here we find no less than thirty-six Bishops since the Year 1555, of whom one was Archbishop of *Canterbury*, two Archbishops of *York*, two Archbishops of *Dublin*, twenty-seven Bishops in *England* and *Wales*, and four Bishops in *Ireland*.

Amongst the *Statesmen*, who studied in this College, were Sir *Francis Bacon*, Viscount St. *Albans*, Lord Chancellor of *England*, and Author of many learned Works in *Philosophy*, *Divinity*, &c. — Sir *Edward Coke*, Chief Justice of both Benches successively, and Author of several Books of Law:— *Robert Devereux* Earl of *Essex*: — Sir *John Coke* Principal Secretary of State: — *Charles Montague* Earl of *Hallifax*, Knight of the Garter, and a noted Poet, Orator, and Statesman; and his Cotemporary *George Stepney*, Esq; employed abroad by King *William*, and admired for his poetical Genius.

Here were educated many eminent *Critics*; no less than seven of those that were employed to translate the Bible, who were distinguished for their Accuracy in the Knowledge of *Greek*, *Hebrew*, and other Languages: and *William Walker* Author of the *Idioms* and *Particles*, the completest Work of its Kind.

It has had many celebrated Poets, *viz.* The divine *Herbert*, whose sacred Poems are in great Esteem: — Doctor *John Donne*, a sacred Poet and eminent Preacher: and *Giles Fletcher* Bachelor of Divinity, a sacred Poet: — The Comedians *Walter Hawksworth*, *Thomas Randolph*, Sir *Ashton Cockain*, *Nathaniel Lee*, and *George Grenvile* Lord *Lansdowne*: and *John Dryden*, and Mr. *Eusden*, *Poets Laureat*.

The Number of other learned Men on this Foundation, who have published their Works would be too tedious to be recited. I shall only mention Sir *Henry Spelman* in the highest Esteem for his Skill in *Antiquities*: The excellent divine *Herbert*. — *Thorndyke*: — Doctor *Anthony Scaterwood*, Editor of *Critici Sacri*: — Bishop *Wilkins*, a profound Philosopher and Divine: — Doctor *Barrow*, rendered immortal by his Treatise *against the Pope's Supremacy*, and upon the *Unity of the Church*: — Doctor *Thomas Gale*, the *Antiquarian* and Editor of several *Greek Authors*: — *John Le Neve*, Esq; Author of the *Fasti Ecclesiæ Anglicanæ* and *Lives of the Protestant Bishops*: — Doctor *John Mapletoft* the pious Author of the *Principles and Duties of the Christian Religion*: — *Roger Cotes*, Professor of *Astronomy* and *Experimental Philosophy*, and most eminent in his Faculty: — Sir *Thomas Millington* Knight, Doctor of Physick, President of the College of Physicians, and Author of a Book of *Anatomy*: — Doctor *Thomas Comber*, Author of the Church History and the Right of Tythes: — Sir *Isaac Newton* the celebrated Founder of the *Newtonian Philosophy*: — Doctor *Conyers Middleton*, who has propagated his Memory by his Life of *Marcus Tullius Cicero*; and a free Enquiry into the *Miraculous Powers*, &c. and several other learned Pieces: — Doctor *Richard Bentley*, of whom before, was Master of this College.

The Library is reputed the greatest of its Kind in the three Kingdoms: and both its Floor and Stair-Cases are most elegantly laid with black and white Marble; and it is well furnished with a grand Col-

lection

lection of scarce and valuable Books in Print and Manuscript, besides other Curiosities, all most beautifully classed.

Here is also an Observatory well situated and furnished, with a Variety of Instruments for Observation.

15. *Emanuel College* was founded by *Walter Mildmay* Chancellor of the Exchequer, upon the Site of an ancient *Monastery* of *Dominican Friars*, founded in 1280 by *Alice* Wife to *Robert Vere*, Earl of *Oxford*. This Monastery being dissolved by *Henry* VIII. it became the Dwelling House of Mr. *Sherwood* a private Gentleman, who purchased it of the Crown, and afterwards sold the Premises to Sir *Walter* aforesaid.

Sir *Walter* obtained a Charter to incorporate this Purchase by the Name of *Emanuel College* to the *Glory* of GOD, in the Year 1584, and placed in it a Master, three Fellows, and four Scholars, intended for a Nursery of *Puritans*, to which Sir *Walter* was much addicted.

This House received in course of Time such Benefactions, that we now find in it a Master, fifteen Fellows, fifty Scholarships, ten Sizars, and thirty-seven Exhibitioners; and a very good Library well classed and stocked with Books, *&c.*

William Sancroft, Archbishop of *Canterbury*, was Master of this College; besides whom this Society has sent off five Bishops to the Church of *England*, and two Bishops to the Church of *Ireland*.

Bishop *Hall*, that pious and learned Divine, who was at the Synod of *Dort*, and published many Pieces in *Divinity*: — *Samuel Cradock*, B. D. Author of the *Harmony of the Evangelists*: — *Matthew Poole*, Author of the *Synopsis*: — Bishop *Kidder*, whose Memory is revered for his Piety and learned Works: — *William Eyre* the famous *Hebrecian*: — *Samuel Foster*, *Astronomy* Professor of *Gresham*, and Author of the Use of the *Quadrant*: — Sir *Robert Twysden*, Bart. an excellent *Antiquary*, and Author of the *Historical Defence of the Church of England*: — Sir *William Temple*, Bart. the great Statesman and Embassador: — *Anthony Blackwall*, Author of Sacred Classics, and the late Doctor *Nathaniel Marshall* the ingenious Translator of St. *Cyprian*'s Works, and Author of a Discourse on the *Penitential Discipline of the primitive Church*.

16. *Sidney-Sussex-College* is built upon the Site of an ancient Convent of *Franciscan*, or *Grey Friars*; wherein the yearly Assemblies of the University were formerly kept.

This Convent being dissolved at the Reformation from *Popery*, was given by *Henry* VIII. to *Trinity College*; from whom the Executors of Lady *Frances Sidney*, Countess of *Sussex*, Widow of *Thomas Radcliffe*, third Earl of *Sussex*, purchased it in *Fee Farm*, under the Authority of an Act of Parliament obtained for that Purpose; and thereupon, pursuant to the Will of the said Lady *Frances* built a College by the Name of *Sidney Sussex*, for the Maintenance of seven Fellows, and ten Scholars, A. D. 1596. And by future Benefactions we find the Addition of ten Fellowships, sixteen Scholarships, and eight Exhibitioners, at least, though the present Members do not exceed eight Fellows, ten Scholars, and two Exhibitioners, besides Servants.

Here is a Foundation for a *Hebrew* Lecture, and another for a *Mathematical* Lecture within the College.

Hence have been advanced, one to the Archbishoprick of *Armagh* in *Ireland*; three to Bishopricks in *England*; one to *Sodor* and *Man*; and one to a Bishoprick in *Ireland*.

Amongst the learned Members of this Society we have Archbishop *Bramhall*, a celebrated Writer in *Divinity*: — *Seth Ward* one of the most esteemed Mathematicians and Divines of his Time: — Sir *John Ent*, Knt. M. D. President of the College of Physicians: — *William Wollaston*, the Author of the *Religion of Nature delineated*; to whom may be added *Thomas Woolston*, whose crazy Discourses on our SAVIOUR's *Miracles*, have blasted that good Character, which he had before justly deserved for his well known Parts in Literature.

Here is a pretty Library well filled with useful Books.

The Foundations for *Public Lectures* in this University are,

1. The Lady *Margaret*'s, who was Foundress of *Christ*'s and St. *John*'s Colleges.

2. Lady *Margaret*'s Sermon. It was instituted to instruct the Ignorant not only in and about *Cambridge* but in many other Places. But since learned Preachers have abounded in those Parts, this Institution is exchanged for a *Latin* Sermon, called *Concio ad Clerum* before the University, the Day before the Term begins; and for others in *English* at stated Times before that learned Body in the Church of *Great St. Mary*'s. The Preachers by the Charter ought to be chosen every Year: But this Choice has also suffered an Alteration; being now chosen every three Years.

3. *Regius Professorship* in *Divinity* founded by King *Henry* VIII. for the Benefit of Bachelors in Divinity and Masters of Arts.

4. *King's*

4. *King's Law* Professorship, for the Benefit of all Students in *Law*; and of the same Royal Foundation.

5. *King's* Professorship of *Physic*, founded also by King *Henry* VIII.

6. *King's Hebrew* Professorship, founded by the said King *Henry* VIII.

7. *King's Greek* Professorship of the same Foundation. *Thomas Smith* and *John Cheke*, the second and third Professors, undertook to reform the corrupt Pronunciation, which then prevailed of the *Greek* Language. But Bishop *Gardiner*, the Chancellor, in his own Name and in the Name of the Senate, forbid them by a public Order to proceed in their new Method (which was proved to be the ancient and true way of pronouncing *Greek*.) In this order it is said *Quisquis nostram potestatem agnoscis sonos Literis, sive Græcis, sive Latinis, ab usu Publico præsentis seculi alienos, privato judicio, affingere ne audeto.* i. e. "Of all who acknowledge my Authority, let none dare to give Sounds according to his own private Judgment, different from the Custom of the present Age, to Letters either *Greek* or *Latin*." Again, η, ι, υ, *uno eodemque sono exprimito*, i. e. "Express the *Greek* Letter η, ι, υ." And the whole Order runs in the same Strain. To which they were obliged to submit till his Authority subsided, and the Reformation of Language was introduced with the Purity of Religion.

8. *Arabic* Professorship. This was founded in 1632 by Sir *Thomas Adams*, Bart. with a Salary of 40 *l. per Annum* to be paid by the Company of *Drapers* of *London*. It is for the Benefit of *Masters of Arts*.

9. *Mathematical* Professorship. This was founded by one *Henry Lucas*, Esq; in 1663. Doctor *Nicholas Sanderson*, who was blind from his Birth, enjoyed this Professorship twenty-eight Years, and complied with its Institution with great Applause.

10. *Plumian* Professorship, so named from Doctor *Thomas Plume* its Founder in 1704.

11. *Natural Philosophy*, commonly called the *Woodwardian* Professorship, founded by Doctor *John Woodward*, M. D. at 150 *l. per Annum* for Salary and to purchase Fossils.

12. Professorship for *Modern History* and *Modern Languages*. This was founded by the late King *George* I. in 1724, with a Salary of 400 *l. per Annum*.

13. *Casuistical* Professorship. This Foundation was made in the beginning of this Century and its Salary was augmented by Doctor *Thomas Smith* its first Professor, who died A. D. 1707.

14. *Professorship of History*. This was founded by *Fulke Greville*, Lord *Broke* and Knight of the Garter, with a Salary of 100 *l. per Annum*. The first Professor was Doctor *Isaac Dorisiaus*, assassinated in *Holland* for being concerned in the Murder of King *Charles* I.

15. *Astronomy* Professorship. This was founded no longer ago than in 1749 by *Thomas Lowndes* of *Overton* in *Cheshire*, Esq; with a Salary of 100 *l. per Annum*.

Here are also Professorships in *Music* founded in 1684; of *Chemistry*, in 1705; of *Anatomy*, 1707; and of *Botany* in ——, all by the University, but without Salaries.

It is observed, that, notwithstanding there are not so many Colleges in *Cambridge*, as in *Oxford*, the Number of Students are nearly upon a Par: and the State of Learning is most flourishing in both Universities.

SCOTLAND the Northern Kingdom in the Island of GREAT BRITAIN contains four *Universities*, *viz.*

The *University* of St. ANDREW's, which was instituted by the Interest of Bishop *Henry Wardlaw*, A. D. 1412, with very ample Privileges.

It was originally governed by a *Chancellor*, who was the Archbishop for the Time being. But since the Establishment of Presbytery in that Kingdom, the Government is committed to a *Rector* chosen annually from amongst the Heads of the Colleges, and invested with the Power and Authority of the Vice-Chancellor in the *English Universities*.

Here are *three* Colleges, *viz.*

St. *Salvator's*, founded by *James Kennedy* Archbishop of St. *Andrews*, and endowed by him for the Maintenance of a Provost, Masters and Professors, *viz.* a Doctor, Batchelor and Licentiate in *Divinity*; four Professors in *Philosophy*, and eight Poor Scholars, called *Bursers*, to be instructed *gratis*.

St. *Leonard's College*, founded by *John Hepburn*, Prior of St. *Andrews*, A. D. 1524, who endowed it with Revenues for the Maintenance of a Principal or Warden, who must be a Doctor in Divinity; four Professors called Regents, and eight Poor Scholars.

Sir *John Sott* did afterwards add a Professor of Philosophy with a handsome Stipend, and favoured it with other Benefactions.

St. *Mary's College* is the Monument of Archbishop *Beaton's* Regard for Literature. He founded this College in 1536, and endowed it with a Maintenance for two Professors in Divinity, besides other

Members. Here is no Provision for *Philosophical* Studies: But there is a fine Observatory and a Professorship of a Modern Foundation for *Mathematical* Improvements.

The *University* of GLASCOW was first erected by a Bull from Pope *Nicholas* V. 7 *mo. Calend Jan.* A. D. 1451, at the Request of King *James* II. of *Scotland*, and at the Expence of Doctor *Turnbull*, Bishop of *Glascow*.

By this Bull, the Bishop of *Glascow*, *pro Tempore*, was constituted perpetual Chancellor of this University, with the Power of the Rectors of the University of *Bononia* in *Italy*; and the University of *Glascow* was to enjoy all the Powers, Privileges and Immunities, which had at any Time been granted by the Holy See to the said University of *Bononia*.

In 1543 King *James* by his Royal Charter confirmed the Pope's Institution, and added many ample Privileges to this Foundation. Which was followed by another Instrument, by which the Bishop, Dean and Chapter granted the Members thereof divers Ecclesiastical Immunities. All these Instruments were confirmed by succeeding Kings and Archbishops.

The Officers of this *University* is a Chancellor, who is elected for Life, and whose Power is chiefly to confer Academical Honours.

A *Rector*, elected annually *in Comitiis* by a Majority of Voices of all the matriculated Members. This Officer answers to the Vice-Chancellor's Power in an *English* University.

The *Dean of the Faculty* elected annually by the Rector and all the Regents and Professors in *Senatu Academico*, or in Convocation. His Duty is to preside in all Affairs of Literature and in public Examinations.

Thirteen Professors in different Branches of Literature: The Principal, and the second Professor in *Divinity* have the Right of Precedency; the others take Place according to Seniority.

Here is a Library Keeper, a Beadle, a Janitor or Porter, and about thirty Bursers.

Here is but one College, whose Professors (except the Principal, and those in *Anatomy* and *History*) are elected by the Faculty.

The Buildings of this College and its Endowments are not inferior to any in that Kingdom. It contains nine large Houses for the Professors; a very spacious and well finished *University Hall*; a common Hall; two Libraries; six convenient Schools for teaching; forty Apartments for Students to lodge in; a Printing House, and a public Kitchen: Besides other capacious Apartments, and a Garden of nine Acres inclosed with a hewn Stone Wall, and a *Physic* Garden.

It was generously endowed by the Founder for the Entertainment of the most learned, and some of the most noble in his Time; amongst whom is found matriculated in 1457, *Andrew Steward*, Dean of *Glascow* University, and Brother to *James* II. King of *Scotland*. And all its first Regents were eminent Clergymen taken from the Cathedral, or neighbouring Counties.

But in 1560, when the Kirk prevailed, this University suffered greatly in the loss of its Revenues, and of its valuable Members, who fled to *France*. The College was almost entirely deserted by these Means, till Queen *Mary* in *July* 1563 encouraged them to re-settle, by a Grant of Lands and Annuities, together with the Houses and Dwellings of the *Dominican* Friars of *Glasgow*, for the Maintenance of Scholars or Bursers; which Grant was a few Years after, followed by another of the Lands, Houses, Annuities, &c. of all Churches or Monasteries found in *Glasgow*.

King *James*, her Son, not only confirmed these Donations, but gave to this College the Tythes of the Parishes of *Govan*, *Renfrew* and *Kilbridge*; which Gifts were confirmed by Parliament.

To these let us add the Donations or Benefactions

Of the Reverend Mr. *Zachary Boyle*	1600 *l. Sterling.*
— *William* Earl of *Dondenal*	60 *per Annum.*
— *Ann* Dutchess of *Hamilton*	1000
— King *William* III.	300 *per Annum.*
— Queen *Anne*	210 *per Annum.*
— King *George* I. a handsome Fund for a Professor in *Ecclesiastical History*	
— Mr. *John Snell* four Sholarships at 40 *l. per Annum*, each to be sent to *Baliol* College *Oxon.*	
— The late Duke of *Chandos* for building a Library	500 *l. Sterling.*
— Mr. *John Arr* for buying of Books	500 *l.*
— Mr. *John Sterling* for Ditto	165 *l.*

The Scholars of *Glasgow* wear *Red Gowns*, while they are *Under-graduates*; and the Professors wear *black Gowns*, like those of Doctors of *Civil Law*.

The UNIVERSITY of ABERDEEN, by some called the *Caroline University*, was erected by the Bull of Pope *Alexander* VI. dated 4 *id. February*, A. D. 1494, at the Instance of King *James* IV. in the City of *Old Aberdeen* by the Stile of *Universitas studii generalis*, i. e. an University for the Study of *Divinity*, the *Canon* and *Civil Laws* *Medicine*, *Philosophy*, and *all Liberal Arts* and *Sciences*; with the Privileges, &c. of the Universities of *Paris* and *Bononia*, and all other Universities. Which the King himself confirmed by his Royal Charter.

But Bishop *Elphinston* is to be esteemed its Founder. For it is to his Generosity this University owes the first Establishments for forty-two Doctors, Professors, Masters and Students, *viz.*

Four *Doctors*, one in *Divinity* and Principal of the whole College; one in *Common Law*; one in *Civil Law*; and one in *Medicine*.

Eight *Masters of Arts*; one to be *Sub-Principal*; the second Professor in *Humanity*; the other *six* to be Students of *Divinity*. Out of these were to be chosen the *Regents*, who together with the *Sub-Principal* were enjoined to teach *Philosophy* and the *Arts*.

Three *Bachelors*; two to study the *Civil Law*; and one the *Canon Law*.

Thirteen *Students* in *Philosophy* and Arts.

Eight *Prebendary Priests* or *Chaplains*, *viz.* a *Chantor*, a *Sacrist*, an *Organist*, and five *Choir Chaplains*.

Six *Singing Boys* to assist the Priests at Divine Service.

Thus stood the Condition of this Seat of Learning, considered only as one Society by the Name of *King's College* in *Old Aberdeen*, when

George Earl *Mareschal* in the Year 1593 founded another or College Society by the Name of the *Mareschal College*, and endowed it for the Maintenance of a Principal, three Regents to teach the *Languages* and *Philosophy*, six Bursers, a Steward, Butler and Cook.

The Government was ordained to be in the Power of a Chancellor, Rector, Dean of the Faculty, and four Assessors; the Rector to be chosen annually by all the Members of the University.

This College continued in this Form as a distinct University from *King's College* in *Old Aberdeen* till King *Charles* I. in the last Parliament held by him in *Scotland*, united them by the Name of the *Caroline University*, and annexed to them the Revenues of the Bishoprick of *Aberdeen*. But

This Royal Act was reversed at the Restoration of King *Charles* II. when the Parliament, in 1661 put the two Colleges again upon their original Foundation of two Ueiversities: since which Time this College has been augmented by several Benefactions, which have encreased the Number of Bursers, and (besides the Magistrates) the *Mareschal College* consists of a Principal, a Professor of *Divinity*, another of *Medicine*, another of *Mathematicks*, three Professors of *Philosophy*, one of *Greek*, and one of *Oriental* Languages, a *Librarian*, a *Porter* and his *Deputy*, &c.

By the Forfeiture of the Earl *Mareschal's* Estates and Privileges the Presentation to his Foundation of the Professorships of *Medicine*, *Philosophy*, and *Greek*, is in the King.

The Professor of *Divinity* by the Foundation is in the Nomination of the Magistrates and Town Council.

The Principal and Professors wear *black Gowns*; the Students wear *red Gowns*.

The UNIVERSITY of EDINBURG founded by King *James* VI. in 1582, was endowed by the Royal Founder with all the Privileges enjoyed by any other University in his Dominions.

It was to consist of a Principal, a Professor in *Divinity*, four Professors in *Philosophy*, a Professor in *Humanity* and *Rhetoric*, and five *Regents*; under the Government of the Magistrates and Council of the City of *Edinburg*. who are perpetual Curators: and the Lord Provost is the Chancellor of the *University*.

The Advantages, which this University had by its Situation in the Metropolis and Place of Residence of the Kings of *Scotland*, and by its Royal Foundation, presently gave it a Reputation; and invited great Numbers of Students, and excited many and great Benefactors to promote its good intention; so that in a little Time the *University* of *Edinburg*, though it consisted but of *one College*, was deemed the chief in that Kingdom.

Here is an extraordinary Provision made for the promoting of Learning; for there are in

DIVINITY, *three Professors*; the *first* is always the Principal of the College, and, *ex Officio*, presides in the Academical Meetings, confers Degrees, in the Presence, and by the Appointment of the Faculties.

Faculties, appoints the public Exercises, visits the Classes, and takes an Account of the Behaviour of the Students.

The *second* is Ordinary Professor, and attends the public Schools five Days in the Week, reads Lectures in Divinity, appoints Exercises, proposes Questions, and solves Difficulties.

The *third* is *Regius Professor*, whose Duty is to read public Lectures on Church History during the Term or Session.

ORIENTAL *Languages* one Professor, who teaches the Students in Divinity the *Hebrew*, *Arabic*, *Syriac*, &c. without Fee or Reward.

PHILOSOPHY *three* Professors, who have each their peculiar Branch allotted, and receive the Students from one another, as they rise from *Logic* to *Physicks*; from *Physicks* to *Ethicks* and *Metaphysicks*.

HUMANITY one Professor, to instruct Beginners to read and write *English* and *Latin*, and in the understanding of the best *Roman* Authors.

GREEK one Professor, to instruct Youths in that useful Language.

MATHEMATICKS one Professor, who usually teaches *Algebra*, *Geometry*, &c. to three or four Classes.

LAW *three* Professors; *one* of the *Law of Nature and Nations*; founded by Queen *Anne*, and is in the Gift of the Crown; *Another* of the *Civil and Canon Law*; and a *third* of the *Municipal* or *Common Law*.

UNIVERSAL HISTORY and ROMAN ANTIQUITIES one Professor. *N. B.* These three Professorships last mentioned were founded and endowed by Act of Parliament; and each Professor is chosen by the Town Council of *Edinburg* out of two presented to them by the Faculty of Advocates.

ANATOMY, one Professor.

Physic or MEDICINE *four* Professors, who consult together, and contrive the most proper Order and Method to teach *Medicine*, and go through a compleat Course of it, once a Year, in all its Branches; beginning about the middle of *October*.

In Session or Term Time the Principal orders divers *Latin* Discourses in the Common Hall in the Presence of all the Professors and Students; which are followed every *Wednesday* till the Month of *May* by Speeches from the Professors in Rotation. Then the public Disputations and Examinations take Place; when the Candidates for Academical Degrees are approved or rejected, according as they are found qualified by proper Examiners.

The *Kingdom* of IRELAND has but one University, and that consists of no more than one College, *viz. Trinity College* in DUBLIN, said to be founded as a Place of *Academical* Learning by Doctor *Alexander Bicknor* Archbishop of *Dublin*, about the Year 1320: But we don't find it of any repute till it was endowed and favoured with the Privileges of an *University* by Queen *Elizabeth* in 1591; since which Time it has given several eminent Scholars both to the Church and State.

The Province of NEW ENGLAND has already adorned the *Northern* Continent of *America* with a *University* called *Cambridge*, in which are two Colleges. Neither must be passed in Silence the Seat of Learning founded in the Island of *Barbadoes* under the *British* Dominion, by the learned and generous ——— *Codrington*, Governor of that Island, commonly known by the Name of *Codrington College* in *Barbadoes*, where we are told the Professors give remarkable Examples of their Learning and Industry in their several Professions.

The Name *Academy* is also applied by the *Jewish* Doctors or Rabbins to the Schools in which they instruct Youth in the *Hebrew* Tongue, read the *Law*, explain the *Talmud*, teach the *Caballa*, &c.

It is become the general Name of the private Seminaries, which the *Dissenters* have raised in divers Parts of *England* for the finishing the Candidates for the Ministry, and others, in Divinity, Philosophy, and Mathematical Learning.

Even some of our *Boarding Schools* of the best note in and about the Metropolis, have presumed to distinguish themselves by the Name of *Academy*, and we have seen *Fencing* and *Riding* Masters presumptuous enough to dignify their Schools with the same Appellation.

We might with much greater Propriety consider the INNS of *Court* and *Chancery* in *London* and *Westminster* for the Study of the *Law* under this Name. Sir *Edward Cooke* is of the same Mind, where he writes that these *Inns* are the most flourishing and most honourable *Academies* of Gentlemen that ever was established in any Nation for the Study and Learning of the *Municipal Laws* thereof; and that they altogether, (saith another eminent Lawyer) make the most famous University for the Profession of the Laws only, or of any one human Science in the World; and advance itself above all others, *Quantum Viburna cupressus*. See *Blount*'s *Law Dict*. Art. *Inns of Court*.

These *Academies* retain the ancient Name of *Inns* from the Custom of our Forefathers, who gave it to the Habitations of the Eminent either in Dignity, Title, or Learning: and has the Signification of the *Latin* Word *Hospitium*, and the Modern *French* Name *Hostel*.

The first Commencement of these *Inns* is ascribed to several Causes. Some incline to think they were established for the Sake of the Public, who might more easily find the learned in the Law on their different Occasions. But it is most rational to give into the Opinion, which ascribe, their Foundation to the Cultivation and Improvement of the Law, by social Conferences and public Lectures read in their respective Halls.

We date this Institution, according to Sir *John Fortescue*, in the Reign of King *Edward* III. about which Time the Common Law began to flourish upon the Ruins of the Canon and Civil Law Schools; which till then were publickly kept in *London*, &c.

Sir *John* also makes this Remark, That these Communities for the Study and Practice of the Common Law are *omni Universitate convenientiora et proniora*, more convenient and better appropriated for such Purposes than any other University; there being no University in any Nation, that can produce the like Number of Students in the Law of so ripe an Age, and of that high Quality, as are to be found in our *Inns of Court* and *Chancery*; in which they live, not upon Exhibitions and Salaries, as Scholars and Fellows in other Academical Institutions; but at their own, or Friend's, Expence: where, besides the Knowledge of the Laws, they may learn all other Accomplishments fit to form the Gentleman, as well as the Lawyer; their Study being *de optimis Disciplinis et Artibus*, that they may be more capable of pleading and presiding in the Courts of Judicature; from which Circumstance they were originally named *the Inns of Court*.

These *Inns* are known by the Names of

Serjeant's Inn, in *Chancery-Lane*.
Serjeant's Inn, in *Fleet-Street*.
The Inner-Temple, } *In Fleet-Street*.
The Middle-Temple, }
Lincoln's Inn, in *Chancery-Lane*.
Gray's Inn, in *Holborn*.
Clifford's Inn, in the Parish of St. *Dunstan*'s, *Fleet-Street*.
Thave's Inn, in the Parish of St. *Andrew*'s, *Holborn*.
Furnival's Inn, Ditto.
Barnard's Inn, Ditto.
Staple Inn, Ditto.
Clement's Inn, in the Parish of St. *Clement Danes*.
New Inn, Ditto.
Lyon's Inn, Ditto.
Simond's Inn, *Chancery-Lane*.

The two first mentioned take their Names from their being appropriated originally to the Lodging and Entertainment of *Serjeants at Law* and the *Judges*.

The *Temples* retain the Name of their first Founders, who were the Knights *Templars*, and for many Years enjoyed great Estates and a large House of Residence on this Spot; some of whose Monuments are still to be seen, well preserved in the *Temple* Church.

Upon the Dissolution of this House, called the *new Temple*, and the Suppression of the Knights *Templars*, it was given to *Valence* Earl of *Pembroke*, by King *Edward* II. But his Estates being forfeited to the Crown by the Attainder of that Earl's Son, King *Edward* III. granted the same to the Knights *Hospitallers* of St. *John* of *Jerusalem* here in *England*. And they in the same Reign devised the Premisses to certain Professors of the Common Law, for a Quit-rent of 10 *l. per Annum*, in whose Possession it has remained ever since, with this Distinction, that what was called the *New Temple* is now divided into *two Inns of Court*, known by the Names of the *inner* and the *middle* Temple; and each of them pay 10 *l. per Annum*, into the Exchequer, by a Grant from King *James* the *First*.

These

These two Inns of Court are the most renowned and famous both for their Studies, Discipline, and Antiquity.

Lincoln's-Inn is so called from *Henry Lacy*, Earl of *Lincoln*, Constable of *Chester*, and *Custos* of *England*; who, in his great Affection for the Advancement of the Study of the common Law, founded this Inn for its Professors and Students. But we read very little of their Proceedings and flourishing State till the Reign of *Henry* VI. when it produced that great Light of the Law Sir *John Fortescue*. It is a spacious Building consisting of four Squares, and large Gardens, pleasantly situated; and this Society is in great Reputation for the Study of the Common Law, and for good Discipline.

Gray's-Inn, once the Mansion-House of the Family of Lord *Grey of Wilton*, begun to be inhabited by Students in the Law in the Reign of King *Edward* III. who leased the same from the Lord *Grey*. But at this Day the Honourable Society of *Gray's-Inn* hold the Premisses by a Grant from King *Henry* VIII. in Fee-Farm at the yearly Rent of 6 *l.* 13 *s.* 4 *d.* payable into the Exchequer. It consists of three spacious Squares, and a very large and agreeable Garden, much frequented by the Citizens and Gentry to take the Air, and for agreeable Conversation.

The *other Inns* are known by the Name of *Inns of Chancery*, being the *Hospitia Minora* or *lesser Hostels* of the municipal and common Laws of this Kingdom, for the Residence and Improvement of Students, Attornies, Solicitors and Clerks.

Thus I have laid before you the several *Seats* and *Nurseries* of the ARTS and SCIENCES throughout the known World: To whom we are indebted for the many and great Improvements in every Part of Literature.

We shall dismiss this Subject by giving some Account of those learned Men, who are properly distinguished by the Name of *Academics*.

Academics were those Philosophers, who adhered to the Doctrine of *Socrates* and *Plato*, concerning Uncertainty of Knowledge and Incomprehensibility of Truth. For,

Their original Maxim was, *I am certain of nothing*; *no, not even that I know nothing*: And therefore insisted that the Mind ought always to remain in Suspense.

This Doctrine to doubt and distrust at every Step, we take in our Researches after Truth, was inculcated to his Disciples by *Plato*, not to deter them from the Pursuit of Knowledge, or to keep them fluctuating always between Truth and Error; but to curb them from those presumptuous and rash Decisions to which young Minds are subject to in their Studies and Arguments; and to engage them to attain to a more perfect Understanding of Things, and to avoid Error, by duely examining every Thing with Candour and Impartiality. According to the Advice of that inspired Writer, who adviseth, That, we *prove all Things, and hold fast what we shall find to be good.*

So that whatever might be the *Sceptic* Notions of some Philosophers, the *Academics* only doubted, that their Determinations afterwards might be the more certain and unalterable: Which I apprehend is the only Method to arrive at Truth and sound Knowledge in all Arguments and Parts of Literature. And upon this Principle is grounded the Practice of both *private and public Disputations* in all Universities; before any Scholar can be admitted to the *Academical* Degrees.

All which is agreeable to what *Cicero*, who was an *Academic* himself, says; *viz.* That all the Difference between the Academic Philosophers and those, who imagin'd themselves possessed of the Knowledge of Things consisted in this: 'That the Latter were fully persuaded of the Truth of their Opi-'nions, without putting them to Trial; whereas the former held many Things to be only probable, 'which might very well serve to regulate their Conduct, though they could not positively assert the 'Certainty of them,' And he adds; 'In this we have greatly the Advantage of the *Dogmatists*, as 'being more disengaged, more unbiassed, and at full Liberty to determine, as Reason and Judgment 'shall direct.' Which alludes to the common prudential Maxim, *Qui nihil dubitat, nil capit inde boni.* Upon which Occasion the Orator and Philosopher makes this Reflection: 'Yet the Generality 'of Mankind, I know not how, are fond of Error; and chuse rather to defend with the utmost Ob-'stinacy, the Opinion, they have once taken up, than with Candour and Impartiality, submit to 'examine which Sentiments are most agreeable to Truth.'

After so clear a Declaration, as this from *Tully* himself, who was a rigid *Academic*, there appears the greatest Probability, That the first *Academics* were frequented by Philosophers, *&c.* who met to examine those Sentiments, with that Candour and Impartiality, which was denied them by the *Dogmatists*, that ruled the *Areopagus*, &c.

A NEW

A NEW

UNIVERSAL HISTORY

OF

ARTS and SCIENCES.

ALCHYMY.

ALCHYMY or *Alchimy*, (which the modern *Greeks* write *Archemia*; and others contend that *Halchymia* is the most genuine Orthography) denotes the more secret parts of *Chemistry*; this art being confined, 1st, to the making of *Gold*, 2d, to the discovery of an *universal medicine*, or *Panacea*; 3d, of an *universal dissolvent*, or *alkahest*.

How far these may be accounted proper objects of our study, the disappointments, which all the practitioners in this art have met with, will readily certify. For, after a succession of labour and vast expence, for many ages, and in different regions, not one of the pretenders to this art has been able to make *Gold*, or to produce any one *medicine*, dissolvent, or *ferment*, capable of operating effectually on every body or subject.

Yet we find the names of very learned men in the list of authors, who have espoused the study of *Alchymy*: and some of them vain enough to imagine the possibility of discovering an *universal menstruum*, to which some have given the name of *The Philosopher's Stone*; for performing the secret mysteries of this art.

This *Philosopher's Stone*, therefore, is the greatest object of *Alchymy*: because without this menstruum there can be no transmutation: but by casting a little quantity thereof upon metals in infusion, it will convert all the true mercurial part of metal into pure gold: there being nothing more required, say they, than to do that by art, which nature does in many years and ages; for, as Gold and Lead do but differ little in weight, there cannot be much in lead besides Mercury and Gold. Consequently, if any body could be found, which would so agitate all the parts of Lead, as to burn all that is not Mercury therein, having also Sulphur to fix the Mercury, would not the mass remaining be converted into Gold?

Such is the foundation for the opinion of the *Philosopher's Stone*, which the *Alchymists* contend to be a most fixed, concenterated fire, which, as soon as it melts with any metal, does, by a magnetic virtue, immediately unite itself to the mercurial body of the metal, volatilizes and cleanses off all that is impure therein, and leaves nothing but a mass of pure gold.

Upon this principle many have set out to try their fortunes in the *Alchymist*'s furnace: some have attempted the *transmutation* of the most imperfect into perfect metals, both *silver* and *gold*, by *Separation*; others by *Maturation* and by real *Transmutation*.

They

They who proceed by the method of *Separation*, muft fuppofe that all inferior metals contain a quantity of *gold* more or lefs. For, unlefs it could be made appear that fuch a *Separation* was ever difcovered, or made by the *Chemifts* in their frequent and different preparations of metals; and that the quantity of gold feparated from the bafer metals was fufficient to defray the expence of the operation; neither of which can be affirmed; there can be very little or no hopes of making gold by this method or procefs.

The procefs by *Maturation* is no lefs liable to exceptions. None but mercury could be changed into gold by *Maturation:* becaufe the principles of all other metals not being pure mercury, their abundant heterogeneous particles, and the fmall quantity of imperfect ones, which enter into their compofition, cannot be feparated from it by a digeftion.

Here Mr. *Chambers* interferes with a fuppofition, that, could *mercury* be once purged of its impurities by *Maturation*, it might eafily be changed into *gold:* becaufe, fays he, it would then be as *heavy*, as *gold*.

A very fuperficial reafon! for *weight* is not the effential quality conftitutive of that perfect metal. It muft be *ductile* and *malleable*. Qualities which have never been difcovered by the *Maturation* of *mercury*. Befides there is another moft effential quality: The *mercury* fhould equal gold in its fixednefs in the fire, refulting from the homogenity and equality of its parts, who all have equal pores or interftices, through which the fiery corpufcules find an eafy paffage, and therefore can't haften its fufion with the fame facility, as that of lefs perfect metals; where through the obliquity and unequal pofition of the pores, they meet with more refiftance

The affair of *M. Langueille* an adept in this art, about the middle of the laft century, will ferve to illuftrate and confirm this obfervation. This gentleman piqued himfelf very highly of having difcovered the art of converting *mercury* into *gold* by *Maturation:* but when his metal fo prepared was put into the crucible, he was foon convinced of his error and prefumption. For its pores not being in the fame pofition, nor at the fame equal diftance, his metal evaporated into fmoke.

Let us now confider the practice of real *Tranfmutation*. This the Alchymifts feem to have moft at heart: and they fay, this *Tranfmutation of metals* is to be done by melting them in the fire, and by cafting a certain quantity of a powder termed by them, *The Powder of Projection*, into the matter fufed: whofe effects they affert will be the fame, as mentioned before in the account of the *Philofopher's Stone*. The practicability of which operation has never been proved; and its poffibility much controverted.

Cardan, and fome others declare pofitively againft the probability of *tranfmuting* other *metals* into *gold* or *filver*. Becaufe, as fuch a work is not pretended to be performed without a calcination of thefe metals, it is impoffible to bring them again to their priftine purity: to which may be added the *Generation* required in fuch a cafe; which is the work of *Nature*, and not to be performed by *Art*; and is a bar againft all Tranfmutations of imperfect metals into the like imperfect; as of iron into Brafs; or of Copper and Lead into Tin.

The *Alchymifts* neverthelefs are fo far from being difcouraged by thefe arguments and their own difappointments, that they look for the *feed of gold* not only in bafe metals, but in *plants*, *blood*, *hair*, and even in the *excrements* of divers animals; with as little fuccefs. Nay the great *Boyle*, (of whom let us not fpeak without veneration for his profound knowledge in Natural Philofophy) feems to be of opinion, That the chalk or earth, which was left at the bottom of the *alembic* after a quantity had been diftilled and rediftilled 200 times, might have been converted into gold; perhaps by the help of the miraculous *Powder of Projection:* a powder never yet defined, nor pretended to be acquired by any of the *adepts* in *Alchymy*; nor did any any of the *Alcymifts* ever prefume to fhew the manner by which that powder operates.

This art (however proftituted by defigning Juglers and Impofters, or mifapplied to fatisfy ambition and avarice) is not to be rejected with contempt.

The artift in his affiduous and indefatigable labour to find the method of making gold, has frequently ftumbled upon *fpecific remedies* or *medicines*, which cure effectually, and fooner, a *chronic*, or fome other dangerous malady, than a *Galenical*, or *other* preparation ufed by our anceftors. A difcovery well worth the moft laborious and expenfive procefs, and more to be prized than the acquifition of a fecret, which, could it be found, would only ferve to gratify covetoufnefs, avarice and ambition; the worft of paffions.

But it does not yet appear that any of thefe hits have deferved the name of a *Panacæa* or *univerfal medicine* to cure all difeafes: though this is fo frequently boafted of by *Impoftors*, *Quacks* and *Charletans* in all countries.

Here we are called by *Paracelfus* and *Van Helmont* to acknowledge *an univerfal diffolvent*, difcoverable by the art of the *Alchymift:* "There is, "fay they, a certain fluid in nature capable of re-"ducing all fublunary bodies, as well homogene-"ous, as mixed, into their firft principle, or ori-"ginal matter, of which they are compofed; or "into an uniform, equal and portable liquor, that "will unite with water, and the juices of our "bodies, yet retain its feminal virtues; and if

"mixed

"mixed with itſelf again, will thereby be con-"verted into pure elementary water."

Van Helmont is poſitive that he was maſter of that noble *menſtruum*; and Mr. *Boyle* conceived ſuch an advantageous opinion thereof, on the ſingle report of *Helmont*, that he preferred it to the diſcovery of the *Philoſopher's Stone.* For why? Becauſe there is not the abſurdity in the notion of an univerſal *Ens*, that reſolves all bodies into their general *Ens*, by freeing them of the heterogeneous particles they were wrapt in, and thereby reſtore them to their priſtine liberty of directing themſelves, as there is to believe, that at the ſame inſtant they are thus freed, they acquire another form, without the allowance of the leaſt moment for a new *direction.*

No one can doubt but that all bodies proceed originally from a firſt matter, which was itſelf once in a fluid form; whoſe particles by the continual agitation and compreſſion of the atmoſphere, the diverſity of their figures, and the occult quality, which direct them to their different poles, have been concatenated together, for the formation of thoſe different bodies.

This *menſtruum* is called ALKAHEST, by the artiſts; and *Van Helmont* gives the honour of its invention to *Paracelſus*; who has left this character of it: "There is, ſays this author, the liquor "Alkaheſt of great efficacy in preſerving the liver; "as alſo in curing hydropical and all other diſ-"eaſes, ariſing from diſorders of that part. If it "have once conquered its like, it becomes ſupe-"rior to all hepatick medicines; and though the "liver itſelf were broken and diſſolved, this me-"dicine could ſupply its place."

Yet neither *Paracelſus*, nor *Van Helmont*, has done that juſtice to mankind as to tranſmit ſo valuable a medicine to poſterity; and perhaps the reaſon was that they might have, in the courſe of their practice, great reaſon to doubt of that ſovereign power aſcribed to it, above. Be that as it will, there is great reaſon to doubt of its efficacy; becauſe, as he who proves too much, proves nothing; ſo to aſcribe to the *alkeheſt* the power of ſupplying the place of a broken and diſſolved liver, is in effect to ſay, what no one can believe, that it could reſtore a dead man to life.

However let us enquire into this wonderful working *menſtruum*, or univerſal diſſolvent of the *Alchymiſts.*

From the known practice of *Paracelſus* (who in giving names to things introduced a kind of myſtery in their ſound, by tranſpoſing or reading the letters of the real name backwards) we might conjecture that *Alkaheſt* is no more than a word formed from *eſt* and *Alkali*, which compoſition, by making *eſt* the termination, ſounds *Alkalheſt* or *Alcal'eſt*, or corruptly *Alkaheſt*, and conſequently this may be ſuppoſed to be nothing but the *alkaline ſalt of tartar* volatilized; as *Glauber* imagines.

Others ſeek for its original in the *German* word *algeiſt*, which ſignifies ſpirituous and volatile; or in the compound word *ſaltz-geiſt*, i. e. *ſpirit of ſalt*; and theſe are ſupported by this fact, that ſpirit of ſalt was the great *menſtruum* uſed by *Paracelſus* on moſt occaſions. But this opinion is overruled by the commentator, who gives an edition of the works of *Paracelſus* at *Delft*, who aſſures us that the alkaheſt was a *mercury* converted into ſpirit. And ſuch is the diſagreement about this *menſtruum*, that one judges it to be a *ſpirit of vinegar from verdigreaſe*; another diſcovers it in *ſoap*; and the elder *Helmont* gives it the name of *fire water*; and in another place ſtiles it, "the higheſt "and moſt ſucceſsful amongſt ſalts; which having "obtained the ſupreme degree of ſimplicity, puri-"ty, and ſubtility, alone enjoys the faculty of "remaining unchanged, and unimpaired by the "ſubject it works upon, and of diſſolving the "moſt ſtubborn and untractable bodies; as ſtones, "gems, glaſs, earth, ſulphur, metals, &c. into "real ſalt equal in weight to the matter diſſolved; "and this with as much eaſe, as hot water diſſolves "ſnow; and by being ſeveral times cohobated "with *Paracelſus's ſal circulatum*, this ſalt loſes "all its fixedneſs; and at length becomes an inſi-"pid water, equal in quantity to the ſalt it was "made from."

All which ſhews that *Paracelſus* and *Van Helmont*, whatever deficiencies might be in their *alkaheſt*, took water for, the univerſal inſtrument of *Chemiſtry* and *Philoſophy*; and earth for the unchangeable baſis of all things; that fire was deſigned as their efficient cauſe; that ſeminal impreſſions were lodged in the mechaniſm of earth; and that water by diſſolving and fermenting with the earth, as it does by means of fire, brings every thing forth; from whence proceed the animal, vegetable, and mineral kingdoms.

If we enquire into the properties of the ALKAHEST, we are told it operates in the five following ways.

1. The firſt operation converts the ſubject into its three principles, *ſalt*, *ſulphur* and *mercury*; then into ſalt alone, which now becomes volatile; after which it is turned wholly into an inſipid water.

The manner of application is by touching the body, *e. g.* gold, mercury, ſand, &c. once or twice with the *Alkaheſt*, and if the preparation anſwers the deſcription of *Paracelſus* and *Helmont*, the body ſo touched will be converted into its own quantity of ſalt.

2. The ſeminal virtues of the bodies thus diſſolved are not deſtroyed. For, gold acted upon by this

this operation is not debaſed into any other ſalt, but the ſalt of gold: antimony becomes a ſalt of antimony: ſaffron a ſalt of ſaffron, *&c.* of the ſame ſeminal virtues or character, as the ſubject thus converted had in its original ſtate, as a metal, *&c.* where by ſeminal virtues we are to underſtand thoſe virtues, which depend upon the ſtructure or mechaniſm of a body, and makes it what it is.

Hence an actual and genuine *aurum potabile* might readily be made by the *Alkaheſt* converting the whole body of gold into ſalt, and making it ſo ſoluble in water, without depriving the metal of its ſeminal or radical virtues.

3. The bodies diſſolved by this *Alkaheſt* may be rendered volatile by a ſand heat; and if after volatilizing the ſolvend, it be diſtilled therefrom, the body is left pure inſipid water, equal in quantity to its original ſelf, but deprived of its ſeminal virtues. Thus if gold be the body diſſolved by this *Alkeheſt*, the metal firſt becomes a ſalt, which is potable gold: But when the *menſtruum* itſelf by further application of fire is diſſolved therefrom, the gold is left mere elementary water; ſo that pure water appears to be the laſt production or effect of the *Alkaheſt*.

4. It ſuffers no change, nor diminution by diſſolving the bodies it works upon; and conſequently ſuſtains no reaction from them, being the only immutable *menſtruum* in nature.

5. Neither is it capable of mixture; and therefore is free from fermentation and putrefaction; coming off as pure from the body it hath diſſolved, as when firſt put thereon, without leaving the leaſt impurity behind.

Such are the properties aſcribed to the *Alkaheſt*, which is rather an imaginary than a real diſſolvent: a *menſtruum* highly deſireable, but no where to be found; and though poſſible, it is hidden ſomewhere with the philoſopher's ſtone. For, neither the commentator on *Paracelſus* nor *Van Helmont* appears thoroughly convinced that *Paracelſus* was maſter of a real and true *Alkaheſt*; the one pretending that it was ſome mercurial preparation; the other allowing it to be nothing but the ſpirit of ſalt, which we all know is far from producing the ſurpriſing effects attributed to the pretended *Alkaheſt*.

Yet how dark and myſterious the ſtudy of this art continues to be, the advocates in its favour pretend to a very great antiquity. Some are weak enough to take *Adam* himſelf into their ſchool; who neither had neceſſities nor paſſions to induce him to ſeek after *arts*; whoſe origin could take its riſe only from covetouſneſs, avarice or ambition. Others go no higher towards the epocha of the world's creation than to the age of *Tubal Cain*, whoſe ſkill in metals furniſhes them with conjectures of his taſte in *Alchymy*; but without any glimmerings of truth. Others are ſatiſfied with eſtabliſhing their ſchool under *Moſes* or *Triſmegiſtus*. But theſe are mere dreams; ſuppoſitions without any authority whatſoever: for neither poet, philoſopher, nor phyſician, from *Homer* till 400 years after Chriſt, mentioned any ſuch thing as *Alchymy*.

In the beginning of the fifth century, (when the prieſts were eſtabliſhing the doctrine of *Tranſubſtantiation*, or the change of the ſubſtance of bread and wine into the ſubſtance of fleſh and blood, *in inſtanti*, by the power of certain words pronounced by themſelves) *Zoſimus* the *Panopolite*, availing himſelf of the people's credulity, attempted to perſwade them that he had diſcovered the ſecret of *tranſmutation* of baſe metals into gold and ſilver; and wrote a treatiſe to confirm the ſame under the title of *the divine art of making gold and ſilver:* which was followed ſoon after by another treatiſe from *Æneas Gazeus*, in the ſame century, in which we have this paſſage; "ſuch "as are ſkilled in the ways of nature, can take "Silver and Tin, and, changing their nature, "turn them into Gold." Where then is there foundation for the opinion of *Suidas*, who would inſinuate that the ſecret of the Philoſopher's Stone is couched in the table of the *Argonauts*. And though I would be underſtood to pay great deference to the authority of *Kircher*, who is poſitive that the theory of the *Philoſopher's Stone* is delivered at large in the tables of *Hermes*; and that *Alchymy* was an art well known to the ancient *Egyptians*; the univerſal ſilence of antiquity, and the little aſſiſtance the *Alchymiſts* of later times have been able to get from their books or traditions, are ſufficient to warrant a diſſent in this argument: which I ſhall conclude with a caution againſt the attempts of impoſtors that try to rook us out of our money, by raiſing our hopes to make Gold of every thing we touch; or of our lives, by poiſonous *noſtrums* or *quackeries*, under the character of *Catholicons* or *Univerſal Medicines*.

They that deſire further light into this myſterious ſtudy may conſult *Heliodorus* and *Syneſius* publiſhed by *Fabricius*; *Boerhaave*'s elements of *Chemiſtry*, tom. I. and *Norton*, *Ripley*, *Pearce* the *Benedictine*, *Carpenter*, *Andrews*, *Charnock*, *Blomfield*, *Kelly*, *Robinſon*, Dr. *Dee*, *Elias Aſhmole*, *&c.* and a number of *monkiſh* authors, whoſe manuſcripts are depoſited in the *French* king's library, and elſewhere, written chiefly from the time of *Zoſimus* downwards.

ALGEBRA.

A L G E B R A.

ALGEBRA known by the name of *Ars Magna*, or the *Great Art*, amongſt the ancients, is an *Arabic* invention, and brought firſt into *Europe* by the *Moors*, who ſettled in *Spain*. From thence it paſt into *Britain*, before this nation knew any thing of the ſyſtem of *Algebra*, written by *Diophantus* in *Greek*, about the year 800 of the *Chriſtian Æra*; but not printed and publiſhed till the the year 1575, by *Xylander*.

The *Weſtern* empire knew ſo little of *Diophantus* that *Lucas Paccioius*, or *De Burgos*, a Cordelier, whoſe treatiſe on *Algebra* was publiſhed in 1494 at *Venice*, never mentions his name, and takes it for granted that the world is indebted to the *Arabs* for the invention.

Paccioius's *Algebra* went no further than ſimple and quadratic Equations; in which he was followed by *Stifelius*, without making any improvement to extend the Art.

Theſe were a little improved by *Scipio Ferreus*, *Cardan*, *Tartaglia*, *&c*, who reached as far as the ſolution of ſome cubic Equations. *Bombelli* took the ſame tract, and proceeded a little further, who was improved by *Nunnius*, *Ramus*, *Schoner*, *Salignac*, *Clavius*: who all took different courſes.

But *Diophantus* coming upon the ſtage of literature, and being found very different from the method derived from the *Arabs*, hitherto practiſed in *Europe*, *Vieta*, in 1590, publiſhed his *ſpecious Arithmetic*, and the method of extracting roots of Equations by approximations; ſince much facilitated by *Ralphſon* in his *Analyſis Æquationum*; and by *Oughtred*, who in 1631 publiſhed his *Clavis Mathematica*, with great improvements upon *Vieta*, and with the invention of ſeveral compendious characters, to ſhew the ſums, differences, rectangles, ſquares, cubes, *&c*.

In the ſame year 1631, was alſo publiſhed an *Analyſis* on *Algebra*, written by one Mr. *Harriot*, which brought *Vieta*'s method into a more practical form, and is that which obtains the approbation of the learned at this time.

In 1657, *Des Cartes* in his *Geometry* then publiſhed, gave a ſpecimen of the uſe of *Algebra* in that ſcience; in which he made uſe of the literal *Calculus*, and the *Algebraic* rules of *Harriot*. A uſe which has been greatly improved by all the geometrical writers ſince his time, both abroad and in *Great Britain*.

Mr. *Kerſey* in 1671, was the firſt that, in the *Engliſh* tongue, profeſſedly compiled and publiſhed *The Elements of this Art*. The like has been done by *Preſtet*, in 1694; by *Ozanam* in 1703; by *Guiſne* in 1704 But in the moſt maſterly manner by the great Sir *Iſaac Newton*, in his *Arithmetica Univerſalis* in 1707.

They that deſire to ſee the improvement in this Art ſince that *Æra* will find them in *Ward*, *Saunderſon*, *Simpſon*, *Maclaurin*, *Fenner*, *&c*.

This Art by ſome is defined an *Univerſal Arithmetic*; by others *The Art of Reſolution and Equations*. I deſcribe it a peculiar kind of Arithmetic, which takes the quantity ſought, whether it be a number, or a line, or any other quantity, as if it were granted; and by means of one or more quantities given, proceeds by conſequence, till the quantity, at firſt only *ſuppoſed* to be known, is found to be equal to ſome quantity or quantities, which are certainly known, and conſequently itſelf is known.

ALGEBRA is both *numeral* and *literal*.

Numeral Algebra, is alſo called *vulgar*, was uſed by the ancients, and ſerved only for the reſolution of *arithmetical* queſtions. This kind expreſſes all the given quantities by numbers, and ſhews the quantity ſought by ſome letter or character.

Literal, which is alſo called *ſpecious Algebra*, is the modern method of expreſſing or repreſenting the given known quantities, as well as the unknown by their ſpecies or letters of the alphabet: which is found to be a great relief to the memory, when obliged to keep ſeveral matters, neceſſary for the diſcovery of the truth in hand, preſent to the mind.

This kind has alſo this peculiar advantage, not to be confined, like the *numeral Algebra*, to certain kinds of problems; but to ſerve *univerſally* for the inveſtigation of *Theorems*, as well as the ſolution and demonſtration of all kinds of *Problems*.

A THEOREM is a ſpeculative propoſition deduced from ſeveral definitions compared together, to demonſtrate the properties of any ſubject.

Suppoſe a *Triangle* be compared with a *Parallelogram*, ſtanding on the ſame baſe, and of the ſame attitude, partly from their immediate definitions, and partly from other of their properties already determined, it is inferred that the *Parallelogram* is double the *Triangle*: This would be the propoſition called a *Theorem*.

So that in every *Theorem* we are to regard chiefly the propoſition and the demonſtration; in the firſt is expreſſed, what agrees to ſome certain thing, under certain conditions, and what does not; in the latter the reasons are laid down, by which the understanding comes to conceive that it does not agree thereto.

A Theorem is either *universal*, *particular*, *negative*, *local*, *plain*, *solid*, or *reciprocal*.

The *Universal* Theorem extends to any quantity without restriction; as, the rectangle of the sum, and the difference of any two quantities is equal to the difference of their square.

The *particular* Theorem extends only to a particular quantity; as, in an equilateral right-lined triangle, each of the angles is sixty degrees.

The *negative* Theorem expresses the impossibility of an assertion; as, the sum of two biquadrate numbers cannot make a square number.

The *local* Theorem relates to a surface as the triangles of the same base and altitude are equal.

The *plane* Theorem relates to a rectilinear surface, or to one terminated by the circumference of a circle; as all angles in the segment of a circle are equal.

The *solid* Theorem considers a space terminated by a solid line, *i. e.* by any of the three *Conic* sections; as, if a right line cuts two asymptotic parabolas, its two parts, terminated by them, shall be equal.

The *reciprocal* Theorem, is that whose converse is true; as, a triangle, which has two equal sides, will have two equal angles; the converse of which is true, *viz.* if it have two equal angles, it must have two equal sides.

As to the Letters used in Algebra; they separately represent either lines or numbers agreeable to the *Problem*, if arithmetical or geometrical; but placed together they represent planes, solids, and powers more or less high, as the letters are in a greater or less number.

Thus *a b* represents a rectangle, with a side *a*, and with another side *b*, which mutually multiplied produce the plane *a b*.

Where the same letter, as *a a* is repeated twice, they denote a square; three letters, *a*, *b*, *c*, represent a solid, or rectangled parallelepipid, whose three dimensions are expressed by the three letters *a*, *b*, *c*, the length by *a*, the breadth by *b*, and depth by *c*; so that by their mutual multiplication they produce the solid *a*, *b*, *c*.

The Power, above-mentioned, is the produce of a number or other quantity, multiplied into itself.

They, who copy after *Des Cartes* distinguish most of their *powers* by the exponents, *first*, *second*, *third*, &c. But there is a difference as to the names of the several *powers*.

The *Arabs* and their disciples call them, the *Square*, *Cube*, *Quadrato Quadratum* or *Biquadrate*, *Surdesolid*, *Square of the Cube*, *second Surdesolid*, *Quadrato-Quadrato*, *Quadratum*, or *Cube of the Cube*, *Square of the Surdesolid*, *third Surdesolid*, &c. But *Diophantus*, *Vieta*, *Oughtred*, and their followers distinguish the names of the *Powers* by the *Side* or *Root*, *Square*, *Cube*, *Quadrato Quadratum*, *Quadrato Cubus*, *Cubo-Cubus*, *Quadrato Quadrato Cubus*, *Quadrato Cubo-Cubus*, *Cubo-Cubo-Cubus*, &c.

These Powers are denoted both in the *Arabic* and *Cartesian* system by the following characters.

	2	4	8	16	32	64	128	256	512	1024
Arabic	*R*	*q*	*c*	*bq*	*s*	*qc*	*Bf*	*tq*	*bc*	*sq*
Cartesian	a	a^2	a^3	a^4	a^5	a^6	a^7	a^8	a^9	a^{10}

The *Characters* used in general by *Algebraists* are *a*, *b*, *c*, *d*, &c. (the first letters of the alphabet) for *given* quantities *z*, *y*, *x*, &c. (the last letters) are characters for quantities *sought*, $^{m, n, r, s, t,}$ &c. are characters of undeterminate exponents both of *Ratios*, and of *Powers*; thus x^m, y^n, z^r, &c. denote undetermined powers of different kinds; *mx*, *ny*, *rz*, denote different multiplies or submultiplies of the quantities *x*, *y*, *z*, according as *m*, *n*, *r*, are either whole numbers or fractions.

$+$ Is an affirmative or positive Sign; and is also the mark of addition signifying *Plus* or *More*: thus $a + b$, or $3 + 5$, implies that *a* is added to *b*, and that 3 is added to 5.

— Before a single quantity is a negative Sign: But between quantities it is the Sign of Subtraction, and signifies *Minus* or *less*; thus $a - b$ or $8 - 4$ implies *b* subtracted from *a*, and 4 from 8.

$=$ and $\propto$ are signs of Equality; thus $a = b$ signifies that *a* is equal to *b*. *N. B.* Some use $=$ to denote the identity of Ratios.

$\times$ Is the Sign of Multiplication, shewing that the quantities it stands between are to be multiplied by one another; as, $a \times b$ signifies that *a* is multiplied into *b*, and 4×8, the product of 4 multiplied into 8; yet some make a dot . between the two factors, the Sign of Multiplication, as, 5.4 to signify the product of 5 and 4. But our modern Algebraists seldom use any Sign in Multiplication, but express the product of two quantities, *viz.* of *b* and *d*, by putting them together thus *bd*

A — drawn over the top of the sum shews that the factors are compounded of several letters; thus the factum of $a + b - c$ into *d* is wrote $d \times \overline{a + b - c}$. But others distinguish the compound factors by a parenthesis, thus $(a + b - c)\,d$.

$\div$ Is the sign of Division; as, $a \div b$ is *a* divided by *b*; or thus $\frac{a}{b}$ denotes the quotient of *a* divided by *b*. But *Wolfius* uses only two dots :, as 12 : 4 to denote 12 divided by 4. And instead of writing the quotient like a fraction, as is commonly

done

done, if either the divifor, or dividend, or both be compofed of feveral letters, thus $\frac{a + b}{c}$ he includes the common quantities in a parenthefis, thus $(a + b) : c$.

⊙ Is the character of *Involution.*

ɷ Is the character of *Evolution.*

$>$ Or ⊏ are figns of majority, as, $a > b$, that a is greater than b.

$<$ Or ⊐ are figns of minority, as $a < b$, that a is lefs than b.

∽ Is a character of fimilitude in fome authors; and ufed by others for the difference between two quantities, while it is unknown which is the greater of the two.

$\surd$ Is the character of radicality, and with a line added to it, thus $\sqrt{}$, denotes the fum of the *fquare roots*, as explained hereafter.

$*$ An afterifm fupplies the the want of a term of an equation, as in this equation

$\left.\begin{matrix} y^2 + py + \frac{1}{4}p^2 + q \\ - py - \frac{1}{4}p^2 \end{matrix}\right\} = 0$, the term $\pm py$ vanifhing, is marked with $*$ as $y^2 * - \frac{1}{4}p^2 + q$.

Hence to raife a quantity to a given *power* or dignity is the fame as to find the factum arifing, upon its being multiplied a given number of times into itfelf; for to raife 2 to the 3d *power*, is to find the factum 8; whofe factors are ^{2}, ^{2}, ^{2}.

Powers of the fame degree are to one another in the Ratio of the Roots, as manifold as their exponent contains units: Thus Squares are in a duplicate Ratio; Cubes in a triplicate Ratio; Quadrato-Quadrato or fourth *Powers* in a quadruple Ratio.

The *Powers* of proportional quantities are alfo proportional to one another.

From a given Power to extract the Root or Side is the fame as to find a number: Thus by multiplying 2 twice, it will produce a 3d Power or 8, which was the Power given. And

To multiply or divide any Power by another of the fame Root, you perform it thus

To *Multiply.*

Add the Exponents of the Factors; and the Sum is the Exponent of the Factum. *e. g.*

$$\begin{array}{l|ccccc} \textit{Factors} & x^3 & y^m & y^m & a^m & x^n \\ & x^4 & y^m & y^n & a^r & x^s \\ \hline \textit{Prod.} & x^7 & y^{2m} & y^{m+n} & a^{m+r} & x^{n+s} \end{array}$$

To *Divide.*

Subtract the Exponent of the Power of the Divifor from the Exponent of the Dividend; and the Remainder is the Exponent of the Quotient. *e. g.*

$$\text{Divid.}\ \begin{matrix} x^7 \\ x^8 \end{matrix}\Big(\ x^7 \Big\| \begin{matrix} y^{m+n} \\ y^n \end{matrix}\Big(\ y^m \Big\| \begin{matrix} a^m \\ a^r \end{matrix}\ \begin{matrix} x^n \\ x^s \end{matrix}\Big(\ a^{m-r}\ \ x^{n-s}$$

Note. In regard to number 6; all the natural Cubic Numbers, *viz.* 8, 27, 64, 125, whofe Root is lefs than 6, being divided by 6, the Remainder of the Divifion is the Root itfelf; and if we proceed, 216 the Cube of 6, being divided by 6, leaves no Remainder, but the Divifor 6, is itfelf the Root. Again, 343 the Cube of 7 being divided by 6, leaves 1, which added to the Divifor 6, makes 7 the Root, &c. And it will be found in practice, that all Numbers raifed to any power whatever, have Divifors, which have the fame effect, with regard thereto, that 6 has to Cubic Numbers.

To find thofe *Divifors* obferve thefe Rules.

When the Exponent of the *Power* of a number be even, *viz.* if the number be raifed to the 2d, 4th, 6th *Power*, &c. it muft be divided by 2; then the remainder of the Divifion, if there be any added to 2, or to a multiple of 2, gives the Root of this Number, correfponding to its *Power*, whether it be the 2d, 4th, 6th, or any other Root.

When the Exponent of the *power* is an uneven number, or raifed to the 3d, 5th, or 7th *power*, the double of that exponent will be the divifor, which has the property mentioned.

Thus it is found in 6, the double of 3, the exponent of the *power* of all the Cubes.

Thus alfo 10 is the divifor of all numbers raifed to the 5th *power*, &c.

ROOT is a quantity confidered as the bafis or foundation of a higher power; or which multiplied into itfelf, any number of times, produces a fquare, cubic, biquadratic, *&c.* quantity, *&c.* called the *fecond*, *third*, *fourth*, &c. power of the root or quantity fo multiplied into itfelf.

Thus if 2 be multiplied by itfelf, the fquare 4, or fecond power of 2, is the product; and 2 itfelf, in regard to that power, is called the *root*, or *fquare root* of 4. For, as unity is to the *fquare root*, fo is the *root* to the fquare; the *root* being a mean proportion between unity and the fquare; as, 1 : 2 : : 0 : 4.

If a fquare number, as 4, be multiplied by its root 2, the product 8 is called the *Cube* or *third power* of 2; and with refpect to the cube number 8, the number 2 is called the *Cube root:* For as unity is to the *root*, fo is the *root* to the fquare; and as unity is to the *root*, fo is the fquare to the cube, *i. e.* Unity, the root, the fquare, and the cube

cube are in continual proportion; as, 1 : 2 :: 4 : 8, where the *Cube root* is the firſt of the two means proportionals between unity and the cube.

Where obſerve, that to extract the *root* out of a given number or power, ſuppoſe 8, is the ſame thing as to find a number, as 2, which being multiplied by itſelf twice produces 8, the number given.

The *roots* of *powers* are expreſſed by placing this character $\sqrt{\;}$ called the *radical ſign* over them, with a number denoting what kind of *root* they are: Thus, the ſquare or ſecond *root* of 16 is expreſſed by $\sqrt[2]{16}$, and the cube or third root of 27 by $\sqrt[3]{27}$; and, in general, the *n*th *root* of *a* raiſed to the power *m* is expreſſed by $\sqrt[n]{am}$

When the *root* of a compound quantity is wanted the vinculum or — of the *radical ſign* muſt be drawn over the whole, as the *ſquare root* of $a^2+2ab+b^2$ is thus expreſſed $\sqrt[2]{a^2+2ab+b^2}$

Obſerve alſo that when the *radical ſign* has no number above it, to ſhew what *root* is wanted, the ſquare root is always meant; as, $\sqrt{a^2}$ or $\sqrt{16}$ is the *ſquare root* of a^2 and of 16.

ROOTS are divided into

Binominal, which conſiſts of two parts; as 24 of 20 + 4.

Trinominal, which conſiſts of three parts, as 245 of 240 + 5, or 100 + 140 + 5.

Multinominal, which conſiſts of more than three parts, as 2456 of 2450 + 6, or 2400 + 56, or 2000 + 456, or 2000 + 400 + 50 + 6.

Real; when the quantity is poſitive, as $x=r$ the *root* is a *real* or *true root*. Becauſe *poſitive quantity*, known by + prefixed or ſuppoſed to be prefixed, is a real quantity greater than nothing.

Falſe; when the value *x* of is negative; as $x=-5$ the *root* is ſaid to be falſe. Becauſe *negative quantity*, known by the ſign —, is ſuppoſed to be leſs than nothing.

ROOT *of an equation*; which denotes the value of the unknown quantity in an equation: Thus if the equation be $a^2+b^2=x^2$, the root of the *equation* is the ſquare *root* of *a*, and that of *b*, expreſſed thus $\sqrt{(a^2+b^2)}$

Theſe explications premiſed, let us proceed to ſhew the method of performing the ſeveral operations in *Algebra*.

The OPERATIONS are performed by *Addition*, *Subtraction*, *Multiplication*, *Diviſion*, *Involution*, *Evolution*, *Fraction*, *Equation*, *Fluxion*, &c.

By ADDITION.

ADDITION in *Algebra* is the connecting or writing into one ſum all the letters or numbers, to be added, with their proper ſigns, + or —; as *a* and *b* make $a+b$, *a* and $-b$ make $a-b$; $-a$ and $-b$ make $-a-b$; *ya* and *g a* make $ya+ga$; $-a\sqrt{ac}$ and $b\sqrt{ac}$ — $a\sqrt{ac}+b\sqrt{ac}$ or $b\sqrt{ac}-a\sqrt{ac}$; it not ſignifying what order they are written in.

ADDITION of *whole quantities*.

To add ſingle or whole quantities that are alike, and have the like ſigns, add together their coefficients, to the ſum of which prefix the common ſign, and ſubjoin the common letter or letters.

Example.

To	$+19a$	To	$4a+6$
Add	$+6a$	Add	$2a+8b$
Sum	$+25a$		$0a+9b$
To	$-2b$	To	$a-5x$
Add	$-5b$	Add	$2a-x$
Sum	$7b$	Sum	$3a\quad 6x$

When quantities are alike, but have unlike ſigns, then ſubtract the quotient or coefficient from each other, prefix the ſign of the greater quotient to what remains, and ſubjoin the common letters.

Example.

To	$-5a$	To	$a-6b$
Sub.	$+2a$	Sub.	$3a+2b$
Sum	$-3a$	Sum	$-2a-4b$
To	$+8b$	To	$4a-8b$
Sub.	$-2b$	Sub.	$-4a+8b$
Sum	$+6$	Sum	$0\quad 0$

N. B. This rule is proved by the nature of poſitive and negative quantities.

When quantities are unlike (be the ſigns ſo or not) ſet them all down after one another with their ſigns and quotients prefixed.

Example.

To	$+4a$	To	$+a$	To	$+4a-2b$
Add	$+2b$	Add	$-7x$	Add	$-8y+4x$
Sum	$+4a-2b$	Su.	$+a-7x$	Su.	$+4a-2b-8y+4x$

When more than two quantities are to be added, *firſt*, add the poſitive quantities into one ſum; and *then* the negative; and then the produce of both ſums.

Example.

Example.

$$\begin{array}{l} \text{To} \\ \text{Add} \end{array}\left\{\begin{array}{r} +\ 5\,a \\ -\ 8\,a \end{array}\right\}\begin{array}{c}\text{To the sum of} \\ \text{the positive}\end{array}\left.\right\}\ +\ 14\,a$$

$$\begin{array}{l} \text{To} \\ \text{Add} \end{array}\left\{\begin{array}{r} +\ 9\,a \\ -\ \ a \end{array}\right\}\begin{array}{c}\text{Add the sum of} \\ \text{the negative}\end{array}\left.\right\}\ -\ \ 9\,a$$

$$\text{Sum of all is}\ \ +\ \ 5\,a$$

By Subtraction.

Subtraction in *Algebra* is performed by connecting the quantities with all the signs of the subtrahend changed, and then by adding it, so changed, to the quantity from which it was to be subtracted, by the rules of *addition*; and the sum, which shall arise from this addition, will be the remainder.

Example.

$$\begin{array}{rl} \text{From} & +\ 9\,a \\ \text{Subtr.} & +\ 7\,a \\ \hline \text{Rem.} & +\ 9a -\ 7\,a \text{ or } 2\,a \end{array}$$

N.B. The characters of the subtracted are to be charged into the contrary ones, *viz.* + into —, and — into +. So in general the subtraction of a negative quantity is equivalent to adding its positive value.

To subtract *specious* numbers or quantities: if the quantities designed by the same letters, have the same signs, and the less to be subtracted from the greater; the subtraction is performed as in common *Arithmetic.*

Example.

$$\begin{array}{ll} \text{From} & 56 + 4d - f = 5\,sh + 4\,p - \tfrac{1}{4} \\ \text{Subtract} & 26 + \ d - f = 2\,sh + 1\,p - \tfrac{1}{4} \\ \hline & 36 + 3d - 0 \quad 3\,sh + 3\,p \quad 0 \end{array}$$

When a greater quantity is to be subtracted out of a less; the less must be subtracted out of the greater, and to the remainder must be prefixed the sign —, if the quantities be affected with the sign +; but prefix the sign +, if the quantities be affected with the sign —.

Example.

$$\begin{array}{llllll} \text{From} & 16\,a + 2b - 9\,d & = 16\ lib. & + 2\,sh & - 9\,d \\ \text{Subtract} & 19\,a + 3b - 11\,d & \ \ 19 & + 3 & - 11 \\ \hline \text{Remains} & -\ 3\,a - 1b + 2 & -\ 3 & -\ 1 & +\ 2 \end{array}$$

When the quantities have different signs, the subtraction is converted into addition, and to the aggregate is prefixed the sign of the quantity, from which the subtraction is to be made.

Example.

$$\begin{array}{ll} \text{From} & 8\,a - 5c + 9d = 8\,lib - 5 + 9d \\ \text{Subtract} & 6\,a - 8\,c + 7\,d = 6 \quad - 8 - 7 \\ \hline \text{Remains} & 2\,a + 3c + 16d = 2\,lib + 3 + 16 \end{array}$$

If the quantities are expressed in different letters they must be connected; only the character of the subtrahend must be changed into the contrary ones.

Example.

$$\begin{array}{lll} \text{From} & a + b - c & a + d \\ \text{Subtract} & d - e + f & c - e - g \\ \hline \text{Remains} & a + b - c - d + e - f & a + d - c + e + 9 \end{array}$$

By Multiplication.

The general rule of the signs is, That when the signs of the factors are alike, *i. e.* both + or both —, the sign of the product is +; but when the signs of the factors are unlike, then the sign of the product is —.

1st Case: When any positive quantity, $+a$ is multiplied by any positive number, $+n$. *Note*, that $+a$ is to be taken as many times as there are units in n, and the product is evidently $n\,a$.

2d Case: When $-\ a$ is multiplied by n, then $-\ a$ is to be taken as often as there are units in n, and the product must be $n\,a$.

3d Case: Multiplication by a positive number implies a repeated addition: but by a negative number, a repeated subtraction. And when $+\ a$ is to be multiplied by $-n$, the meaning is that $+\ a$ is to be subtracted as often as there are units in n, therefore the product is negative or $-\ n\,a$.

4th Case: When $-\ a$ is to be multiplied by $-n$, then $-\ a$ is to be subtracted as often as there are units in n; but to subtract $-\ a$ is equivalent to adding $+\ a$, consequently the product is $+\ na$.

To illustrate the second and fourth Cases:

It is evident that $+\ a - a = 0$; therefore if we multiply $+\ a - a$ by n, the product must vanish or be 0, because the factor $a - a$ is 0. The first term of the product is $+\ n\,a$ (by Case 1st) therefore, the second term of the product must be $n - a$, which destroys more $+\ n\,a$; so that the whole product must be $+\ n\,a - n\,a = 0$. Therefore $-\ a$ multiplied by $+\ n$ gives $-\ n\,a$.

If we also multiply $+\ a - a$ by $-\ n$; the first term of the product being $-\ n\,a$, the latter term must be $+\ n\,a$, because the two together must destroy each other, or their amount must be 0, since one of the factors, $a - a$ is 0. Therefore $-\ a$ multiplied by $-\ n$, must give $+\ n\,a$.

If the quantities multiplied are simple, and the sign of the product by the last rule: after it place the

the product of the co-efficients, and ſet down all the letters after one another.

Examples.

Multiply	$+a$	$-2a$	$+6x$
By	$+b$	$+4b$	$-5a$
Product	$+ab$	$-8ab$	$-30ax$

Multiply	$-8x$	$+3ab$
By	$-4a$	$-5ac$
Product	$+32ax$	$-15aabc$

MULTIPLICATION of *compound Quantities* is performed by multiplying every part of the multiplicand by all the parts of the multiplier, taken one after another; and then collect all the products into one, and the ſum they produce ſhall be the product required.

Example.

Multiply	$a+b$	$2a-3b$
By	$a+b$	$4a+5b$
Prod.	$aa+ab$	$8aa-12ab$
	$+ab+bb$	$+10ab-15bb$
Sum	$aa+2ab+bb$	

Multiply	$2a-4b$	$xx-ax$
By	$2a+4b$	$x+a$
Prod.	$4aa-8ab$	$xxx-axxx$
	$+8ab-16bb$	$+axx-ax$
Sum	$4aa \quad 0 \quad -16bb$	$xxx \quad 0 \quad -aax.$

Multiply	$aa+ab-bb$
By	$a-b$
Product	$aaa+aab+abb$
	$-aab-abb-bbb$
Sum	$aaa \quad 0 \quad 0 \quad -bbb$

Sometimes inſtead of multiplying compounded quantities, it is convenient only to ſet them down with $\times$ the ſign of multiplication between them, and to draw a line over each of the compound factors: thus $\overline{a+b} \times \overline{1}$ expreſſes the product of $\overline{a+b} \times$ by $\overline{a-b}$. *Note.* Products, which ariſe from the multiplication of 2, 3 or more quantities, as a, b, c, are ſaid to be of 2, 3 or more dimenſions; and thoſe qualities are called *Factors*.

Again: when all the *Factors* are equal, then theſe products are called *Powers*; as aa or aaa are *Powers* of a; and theſe *Powers* are ſometimes denoted by placing, above the root to the right hand, a figure expreſſing the Number of factors that produce them: Thus

a	1ſt	Power	of the Root a after this form.	a
aa	2d			a^2
aaa	3d			a^3
$aaaa$	4th			a^4
$aaaaa$	5th			a^5

which figures are properly called *Indices* or *Exponents*: and *Powers* of the ſame root are multiplied by adding their Exponents thus $a^3 \times a^3 = a^5$; $a^4 \times a^5 = a^7$; $a^3 \times a = a^4$.

By DIVISION.

DIVISION in *Algebra* is performed by placing the dividend, as, ab above, and the diviſor, as cd under a ſhort line, thus $\frac{ab}{cd}$

Then expunge all ſimilar letters found in all the quantities of the dividend and diviſor, and divide the coefficients of all the terms by any common meaſure.

Example.

Dividend	$10ab + 15ac$
Diviſor	$20\ ad$

Here expunge a out of all the terms, and divide all the coefficients by 5, and it will be reduced to $\frac{2b+3c}{4d}$. In the ſame manner $2b)\ ab + bb = \frac{ab+bb}{2b} = \frac{a+b}{2}$. Again $12\ ab)\ 30\,ax - 54\,ay = \frac{30\,ax - 54\,ay}{12\,ab} = \frac{5x-9y}{2b}$; and $4\ aa)\ 8\,ab + b\,ac = \frac{8\,ab + 6\,ac}{4\,aa} = \frac{4b+3c}{2a}$; and to add no more, $2b\,c)$ $5\,abc = \frac{5\,abc}{2bc} = \frac{5a}{2}$.

Note, If the ſigns of the diviſor and dividend be alike, the ſign of the quotient muſt be $+$; but if they are unlike, the ſign muſt be $-$.

Divide powers of the ſame root by ſubtracting their exponents. Thus if a^5 be divided by a^2; and b^8 by b^2, it gives the quotient $b^{8-2} = b^6$; and ſo in other caſes.

In the *diviſion* of a *Compound Quantity*, you muſt range the parts according to the dimenſions of ſome one of its letters.

Example.

To divide $a^2 + 2ab + b^2$ you range them according to the dimenſions of a, the quantity of a^2, (where a is of two dimenſions) being placed firſt; $2ab$ where it is of one dimenſion) next; and b^2, (where a is not found) laſt. Then range the diviſor $a+b$ in the ſame manner, you are to divide the firſt

first term of the dividend by the first term of the divisor: and having set down the quotient, which, in this case, is a, multiply this quotient by the whole divisor, and subtract the product, *viz.* $a^2 + ab$ from the two first terms of the dividend $a^2 + 2ab$, and the remainder ab together with the last term b^2, gives a new Dividend $ab + b^2$, divide the first term of this new dividend by the first term of the divisor, and set down the quotient, which in this example is b; then multiplying the whole divisor by this part of the quotient, subtract the product from the new dividend, and if there be no remainder, the division is finished, as is the case here

$$
\begin{array}{l}
a+b)\ a^2+2ab+b^2\ (a+b \\
\qquad\quad a^2+ab \\
\hline
\qquad\qquad ab+b^2 \\
\qquad\qquad ab+b^2 \\
\hline
\qquad\qquad\ 0 \quad 0
\end{array}
$$

But should there be a remainder; then proceed after the same manner till no remainder can be found, or till it appear that there will always be some remainder, as in the following examples.

EXAMPLE *without a* REMAINDER.

$$
\begin{array}{l}
3a-6)\ 6a^4-96\ (2a^3+4a^2+8a+16 \\
\qquad\quad 6a^4-12a^3 \\
\hline
\qquad\qquad 12a^3-96 \\
\qquad\qquad 12a^3-24a^2 \\
\hline
\qquad\qquad\qquad 24a^2-96 \\
\qquad\qquad\qquad 24a^2-48a \\
\hline
\qquad\qquad\qquad\qquad 48a-96 \\
\qquad\qquad\qquad\qquad 48a-96 \\
\hline
\qquad\qquad\qquad\qquad\ 0 \quad 0
\end{array}
$$

EXAMPLE *with a* REMAINDER.

$$
\begin{array}{l}
a+x)\ a^2+x^2\ (a-x+\frac{2x^2}{a}-\frac{2x^3}{a^2}+\frac{2x^4}{a^3}-\ \&c. \\
\qquad a^2+ax \\
\hline
\qquad -ax+x^2 \\
\qquad -ax-x^2 \\
\hline
\qquad\qquad +2x^2 \\
\qquad\qquad +2x^2+\frac{2x^3}{a} \\
\hline
\qquad\qquad\qquad -\frac{2x^3}{a} \\
\qquad\qquad\qquad -\frac{2x^3}{a}\ \frac{2x^4}{a^2} \\
\hline
\qquad\qquad\qquad\qquad +\frac{2x^4}{a^2}.\ \&c.
\end{array}
$$

Where *Note*, in this example the signs are alternately + and —, the coefficient is always 2, after the two first terms, and the letters are powers of x and a; so that the quotient may be continued without any farther division.

But in common examples after you come to the remainder of one term, as $2x^2$, it is usually set down in the quotient, with the divisor under it, after the other terms; and the quotient in the last example will stand thus, $a - x + \frac{2x^2}{a+x}$

By INVOLUTION.

INVOLUTION is the raising of a quantity from its *Root* to any *Power* assigned, and is thus performed.

If the quantity is simple, it is *involved* by multiplying the exponent by that of the power required: for, to raise any simple quantity to its *2d*, *3d*, *4th*, *&c.* Power, we only multiply its exponent 1 by 2, 3, 4, *&c.* and, in general the power expressed by m of any quantity is had by multiplying its exponent by m.

Example.

The second Power of a is $a^{2\times 1} = a^2$.
The third Power or Cube is $a^{3\times 1} = a^3$.
The mth Power of a is $a^{m\times 1} = a^m$.
The Square a^4 is $a^{2\times 4} = a^8$.
The Cube of a^4 is $a^{3\times 4} = a^{12}$.
The mth Power of a^4 is $a^{4\times m}$.
The Square of abc is $a^2b^2c^2$.
The Cube is $a^3b^3c^3$.
The mth Power is $a^mb^mc^m$.

The coefficients must also be raised to the same power by a continual multiplication of itself by itself, as often as unit is contained in the exponent of the power required.

Example.

The Square of $3a$ is $3\times 3\times a^2 = 9a^2$
The Cube of $3ab$ is $3\times 3\times 3\times a^3b^3 = 27a^3b^3$

When the quantity to be involved is *positive* all the powers must be *positive* too: and when *negative*, all its powers, whose exponents are even numbers, must be *positive* also; but if their exponents are odd numbers, it must be *negative*; because any number of multiplications of a negative, if that number be even, gives a positive: therefore the power can then only be negative, when its exponent is an odd number; though the quantity to be involved be negative. Thus the powers of $-a$ are $+a^2$, $-a^3 + a^4$, $-a^5 + a^6$, &c.

The

Theſe Powers, whoſe Exponents are 2, 4, 6, &c. being poſitive: but thoſe whoſe Exponents are 1, 3, 5, &c. negative.

The *Involution* of any *Compound Quantity* is performed by a continual Multiplication of itſelf by itſelf, as in the binominal $a+b$.

Example.

$$a+b = \text{Root.}$$
$$\times a + b$$
$$a^2+ab$$
$$+ab+b^2$$
$$a^2+2ab+b^2 = \text{the Square, or ſecond Power.}$$
$$\times a + b$$
$$a^3+2a^2b+ab^2$$
$$+a^2b+2ab^2+b^3$$
$$a^3+3a^2b+3ab^2+b^3 = \text{Cube, or third Power.}$$
$$\times a + b$$
$$a^4+3a^3b+3a^2b^2+ab^3$$
$$+a^3b+3a^2b^2+3ab^3+b^4$$
$$a^4+4a^3b+6a^2b^2+4ab^3+b^4 = \text{biquadratic, or fourth Power.}$$
$$\times a + b$$
$$a^5+4a^4b+6a^3b^2+4a^2b^3+ab^4$$
$$+a^4b+4a^3b^2+6a^2b^3+4ab^4+b^5$$
$$a^5+5a^4b+10a^3b^2+10a^2b^3+5ab^4+b^5 = \text{the fifth Power.}$$
$$\times a + b$$
$$a^6+5a^5b+10a^4b^2+10a^3b^3+5a^2b^4+ab^5$$
$$+a^5b+5a^4b^2+10a^3b^3+10a^2b^4+5ab^5+b^6$$
$$a^6+6a^5b+15a^4b^2+20a^3b^3+15a^2b^4+6ab^5+b^6 = \text{the ſixth Power, \&c.}$$

If the Powers of ab are required they will be found the ſame as the preceding; only the terms in which the exponent of b is an odd number, will be negative; becauſe an odd number of multiplication of a negative, as obſerved before, produceth a negative. Thus the cube of $a-b$ will be found to be $a^3 - 3a^2 + 3ab^2 - b^3$; where the ſecond and third terms are negative; the exponent of b being an odd number in theſe terms.

In general, the terms of any power of the Binominal $a-b$ are poſitive and negative by turns.

It is to be obſerved that in the firſt term of any power of a $a \mp b$, the quantity a has the exponent of the power required; that in the following terms, the exponents of a decreaſe gradually by the ſame differences, *viz.* unit; and that in the laſt terms it is never found. The powers of b are in the contrary order; it is never found in the firſt term; but its exponent in the ſecond term is unit; in the third term 2; and ſo increaſes, till in the laſt term the exponent becomes equal to the exponent of the power required.

As the exponents of a thus decreaſe, and at the ſame time thoſe of b increaſe; the ſum of their exponents is always the ſame, and is equal to the exponent of the power required. Thus, as in the ſixth power of $a+b$, you have ſeen $a^6 + 6a^5 + 15a^4 b^2 + 20a^3b^3 + 15a^2b^4 + 6ab^5 + b^6$ where the exponents of a decreaſe in this order 6, 5, 4, 3, 2, 1, 0, and thoſe of b increaſe in the contrary order, 0, 1, 2, 3, 4, 5, 6. The ſum of their exponents in any term being always 6.

Therefore if $a+b$ is to be raiſed to any power m, the terms without their coefficients will be $a^m, a^{m-1}b, a^{m-2}b^2, a^{m-3}b^3, a^{m-4}b^4, a^{m-5}b^5$, &c. till the exponent of b becomes equal to m.

The Coefficients of the reſpective terms will be $1, m, m \times \frac{m-1}{2}, m \times \frac{m-1}{2}, \times \frac{m-2}{3}, m \times \frac{m-1}{2} \times \frac{m-2}{3} \times \frac{m-3}{4}, m \times \frac{m-1}{2} \times m\, \frac{m-2}{3} \times \frac{m-3}{4} \times \frac{m-4}{5}$, &c. continued untill you have one Coefficient more than there are units in m.

Hence it follows that $\overline{a+b}^m = a^m + m a^{m-1} b + m \times \frac{m-1}{2} \times a^{m-2} b^2 + m \times \frac{m-1}{2} \times \frac{m-2}{3} \times a^{m-3} b^3 + m \times \frac{m-1}{2} \times \frac{m-2}{3} \times \frac{m-3}{4} \times a^{m-4} b^4 +$, &c. which is the *Binominal*, or general Theorem for raiſing a quantity, conſiſting of two terms to any power m.

If a quantity, conſiſting of *three* or *more* terms, is to be *involved*, it may be diſtinguiſhed into two parts, which are to be raiſed to any power in the ſame manner as a Binominal: and by the ſame Rules, you may ſubſtitute, inſtead of the powers of theſe compound parts, their values; as,

$a+$

$\overline{a + b + c}^2 = \overline{\overline{a + b} + c}^2 = \overline{a + b}^2 + 2c \times \overline{a + b} + c^2 = \overline{a^2 + 2ab + b^2} + \overline{2ac + 2bc} + c^2$. And, $\overline{a + b + c}^3 = \overline{a + b}^3 + 3c \times \overline{a + b}^2 + 3c^2 \times \overline{a + b} + c^3 = a^3 + 3a^2b + 3ab^2 + b^3 + 3a^2c + 6abc + 3b^2c + 3ac^2 + 3bc^2 + c^3$.

In which Examples $a + b + c$ is confidered as compofed of the compound parts of $a + b$ and the fimple part c, and then the powers of $a + b$ are formed by the Binominal Theorem, and fubftituted for $\overline{a + b}^3$, and $\overline{a + b}^2$.

For the better underftanding of the premiffes, and to affift the learner in the attainment of what follows, we fhall explain more minutely what is meant by a *Coefficient*, and its ufes.

Coefficients in *Algebra* are fuch numbers, or given quantities, as are put before letters, or unknown quantities, into which letters they are fuppofed to be multiplied: thus, in $3a$ or bx, or cxx, 3 is the *Coefficient* of $3a$, b of bx, and c of cxx.

When no number is prefixed, unit is fuppofed to be the *Coefficient*; as, 1 is the Coefficient of a, or of b.

In a *quadratic* Equation the *Coefficient* is, according to its fign, either the fum, or the difference of its roots.

In any equation, the *Coefficient* of the fecond term is always equal to the fum of all the roots, keeping their proper figns.

The *Coefficient* of the third term is the fum of all the rectangles, arifing by the multiplication of every two of the roots, how many ways foever thefe combinations of the two can be had, as, three times in a *cube*, fix in a *biquadratic* equation, *&c.*

The *Coefficient* of the fourth term is the aggregate of all the folids made by the continual multiplication of every three of the roots, how often foever fuch a *ternary* may be had, *ad infinitum.*

In *Fluxions* the Coefficient of any *generating term* is the quantity arifing from the divifion of that term.

By Evolution.

Evolution or *the Extraction of Roots* is the finding the roots of the powers of any quantity, whether fimple or compound.

This is the reverfe of *Involution*; and therefore the roots of the fingle quantities are eafily extracted by *dividing* their exponents by the number that denominates the root required; for the powers of any root are found by multiplying its exponent by the index that denominates the power; confequently, when any power is given, the root muft be found by dividing the exponent of the given power by the number that denominates the kind of root, that is required; thus,

The fquare Root of a^8 is $2^{\frac{8}{2}} = a^4$
The fquare Root of $a^4 b^8 c^2$ is $a^2 b^4 c$
The cube Root of $a^6 b^3$ is $a^{\frac{6}{3}} b^{\frac{3}{3}} = a^2 b$; and
The cube Root of $x^9 y^6 z^{12}$ is $x^3 y^2 z^4$.

It alfo appears, from what has been faid of *Involution*, that any power that has a *pofitive* fign, may have either a pofitive or negative root, if the root is denominated by an even number: but if a power have a *negative* fign, no root of it, denominated by an even number, can be affigned, fince there is no quantity, that multiplied into itfelf an even number of times, can give a *negative* product. Thus, the fquare root of $-a^2$ cannot be affigned; and is therefore called an impoffible, or imaginary quantity.

But if the root to be extracted is denominated by an odd number, then fhall the fign of the root be the fame as the fign of the given number, whofe root is required; thus,

The cube root of $-a^3$ is $-a$.
The cube root of $-a^6 b^3$ is $-a^2 b$.

If the number that denominates the root required is a *Divifor* of the exponent of the given powers, then fhall the root be only a lower power of the fame quantity; as,

The cube root of a^{12} is a^4, number 3 that denominates the cube root being a *divifor* of 12.

But if the number that denominates what fort of root is required, is not a *divifor* of the exponent of the given power, then the root required fhall have a *fraction* for its exponent; as,

The fquare root of a^3 is $a^{\frac{3}{2}}$
The cube root of a^5 is $a^{\frac{5}{3}}$.
The fquare root of a is $a^{\frac{1}{2}}$.

Thofe Powers that have *fractional* exponents are called *imperfect powers* or *furds*, and are *multiplied* and *divided*, *involved* and *evolved*, after the fame manner as *perfect Powers*; thus,

The fquare of $a^{\frac{3}{2}}$ is $a^{2 + \frac{3}{2}} = a^3$.
The cube of $a^{\frac{2}{5}}$ is $a^{3 \times \frac{2}{5}} = a^{\frac{6}{5}}$.
The fquare root of $a^{\frac{2}{3}}$ is $a^{\frac{2}{3 \times 2}} = a^{\frac{1}{3}}$.
The cube root of $a^{\frac{3}{4}}$ is $a^{\frac{1}{4}}$.

The fquare root of any *compound quantity*, as $a^2 + 2ab + b^2$, is difcovered after this manner. *Firft* take care to difpofe the terms according to the dimenfions of the alphabet, as in divifion; *then*, find the

the ſquare root of the firſt term aa, which gives a for the firſt member of the root. *Then*, ſubtract the ſquare from the propoſed quantity, and divide the firſt term of the remainder $2ab+b^2$, by the double of that member, *viz.* $2a$, and the quotient b is the ſecond member of the root. *Add* this ſecond member to the double of the firſt; *multiply* their ſum $2a+b$ by the ſecond member b; *ſubtract* the product $2ab+b^2$ from the foreſaid remainder $2ab+b^2$, and if nothing remains, then the ſquare root is obtained.

The manner of the operation is thus:

$$\begin{array}{rl} & a^2+2ab+b^2\ (a+b^2 \\ & a^2 \\ \hline 2a+b) & 2ab+b^2 \\ \times b) & 2ab+b^2 \\ \hline & 0. \quad 0. \end{array}$$

But, if there had been a remainder, you muſt have divided it by the double of the ſum of the two parts already found, and the quotient would have given the third member of the root. Thus:

If the quantity propoſed had been $a^2+2ab+2ac+b^2+2bc+c^2$, after proceeding, as above, you would have found the remainder $2ac+2bc+c^2$, which divided by $2a+2b$, gives c to be annexed to $a+b$, as the third member of the root. Then adding c to $2a+2b$, and multiplying their ſum $2a+2b+c$ by c, ſubtract the product $2ac+2bc+c^2$ from the foreſaid remainder; and ſince nothing now remains, you conclude that $a+b+c$ is the ſquare root required.

The operation is thus:

$$\begin{array}{rl} & a^2+2ab+2ac+b^2+2bc+c^2\ (a+b+c \\ & a^2 \\ \hline 2a+b) & 2ab+2ac+b^2+2bc+c^2 \\ \times b) & 2ab \qquad\quad +b^2 \\ \hline 2a+2b+c) & 2ac+2bc+c^2 \\ \times c) & 2ac+2bc+c^2 \\ \hline & 0. \quad 0. \quad 0. \end{array}$$

Another example. Required the ſquare root of $xx-ax+\frac{1}{4}aa$

$$\begin{array}{rl} & xx-ax+\frac{1}{4}aa\ (x-\frac{1}{2}a \\ & xx \\ \hline 2x-\frac{1}{2}a) & -ax+\frac{1}{4}aa \\ \times-\frac{1}{2}a) & -ax+\frac{1}{4}aa \\ \hline & 0. \quad 0. \end{array}$$

The *ſquare root* of any number is found out after the ſame manner.

In general, to extract any root out of any given quantity: firſt range that quantity according to the dimenſions of its letters, and extract the ſaid root out of the firſt term, and that ſhall be the firſt member of the root required. Then raiſe this root to a dimenſion lower by unit than the number that denominates the root required, and multiply the power that ariſes by that number itſelf; divide the ſecond term of the given quantity by the product, and the quotient ſhall give the ſecond member of the root required. Thus to extract the root of the fifth power out of $a^5+5a^4b+10a^3b^2+10a^2b^3+5ab^4+b^5$, I find that the root of the fifth power out of a^5, gives a; which I raiſe to the fourth power, and multiplying by 5, the product is $5a^4$; then dividing the ſecond term of the given quantity $5a^4b$ by $5a^4$, I find b to be the ſecond member; and raiſing $a+b$ to the fifth power and ſubtracting it, there being no remainder, I conclude that $a+b$ is the root required.

If the root has three members, the third is found after the ſame manner from the firſt two, conſidered as one member; as the ſecond member was found from the firſt, which may eaſily be underſtood from what was ſaid of extracting the ſquare root.

In extracting roots, it will often happen that the exact root cannot be found in finite terms. Thus the ſquare root of a^2+x^2 is found to be $a+\frac{x^2}{2a}-\frac{x^4}{8a^3}+\frac{x^6}{16a^5}-\frac{5x^8}{128a^7}+$, &c. &c.

The operation is thus:

$$\begin{array}{rl} & a^2+x^2\ \left(a+\frac{x^2}{2a}-\frac{x^4}{8a^3}+\frac{x^6}{16a^5}-\text{\&c.}\right. \\ & a^2 \\ 2a+\frac{x^2}{2a}) & *+x^2 \\ \times\frac{x^2}{2a}) & =x^2+\frac{x^4}{4a^2} \\ \hline 2a+\frac{x^2}{a}-\frac{x^4}{8a^3}) & -\frac{x^4}{4a^4} \\ \times-\frac{x^4}{8x^3}) & =-\frac{x^4}{4a^2}-\frac{x^6}{8a^4}+\frac{x^8}{64a^6} \\ \hline & +\frac{x^6}{8a^4}-\frac{x^8}{64a^6},\ \text{\&c. \&c.} \end{array}$$

After the ſame manner, the Cube Root of a^3+x^3 will be found to be $a+\frac{x^3}{3a^2}-\frac{x^6}{9a^5}+\frac{5x^9}{81a^8}-\frac{10x^{12}}{243a^{11}}+$, &c.

The reader will find a general theorem for extracting the root of any binominal under the title INVOLUTION.

Before we proceed to *Fractions* it may be proper to explain what is meant above by *imperfect* or SURD *Powers*.

A SURD in *Algebra* denotes any number or quantity that is *incommenſurable* to Unity; otherwiſe called an irrational Number or Quantity.

The ſquare roots of all numbers, except 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144, &c. (which are the ſquares of the integer numbers, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, &c.) are *incommenſurables*.

And after the ſame manner the cube roots of all numbers but of the cubes of 1, 2, 3, 4, 5, 6, &c. are

are *incommenſurables:* and quantities that are to one another in the proportion of ſuch numbers, muſt alſo have their ſquare-roots, or cube-roots, *incommenſurable*.

The roots, therefore, of ſuch numbers, being *incommenſurable*, are expreſſed by placing the proper radical ſign over them: thus $\sqrt[2]{2}$, $\sqrt[2]{3}$, $\sqrt[2]{5}$, $\sqrt[2]{6}$, &c. expreſs numbers incommenſurable with Unity.

However, though theſe numbers are incommenſurable themſelves with unity, yet they are commenſurable in power with it; becauſe their powers are integers, that is, multiples of unity. They may alſo be commenſurable ſometimes with one another, as the $\sqrt[2]{8}$ and $\sqrt[2]{2}$; becauſe they are to one another as 2 to 1: and when they have a common meaſure, as $\sqrt[2]{2}$ is the common meaſure of both; then their ratio is reduced to an expreſſion in the leaſt terms, as that of commenſurable quantities, by dividing them by their greateſt common meaſure.

The common meaſure is found as in commenſurable quantities, only the root of the common meaſure is to be made their common diviſor: thus $\frac{\sqrt{12}}{\sqrt{3}}=\sqrt{4}=2$, and $\frac{\sqrt{18a}}{\sqrt{2}}=3\sqrt{a}$.

A rational quantity may be reduced to the form of any given *Surd*, by raiſing the quantity to the power that is denominated by the name of the *Surd*, and then ſetting the radical ſign over it: thus, $a=\sqrt[2]{a^2}=\sqrt[3]{a^3}=\sqrt[4]{a^4}=\sqrt[5]{a^5}=\sqrt[n]{a^n}$, and $4=\sqrt{16}=\sqrt[3]{64}=\sqrt[4]{256}=\sqrt[5]{1024}=\sqrt[n]{4^n}$.

As *Surds* may be conſidered as *Powers* with fractional exponents, they are reduced to others of the ſame value that ſhall have the ſame radical ſign, by reducing theſe fractional exponents to fractions having the ſame value and a common denominator. Thus $\sqrt[n]{a}=a^{\frac{1}{n}}$, and $\sqrt[m]{a}=a^{\frac{1}{m}}$, and $\sqrt[m]{a}=a^{m}$, and $\frac{1}{n}=\frac{m}{nm}$, $\frac{1}{m}=\frac{n}{nm}$, and therefore $\sqrt[n]{a}$ and $\sqrt[m]{a}$, reduced to the ſame radical ſign, become $\sqrt[nm]{a^m}$ and $\sqrt[nm]{a^n}$. If you are to reduce $\sqrt[2]{3}$ and $\sqrt[3]{2}$ to the ſame denominator, conſider $\sqrt[2]{3}$ as equal to $3^{\frac{1}{2}}$, and $\sqrt[3]{2}$ as equal to $2^{\frac{1}{3}}$, whoſe indices reduced to a common denominator, you have $3^{\frac{1}{2}}=3^{\frac{3}{6}}$, and $2^{\frac{1}{3}}=2^{\frac{2}{6}}$, and conſequently, $\sqrt[2]{3}=\sqrt[6]{3^3}=\sqrt[6]{27}$, and $\sqrt[3]{2}=\sqrt[6]{2^2}=\sqrt[6]{4}$, ſo that the propoſed ſurds $\sqrt[2]{3}$ and $\sqrt[3]{2}$ are reduced to other equal Surds $\sqrt[6]{27}$ and $\sqrt[6]{4}$, having a common radical ſign.

Surds of the ſame rational quantity are multiplied by adding their exponents, and divided by ſubtracting them; thus, $\sqrt[2]{a}\times\sqrt[3]{a}=a^{\frac{1}{2}}\times a^{\frac{1}{3}}=a^{\frac{3+2}{6}}=a^{\frac{5}{6}}=\sqrt[6]{a^5}$; and $\frac{\sqrt[3]{a}}{\sqrt[5]{a}}=\frac{a^{\frac{1}{3}}}{a^{\frac{1}{5}}}=a^{\frac{1}{3}-\frac{1}{5}}=a^{\frac{5-3}{15}}=a^{\frac{2}{15}}=\sqrt[15]{a^2}$; $\sqrt[m]{a}\times\sqrt[n]{a}=a^{\frac{m+n}{mn}}$; $\frac{\sqrt[m]{a}}{\sqrt[n]{a}}=a^{\frac{n-m}{mn}}$;

$\sqrt[2]{2}\times\sqrt[3]{2}=\sqrt[6]{2^5}=\sqrt[6]{3^2}$; $\frac{\sqrt[2]{2}}{\sqrt[3]{2}}=\sqrt[6]{2}$.

If the *Surds* are of different rational quantities, as $\sqrt[n]{a^2}$ and $\sqrt[n]{b^3}$, and have the ſame ſign, multiply theſe rational quantities into one another, or divide them by one another, and ſet the common radical ſign over their product or quotient. Thus,

$\sqrt[n]{a^2}\times\sqrt[n]{b^2}=\sqrt[n]{a^2b^3}$; $\sqrt[2]{2}\times\sqrt[2]{5}=\sqrt[2]{10}$; $\frac{\sqrt[m]{a^4}}{\sqrt[m]{b^3a}}=\sqrt[m]{\frac{a^4}{b^3a}}=\sqrt[m]{\frac{a^3}{b^3}}$; $\frac{\sqrt[3]{9}}{\sqrt[3]{24}}=\sqrt[3]{\frac{9}{24}}=\sqrt[3]{\frac{3}{8}}=\frac{1}{2}\sqrt[3]{3}$.

If *Surds* have not the ſame radical ſign, reduce them to ſuch as ſhall have the ſame radical ſign, and proceed as before;

$\sqrt[m]{a}\times\sqrt[n]{b}=\sqrt[nm]{a^nb^m}$; $\frac{\sqrt[m]{a}}{\sqrt[n]{x}}=\sqrt[mn]{\frac{a^n}{x^m}}$; $\sqrt[2]{2}\times\sqrt[3]{4}=2^{\frac{1}{2}}\times 4^{\frac{1}{3}}=2^{\frac{3}{6}}\times 4^{\frac{2}{6}}=\sqrt[6]{2^3\times 4^2}=\sqrt[6]{8\times 16}=\sqrt[6]{12}$; $\frac{\sqrt[3]{4}}{\sqrt[2]{2}}=\frac{4^{\frac{1}{3}}}{2^{\frac{1}{2}}}=\frac{4^{\frac{2}{6}}}{2^{\frac{3}{6}}}=\sqrt[6]{\frac{4^2}{2^3}}=\sqrt[6]{\frac{16}{8}}=\sqrt[6]{2}$.

If the Surds have any rational coefficients, their product or quotient muſt be prefixed; thus, $2\sqrt[2]{3}\times 5\sqrt[2]{6}=10\sqrt[2]{18}$.

The *Powers* of *Surds* are found as the powers of their quantities, by multiplying their exponents by the index of the power required; thus the ſquare of $\sqrt[3]{2}$ is $2^{\frac{1}{3}\times 2}=2^{\frac{2}{3}}=\sqrt[3]{4}$; the cube of $\sqrt[2]{5}=5^{\frac{1}{2}\times 3}=5^{\frac{3}{2}}=\sqrt[2]{125}$. Or you need only, in *involving Surds*, raiſe the quantity under the radical ſign to the power required, continuing the ſame radical ſign; unleſs the index of that power is equal to the name of the *Surd*, or a multiple of it, and in that caſe the power of the *Surd* becomes rational. *Evolution* is performed by dividing the fraction, which is the exponent of the *Surd*, by the name of the root required, Thus the ſquare root of $\sqrt{a^4}$ is $\sqrt[3]{a^2}$ or $\sqrt[6]{a^4}$.

The *ſurd* $\sqrt[m]{a^mx}=a\sqrt[m]{x}$; and, in like manner

ner, if a power of any quantity, of the ſame name with the *ſurd*, divides the quantity under the radical ſign without a remainder, as here a^m divides $a^m x$, and 25 the ſquare of 5, divides 75 the quantity under the ſign in $\sqrt[2]{75}$ without a remainder; then place the root of that power rationally before the ſign, and the quotient under the ſign, and thus the *ſurd* will be reduced to a more ſimple expreſſion. Thus $\sqrt[2]{75} = 5\sqrt{3}$; $\sqrt[2]{48} = \sqrt[2]{3 \times 16} = 4\sqrt[2]{3}$; $\sqrt[3]{81} = \sqrt[3]{27 \times 3} = 3\sqrt[3]{3}$.

When *ſurds* are reduced to their leaſt expreſſions, if they have the ſame irrational part, they are added or ſubtracted, by adding or ſubtracting their rational coefficients, and prefixing the ſum or difference to the common irrational part. Thus, $\sqrt[2]{75} + \sqrt[2]{48} = 5\sqrt{3} + 4\sqrt{3} = 9\sqrt{3}$; $\sqrt[3]{81} + \sqrt[3]{24} = 3\sqrt[3]{3} + 2\sqrt[3]{3} = 5\sqrt[3]{3}$; $\sqrt[2]{150} - \sqrt[2]{54} = 5\sqrt{6} - 3\sqrt{6} = 2\sqrt{6}$; $\sqrt{a^2 x} + \sqrt{b^2 x} = a\sqrt{x} + b\sqrt{x} = \overline{a+b} \times \sqrt{x}$.

Compound ſurds are ſuch as conſiſt of two or more joined together; the *ſimple ſurds* are commenſurable in power, and by being multiplied into themſelves, give at length rational quantities; yet *compound ſurds* multiplied into themſelves, commonly give ſtill irrational products. But, when any *compound ſurd*, is propoſed, there is another *compound ſurds* which, multiplied into it, gives a rational product. Thus if $\sqrt{a} + \sqrt{b}$ were propoſed, multiplying it by $\sqrt{a} - \sqrt{b}$, the product will be $a - b$.

The inveſtigation of that *ſurd*, which multiplied into the propoſed *ſurd*, gives a rational product, is made eaſy by three theorems, delivered by Mr *Mac'aurin*, in his *Algebra*, p. 109, ſeq. to which we refer the curious.

This operation is of uſe in reducing *ſurd* expreſſions to more ſimple forms. Thus ſuppoſe a *binominal ſurd*, divided by another, as $\sqrt[2]{20} + \sqrt[2]{12}$, by $\sqrt[2]{5} - \sqrt[2]{3}$, the quotient might be expreſſed by $\frac{\sqrt{20}+\sqrt{12}}{\sqrt{5}-\sqrt{3}}$. But this might be expreſſed in a more ſimple form, by multiplying both numerator and denominator, by that *ſurd*, which multiplied into the denominator, gives a rational product: thus, $\frac{\sqrt{20}+\sqrt{12}}{\sqrt{5}-\sqrt{3}} = \frac{\sqrt{20}+\sqrt{12}}{\sqrt{5}-\sqrt{3}} \times \frac{\sqrt{5}+\sqrt{3}}{\sqrt{5}+\sqrt{3}} = \frac{\sqrt{100}+2\sqrt{60}+6}{5-3} = \frac{16+2\sqrt{60}}{2} = 8+2\sqrt{15}$. To do this generally, ſee *Maclaurin*, ib. p. 113.

When the ſquare root of a *ſurd* is required, it may be found, nearly, by extracting the root of a rational quantity that approximates to its value. Thus to find the ſquare root of $3 + 2\sqrt{2}$, firſt calculate $\sqrt{2} = 1,41421$. Hence $3 + a\sqrt{2} = 5,82842$, the root of which is found to be nearly 2,41421.

In like manner we may proceed with any other propoſed root. And if the index of the root, propoſed to be extracted, be great, a table of logarithms may be uſed. Thus $\sqrt[7]{5 + \sqrt[13]{17}}$ may may be moſt conveniently found by *logarithms*.

Take the *logarithms* of 17, divide it by 13; find the number correſponding to the quotient; add this number to 5; find the *logarithm* of the ſum, and divide it by 7, and the number correſponding to this quotient will be nearly equal to $\sqrt[7]{5+\sqrt[13]{17}}$.

But it is ſometimes requiſite to expreſs the roots of ſurds exactly by other ſurds. Thus, in the firſt example the ſquare root of $3 + 2\sqrt{2}$ is $1 + \sqrt{2}$: for $\overline{1+\sqrt{2}} \times \overline{1+\sqrt{2}} = 1 + 2\sqrt{2} + 2 = 3 + 2\sqrt{2}$. For the method of performing this the curious may conſult Mr. *Maclaurin's Algebra*, p. 115, & ſeq.

BY FRACTION.

FRACTION is a part or parts of a number or quantity conſidered as an unit or integer.

There is ſo great an affinity between the proceſs in *fractions* of *algebraic* quantities, and in *arithmetical fractions*, that it will be neceſſary, before we proceed to the *algebraic* proceſs, to give a clear deſcription of *numerical fractions*, which are uſually divided into *decimal*, *ſexageſſimal* and *vulgar*; and each of theſe diviſions has a part called the *denominator*; another named the *numerator*.

The *denominator* of a *fraction* always repreſents an *integer*, and is the *number* or *letter* below the line $\frac{7}{12}$ or *ſeven twelfths*; where 12 is the *denominator*, and ſhews that the integer here is divided into 12 parts. Its real uſe is to ſhew what aliquot part the broken number has in common with unity.

The *numerator* is that part of the *fraction*, which expreſſes the parts to be taken out of the *integer*, and is placed above the line, thus $\frac{7}{12}$ where *ſeven* is the *numerator*, and ſhews that *ſeven twelfths* is the number of parts to be taken out of *twelve*.

Decimal fractions are thoſe, whoſe *denominator* is 1, with one, or more cyphers to the right of the

the unit, as 10, 100, 1000, 10,000, &c. thus $\frac{5}{10}$, $\frac{6}{100}$, $\frac{7}{1000}$, $\frac{8}{10,000}$ &c. are *decimal fractions.*

Note, When the cypher or cyphers are ſet on the left of the *integers*, as 0005, they have no value and ſerve only to fill up places, the whole making no more than *five* units.

Sexageſimal fractions are thoſe, whoſe *denominator* proceeds in a ſexagecuple ratio, or is always 60 or a multiple thereof. Theſe are ſometimes called *aſtronomical fractions*; in which the *denominator* is uſually omitted, as in 4°, $59'$, $32''$, $50'''$, $16''''$, where there is only the *numerator* ſet down, and we read thus 4 degrees, 59 minutes, 32 ſeconds of a degree, 50 thirds, 16 fourths, &c.

Vulgar fractions, or *ſimple fractions* are always expreſſed by two numbers thus $\frac{2}{3}$ where the *denominator* 3 ſhews that the whole line is ſuppoſed to be divided into *three* equal parts; and the *numerator* 2 indicates, or aſſigns two of ſuch parts.

If the *numerator* of a *fraction* is equal to its *denominator*, then the *fraction* is equal to unity. Thus

$\frac{4}{4}=1$ and $\frac{a}{a}$ or $\frac{b}{b}$ are likewiſe equal to unity.

If the *numerator* is greater than the *denominator*, then the *fraction* is greater than the unit. And in both theſe caſes the fraction is called *improper*. But if the *numerator* be leſs than the *denominator*, then the *fraction* is leſs than unit, and is called *proper*. Thus $\frac{5}{3}$ is an *improper fraction*; but $\frac{3}{4}$ or $\frac{2}{3}$ are *proper*.

There is alſo a mixt quantity, one part whereof is an *integer*, and the other a *fraction*; as, $3\frac{4}{5}$ and $5\frac{2}{3}$ and $a+\frac{a^2}{b}$

Problem I. To reduce a *mixt* quantity to an *improper fraction*, multiply the part that is an *integer* by the *denominator* of the *fractional* part; and, to the product, add the *numerator*; then place the former *denominator* under this ſum, and you will have the *improper fraction* required.

Thus, $2\frac{3}{5}$, reduced to an improper fraction, gives $\frac{13}{5}$; for $2\times5=10$, and $10+3=13$, which divided by the former denominator 5, gives $\frac{13}{5}$. In the ſame manner $4\frac{1}{2}$ gives $\frac{9}{2}$; and $a+\frac{a^2}{b}$ gives $\frac{ab+a^2}{b}$; and $a-x+\frac{a^2-ax}{x}=\frac{a^2-x^2}{x}$.

Problem II. To reduce an *improper fraction* to a *mixt* quantity, divide the *numerator* of the fraction by the *denominator*, and the quotient ſhall give the integral part; and the remainder, ſet over the *denominator*, ſhall be the *fractional* part. Thus, $\frac{12}{5}=2\frac{2}{5}$; $\frac{ab+a^2}{b}=a+\frac{a^2}{b}$; $\frac{ax+2xx}{a+x}=x+\frac{}{a}$ and $\frac{aa+xx}{a-x}=a+x+\frac{2xx}{a-x}$.

Problem III. To reduce fractions of *different denominations* to fractions of equal value, that ſhall have the ſame denominator; multiply each *numerator*, taken ſeparately, into all the *denominators* but its own, and the products ſhall give the new *numerators*: then multiply all the *denominators* into one another, and the product ſhall give the common *denominator*. Thus $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{4}{5}$ are reſpectively equal to $\frac{40}{60}$, $\frac{45}{60}$, and $\frac{48}{60}$; and $\frac{a}{b}$, $\frac{b}{c}$, and $\frac{c}{d}$ are reſpectively equal to $\frac{acd}{bcd}$, $\frac{bbd}{bcd}$, and $\frac{ccb}{bcd}$.

Problem IV. To *add* and *ſubtract* fractions, firſt reduce them to a common *denominator* (by *Probl.* III.) then *add* or *ſubtract* the *numerators*, and the ſum or difference ſet over the common *denominator*, will be the ſum or difference required. Thus, $\frac{2}{3}+\frac{3}{4}=\frac{8+9}{12}=\frac{17}{12}=1\frac{5}{12}$; and $\frac{3}{4}-\frac{2}{3}=\frac{9-8}{12}=\frac{1}{12}$. In the ſame manner, $\frac{a}{b}+\frac{c}{d}+\frac{e}{f}=\frac{adf+cbf+cbd}{bdf}$. $\frac{a}{b}-\frac{c}{d}=\frac{ad-cb}{bd}$; and $\frac{x}{2}-\frac{x}{3}=\frac{3x-2x}{6}=\frac{x}{6}$. See SUBTRACTION.

Problem V. To *multiply* fractions; let their *numerators* be multiplied into one another, to obtain a new *numerator*, and the *denominators* into one another, to obtain a new *denominator*; and the *numerator* and *denominator* ſo found will be the product required.

Thus, $\frac{2}{3}\times\frac{4}{5}=\frac{8}{15}$; and $\frac{1}{2}\times\frac{2}{3}=\frac{2}{6}=\frac{1}{3}$. In the ſame manner, $\frac{a}{b}\times\frac{c}{d}=\frac{ac}{bd}$; and $\frac{a+b}{c}\times\frac{a-b}{d}=\frac{a^2-b^2}{cd}$.

If a *mixt* quantity is to be multiplied, firſt reduce it to the form of a fraction (by *Prob.* I.) and if an *integer* is to be multiplied by a fraction, you may reduce it to the form of a fraction, by placing unit under it. Thus, $5\frac{2}{3}\times\frac{3}{4}=\frac{17}{3}\times\frac{3}{4}=\frac{51}{12}=4\frac{1}{4}$, (by *Prob.* II.) Alſo $9\times\frac{2}{3}=\frac{9}{1}\times\frac{2}{3}=\frac{18}{3}=6$; and, in the ſame manner, $b+\frac{bx}{a}\times\frac{a}{x}=\frac{ba+bx}{a}\times\frac{a}{x}=\frac{a^2b+abx}{ax}=\frac{ab+bx}{x}$.

Problem VI. To *divide* fractions; firſt multiply the *numerator* of the *dividend* by the *denominator* of the *diviſor*, and the product will be the *numerator*

of

or the quotient; then multiply the *denominator* of the dividend by the numerator of the diviſor, and their product will give the *denominator* of the quotient. Thus.

$\frac{4}{5})\frac{2}{3}(\frac{10}{12}$; $\frac{3}{7})\frac{5}{8}(\frac{35}{24}$; $\frac{c}{d})\frac{a}{b}(\frac{a\,d}{c\,b}$;

and $\frac{a+b}{a-b})\frac{a-b}{a}(\frac{a^2-a\,b+b^2}{a^2+a\,b}$.

Theſe laſt four problems are eaſily demonſtrated from the definition of a fraction. 1. It is obvious, that the fractions $\frac{a}{b}$, $\frac{c}{d}$, $\frac{e}{f}$, are reſpectively equal to $\frac{a\,d\,f}{b\,d\,f}$, $\frac{c\,b\,f}{b\,d\,f}$, $\frac{e\,b\,d}{b\,d\,f}$, ſince if you divide $a\,df$ by $b\,df$, the quotient will be $\frac{a}{b}$; $\frac{c\,b\,f}{d\,b\,f} = \frac{c}{b}$; and $\frac{e\,b\,d}{b\,d\,f} = \frac{e}{f}$.

2. Fractions reduced to the ſame denominator are added by adding their numerators and ſubſcribing the common denominator.

Thus, $\frac{a}{b}+\frac{c}{b}=\frac{a+c}{b}$; for call $\frac{a}{b}=m$, and $\frac{c}{b}=n$, and it will be $a=m\,b$, and $c=nb$; and $mb+nb=a+c$, and $m+n=\frac{a+c}{b}$; that is, $\frac{a}{b}+\frac{c}{b}$. After the ſame manner, $\frac{a}{b}-\frac{c}{b}=m-n=\frac{a-c}{b}$.

3. Again, $\frac{a}{b}\times\frac{c}{d}(=m\times n)=\frac{a\,c}{b\,d}$; for $b\,m = a$, $d\,n = c$; and $b\,d\,m\,n = a\,c$, and $m\,n = \frac{a\,c}{b\,d}$; that is, $\frac{a}{b}\times\frac{c}{d}=\frac{a\,c}{b\,d}$.

4. Laſtly, $\frac{a}{b}\div\frac{c}{d}$, or $\frac{m}{n}$, gives $\frac{a\,d}{c\,b}$; for $m\,b = a$, and $m\,b\,d = a\,d$; $n\,d = c$, and $n\,d\,b = c\,b$; therefore $\frac{m\,b\,d}{n\,d\,b}=\frac{a\,d}{c\,b}$; that is, $\frac{m}{n}=\frac{a\,d}{c\,b}$.

Problem VII. To find the *greateſt common meaſure* of two numbers; that is, the greateſt number that can divide them both without a remainder. *Firſt*, divide the greater number by the leſſer, and if there is no remainder, the leſſer number is the greateſt common *diviſor* required. If there is a remainder, divide your laſt diviſor by that remainder; and thus proceed, continually dividing the laſt diviſor by its remainder, till there is no remainder left; and then the laſt diviſor is the greateſt common meaſure required. Thus, the greateſt common meaſure of 45 and 63 is 9; and the greateſt common meaſure of 256 and 48, is 16, as appears from the operation at large.

```
45)63(1                  48)256(5
   45                        240
   --                        ---
   18)45(2                   16)48(3
      36                        48
      --                        --
       9)18(2                   00
         18
         --
         00
```

Much after the ſame manner, the greateſt common meaſure of *algebraical* quantities is diſcovered; only the remainders that ariſe in the operation are to be divided by their ſimple diviſors, and the quantities are always to be ranged according to the dimenſions of the ſame letter. Thus, to find the *greateſt common meaſure* of $a^2 - b^2$ and $a^2 - 2\,a\,b^2$, the operation is thus:

$$
\begin{array}{l}
a^2 - b^2)\; a^2 - 2\,a\,b + b^2\,(1 \\
\qquad\quad\; \underline{a^2 - b^2} \\
\qquad\quad\; -2\,a\,b + 2\,b^2 \text{ remainder, which di-}
\end{array}
$$

vided by $-2\,b$ is reduced to

$$
\begin{array}{l}
a - b)\; a^2 - b^2\,(a + b. \\
\qquad\;\; \underline{a^2 - b^2} \\
\qquad\;\; 0 \quad 0
\end{array}
$$

Therefore, $a-b$ is the greateſt common meaſure required.

The ground of this operation is, that any quantity that meaſures the diviſor and the remainder (if there is any) muſt alſo meaſure the dividend; becauſe the dividend is equal to the ſum of the diviſor multiplied into the quotient, and of the remainder added together. Thus, in the laſt example, $a-b$ meaſures the diviſor a^2-b^2, and the remainder $-2\,a\,b+2\,b^2$; it muſt therefore likewiſe meaſure their ſum $a^2 - 2\,a\,b + b^2$.

You muſt obſerve, in this operation, to make that the *dividend*, which has the higheſt powers of the letter, according to which the quantities are ranged

Problem VIII. To *reduce* any fraction to its *loweſt terms:* find the greateſt common meaſure of the *numerator* and *denominator*; divide them by that common meaſure, and place the *quotients* in their room, and you ſhall have a fraction, equivalent to the given fraction, expreſſed in the loweſt terms. Thus $\frac{3}{9}$ is reduced to $\frac{1}{3}$, by dividing the numerator and denominator by the greateſt common meaſure 3. In the ſame manner $\frac{20}{25} = \frac{4}{5}$ for $\frac{20}{5} = 4$, and $\frac{25}{5} = 5$.

In algebraical terms, the operation is thus: $\frac{25\,b\,c}{25\,b\,c})\frac{75\,a\,b\,c}{125\,b\,c\,x}=\frac{3\,a}{5\,x}$; which is found by by rejecting the *diviſor* (as being nothing) rejecting the letters $b\,c$ of the *dividend* (as being common to *numerator* and *denominator*) and *dividing* the *co-efficients*

efficients 75 and 125 by their greateſt common meaſure 25; the reſult of which is $\frac{3a}{5x}$. In the ſame manner, $\frac{156\,a^2 + 156\,ab}{572\,a^2 - 572\,ab} = \frac{3a + 3b}{11\,a - 11\,b}$; $\frac{a^2 - b^2}{a^2 - 2ab + b^2} = \frac{a+b}{a-b}$; $\frac{a^3\,b^2\,a}{a^2 + 2ab + b^2} = \frac{a^2 - ba}{a+b}$; and $\frac{a^4 - b^4}{a^5 - a^3\,b^2} = \frac{a^2 + b^2}{a^3}$.

When *unit* is the greateſt common meaſure of the numbers and quantities, then the fraction is already in its *loweſt terms.* Thus, $\frac{3ab}{3dc}$ cannot be reduced lower. It ought alſo to be remarked, that numbers whoſe greateſt common meaſure is unit, are ſaid to be *prime* to each other.

If it is required to reduce a given fraction to a fraction equal to it, that ſhall have a given *denominator*; you muſt multiply the *numerator* by the given *denominator*, and divide the product by the former *denominator*; and this quotient, ſet over the given *denominator* will be the fraction required. Thus, if it were required to reduce $\frac{2}{3}$ to an equal fraction, whoſe denominator ſhall be 6; find the quotient of $\overline{2 \times 6} - 3 = 4$, then will $\frac{4}{6}$ be the fraction required. In the ſame manner, $\frac{a}{b}$ is reduced to an equal fraction, which has the denominator c, *viz.* $\frac{ac - b}{c}$; for rejecting c out of both numerator and denominator, there remains $a \div b = \frac{a}{b}$.

Beſides the common notion of a *fraction* there is this alſo to be conſidered.

Suppoſe $\frac{3}{4}$ of 20 *s.* or a pound *ſterling*, were the fraction; this fraction, inſtead of three quarters of a pound may be conſidered as a 4th part of *three* pounds, i e. by taking as many of the integers as the *numerator* expreſſes, *viz* 3, and dividing them by 4 the *denominator*, for then inſtead of 4 there will ariſe 60*s.* the quotient of the ſame value will ariſe for 4) 60*s.* (15*s.* which ſhews the reaſon of the manner of expreſſing uſed by *Geometers* and *Algebraiſts*, who read $\frac{a}{b}$ thus as divided by b.

By Equation.

Equation is the expreſſion of the ſame quantity in two different, i. e. diſſimilar, but *equal* terms or denominations; Thus 2, $3 = 4 + 2$, or twice three is equal to four and two. And *Stifelius* defines it, the ratio of equality between two quantities *differently* denominated; Thus 3 ſhillings $= 36$ pence, or 50 *ſh* $= 2$ *l.* 10 *s.* $= 600$ pence $= 2400$ farthings; or, $6 = d + c$; or $12 = a - p$, &c.

Hence, the reduction of two heterogeneous, or diſſimilar quantities to the ſame value, i e. to an equality is called *the bringing them to an equation*, i. e. The bringing the ſeveral mediate *equations* to a final one.

But before we ſhew how this is to be done it will be neceſſary to be informed ſomewhat concerning the terms, root and diviſion of an *equation.*

The *terms* are the quantities or parts that compoſe the *equation*, and are connected by the ſigns + and —; as, $b + c = d$, where b, c, d are the terms, and ſhew that what is repreſented by d is equal to the two quantities b and c.

The *root* of an equation is the value of its unknown quantity; as, in $a^2 + b^2 = x^2$; the root will be $\sqrt{(a^2 + b^2)}$

Equations, in regard to the powers of unknown quantities are divided into *ſimple*, *quadratic*, *cubic*, *biquadratic*, &c.

In *ſimple equation* the unknown quantity is only of one dimenſion, or in the firſt power, as $x = (a + b) : 2$.

In the *quadratic* the unknown quantity is in the ſecond power, as $x^2 = a^2 + b^2$.

In the *cubic*, it is in the 4th power, as, $x^3 = -a^3\,b^3$, &c.

In the *biquadratic*, it is in the 4th power; as $x^4 = a^4 - b^4$.

Equations are (1) thoſe *ultimate concluſions* we arrive at in the ſolution of *problems*; or (2) the *means* to obtain thoſe final reſolutions.

The firſt ſort conſiſts only of one unknown quantity, intermixed with other quantities.

The other kind conſiſts of ſeveral unknown quantities to be compared, and connected together, till there ariſes a *new* equation, in which the unknown quantity ſought is mixt with the known.

To perform this, or to *ſolve queſtions* by *equations* you muſt obſerve.

1ſt. That all *equations* have as many *affirmative roots*, as there are permutations of ſigns; and as many *negative roots*, as there are ſucceſſions of them; as, in the *quadratic* $x^2 + x - 6 = 0$, there is only one ſucceſſion of ſigns + +, and one permutation of them, + —; hence the *equation* has *two* roots, one *affirmative* + 2. and the other *negative* — 3. Alſo in the *cubic* $x^3 - 3x^2 - 10x + 24 = 0$ there are two permutations of ſigns + — and — +; and only one ſucceſſion — —; hence its *roots* are two *affirmative* + 2 and + 4, and only one *negative* — 3.

2. That the ſeveral quantities and ſigns be properly ſet down and expreſſed.

3. That the quantities thus denoted be brought to an equation.

4. That the equation be reduced to its loweſt and ſimpleſt terms.

5. That the equation be conſtructed or repreſented in geometrical lines.

For a queſtion or problem being propoſed, you are to conceive the thing required, as already done, *i.e.* to form a clear conception of the conditions and nature of it, and to expreſs it by one of the laſt letters of the alphabet x, y, or z, noting the known quantities by the letters that begin the alphabet b, c, d, &c.

Then, by due reaſoning from the conditions of the queſtion, let the quantities concerned therein be juſtly ſtated, and carefully compared; ſo that their *relation* to one another may appear, and the *difference*, which renders them unequal, be diſcovered; and conſequently, the ſame thing found expreſſible two ways, or brought into an equation, or ſeveral equations independent on each other. And Here again it is to be obſerved,

1. That if there are as many equations given, as there are quantities ſought, then the queſtion has a determinate number of ſolutions, or is truly limited, *viz.* each quantity ſought hath but one ſingle value. Thus,

Suppoſe a queſtion propoſed concerning the age of *three* perſons, was conditioned as follows, *viz.* the *ſecond* is *ſeven years* older than the *firſt*, the age of the *third* is *triple* that of the *firſt* and *ſecond*, and the ſum of all their ages is 68. Required the age of each.

In order to bring this queſtion to an equation, put z for the age of the *firſt*; then will the age of the *ſecond* be $z+7$, and the age of the *third* $6z+12$: the ſum of all their ages $z+z+7+6z+21=68$. So that here is but one equation given, and one quantity required, *viz.* the age of the firſt.

2. When the number of the quantities ſought *exceed* the number of the given equations, the queſtion is capable of an indeterminate number of anſwers; and, therefore, can be but imperfectly determined. If the queſtion when ſtated, is found to have a determinable number of ſolutions, then the *equation*, directly drawn from the conditions of the queſtion, muſt be *reduced* into another, by equal augmentation and diminution; ſo that the known quantities may ſtand on one ſide, and one of the unknown quantities, or ſome power of it, on the other ſide of the equation. This is called *reduction of equations*, and depends upon a right application of the five following *axioms:*

1. If equal quantities be added to equal quantities, the ſum of thoſe quantities will be equal.

2. If equal quantities be ſubtracted or taken from equal quantities, the quantities remaining will be equal.

3. If equal quantities be multiplied by equal quantities, their products will be equal.

4. If equal quantities be divided by equal quantities, their quotients will be equal.

5. Quantities that are equal to one and the ſame thing, are alſo equal to one another.

If theſe axioms be well underſtood, the reduction of equations will appear very plain, and the operations be eaſily performed.

1. *Reduction* by *tranſpoſition*, is performed by transferring a quantity to the other ſide of the equation with a contrary ſign; or by equal addition, if the quantity be negative; and by equal ſubtraction, if affirmative. Thus, the *equation* $x-10=40$, is reduced by adding $+10$ to each ſide, and the reſult will be the ſame as if -10 had been tranſpoſed to the oppoſite ſide with the contrary ſign; for $x-10+10=40+10$, is the ſame with $x=40+10$, the -10 and $+10$ deſtroying each other. In the ſame manner $x+10=40$, is reduced to $x=40-10$, by tranſpoſing the $+10$ with a contrary ſign.

2. *Reduction* is performed by equal *multiplication*, in caſe there are fractional quantities; for by multiplying every term in the equation by the denominators of the fractions, it will be cleared of fractions: thus, by multiplying every term of the equation $\frac{z}{a}=b$ by the denominator a, we will have $z=ab$. Again, if $\frac{z^3+3a^2}{c}+n+a=z+a$; then by multiplying by the denominator c, we will have an *equal equation* free from fractions, *viz.* $z^3+3a^2+cn+ac=c+ac$, or $z^3+3a^2+cn=cz$, the ac on each ſide being rejected.

3. By equal *diviſion*, as in the equation $ax=c$; for by dividing each ſide by a, we will have $x \left(\text{or } \frac{ax}{a}\right)=\frac{c}{a}$. In the ſame manner, in the equation $az+ez=cb$, by dividing each ſide by $a+e$, we get the equation $z=\frac{cb}{a+e}$.

4. *Equations* are cleared of *ſurd* quantities by *involution:* thus, if the equation be $\sqrt{a}=6$; then by *involution* or ſquaring each ſide of the equation, we have the equation $a=36$. If both ſides be ſimilar *ſurds*, or of the ſame power, all that we have to do is to reject the radical ſign: thus, for $\sqrt{a}=\sqrt{d+c}$, we write $a=d+c$, rejecting the radical ſign of both.

5. When any ſingle power of the unknown quantity is on one ſide of the equation, evolve or extract the root of both ſides, according as the index of that power denotes, and their roots will be

be equal. Thus, if $zz=25$, by extracting the root of each ſide we have $z=5$. In the ſame manner if $aaa=27$, their cube roots will be equal, *viz.* $a=3$. Or, if any compound power of the unknown quantity be on one ſide of an equation, that hath a true root of its kind; then, by *evolving* both ſides of the equation it will be expreſſed in lower terms: thus, $a^2+2ba+b^2=d^2$, by *evolving* both ſides, comes out $a+b=d$.

6. A *proportion* may be converted into an equation, aſſerting the product of the extremes to be equal to that of the means; or, any one of the extremes may be made equal to the product of the means divided by the other extreme: thus, if $12-x:\frac{x}{2}::4:1$, then $12-x=2x$; and by tranſpoſing the $-x$, we will have $3x=12$, and dividing by 3, $x=\frac{12}{3}=4$, by the preceding rules.

7. If any quantities be found on both ſides of the equation, with the ſame ſign prefixed, they may be taken away from both: thus, for $3x+b=a+b$, we ſay $3x=a$. Alſo, if all the quantities of the equation be multiplied or divided by the ſame quantity, it may be ſtruck out of them all: thus, if $3ax+5ab=8ac$, dividing by a, we have $3x+5b=8c$; and tranſpoſing $5b$ and dividing by 3, we have $x=\frac{8c-5b}{3}$, according to the firſt and third rules.

8. Inſtead of any quantity in an equation, you may ſubſtitute another equal to it: thus, if $3x+y=24$, and $y=9$; then $3x+9=24$, or $x=\frac{24-9}{3}=5$.

To ſolve Simple EQUATIONS.

1. After an equation is formed, if you have only one unknown quantity, then, by the preceding rules, you bring it to ſtand alone on one ſide, ſo as to have none but known quantities on the other ſide; by which means you will diſcover its value. Thus, if the queſtion propoſed be that of the three perſons ages already mentioned, the equation thence reſulting has been found to be as in

Example I.

By queſt.	1	$z+z+7+6z+21=68$
1 tranſp.	2	$8z=68-28=40$
$2\div 8$	3	$z=\frac{40}{8}=5=$ firſt age.
Hence	4	$z+7=12=$ ſecond age.
And	5	$12+5\times 3=51=$ third age.

Example II.

$$\frac{3x}{4}\times\frac{x}{12}=x$$

$$\frac{3x^2}{48}=x$$

and $3x^2=48x$ by the ſecond rule.

and $3x=18$ by the ſeventh rule.

and $x=\frac{48}{3}=16$ by the third rule.

2. If there are two unknown quantities, then there muſt be two equations ariſing from the conditions of the queſtion; ſuppoſe x and y. The rule is, to find a value of x or y from each of the equations, and then by putting theſe two values equal to each other, there will ariſe a new equation involving only one unknown quantity, which muſt be reduced by the ſame rules as formerly.

Example.

Let the ſums of two quantities be s, and their difference d; let s and d be given and let it be required to find the quantities themſelves.

Suppoſe the quantities to be x and y; then, by the queſtion, $x+y=s$, and $xy=d$; whence $x=s-y=d+y$; and, by tranſpoſition, $2y=s-d$; ſo that dividing by 2, we have $y=\frac{s-d}{2}$; and by comparing the value of x, viz. $s-y$, we find $x=s-\frac{s+d}{2}$, or $2x=2s-s+d$, and dividing by 2, the value of $x=\frac{s+d}{2}$, as expreſſed in this form.

$$\begin{aligned} x+y&=s\\ x-y&=d\\ \hline x&=s-y\\ x&=d+y\\ s-y&=d+y\\ 2y&=s-d\\ y&=\frac{s-d}{2}\\ x&=\frac{s+d}{2} \end{aligned}$$

3. When in one of the given equations, the unknown quantity is of one dimenſion, and in the other of a higher dimenſion; you muſt find a value of the unknown quantity from that equation where it is of one dimenſion, and then raiſe that value to the power of the unknown quantity in the other equation; and by comparing it, ſo involved, with the value you deduce from that other equation, you will obtain an equation that will have only one

unknown quantity and its powers: that is, when you have two equations of different dimenſions, if you cannot reduce the higher to the ſame dimenſion with the lower, you muſt raiſe the lower to the ſame dimenſion with the higher.

Example.

The ſum of two quantities, and the difference of their ſquares, being given, to find the quantities themſelves. Suppoſe them to be x and y, their ſum s, and the difference of their ſquares d. Then,

$$x+y=s$$
$$x^2-y^2=d$$
$$x=s-y$$
$$x^2=s^2-2sy+y^2$$
$$x^2=d+y^2, \text{ whence}$$
$$d+y^2=s^2-2sy+y^2$$
$$d=s^2-2sy$$
$$2sy=s^2-d$$
$$y=\frac{s^2-d}{2s}$$
$$\text{and } x=\frac{s^2+d}{2s}$$

4. If there are three unknown quantities, there muſt be three equations in order to determine them, by comparing which you may, in all caſes, find an equation involving only one unknown quantity; which may be reſolved by the rules for reduction of equations already mentioned.

From three equations involving any three unknown quantities, x, y, and z, to deduce two equations involving only two unknown quantities, the following rule will always ſerve: find three values of x from the three given equations; then, by comparing the firſt and ſecond value, you will find another equation involving only y and z: again, by comparing the firſt and third, you will find another equation involving only y and z; and, laſtly, thoſe equations are to be ſolved by the ſecond direction:

Example: ſuppoſe

$$\left.\begin{array}{l} x+y+z=12 \\ x+2y+3z=20 \\ \frac{x}{3}+\frac{y}{2}+z=6 \end{array}\right\} \text{then } x=\left\{\begin{array}{l} 12-y-z \\ 20-2y-3z \\ 18-\frac{3y}{2}-3z \end{array}\right\}\left\{\begin{array}{l} \text{firſt} \\ \text{ſecond} \\ \text{third} \end{array}\right\}\text{value}$$

$$12-y-z=20-2y-3z$$
$$12-y-z=18-\frac{3y}{2}-3z$$

These two laſt equations involve only y and z, and are to be reſolved by the ſecond direction. Thus.

$$\left\{\begin{array}{l} 2y-y+3z-z=20-12=8 \\ y+2z=8 \end{array}\right.$$
$$\left\{\begin{array}{l} 36-3y-6z=24-2y-2z \\ 12=y+4z \end{array}\right.$$
$$\text{whence } y=\left\{\begin{array}{l} 8-2z \text{ firſt} \\ 12-4z \text{ ſecond} \end{array}\right\}\text{value}$$
$$\text{and } 8-2z=12-4z$$
$$2z=12-8=4$$
$$z=\tfrac{4}{2}=2$$
$$y\ (=8-2z)=4$$
$$x\ (=12-y-z)=6$$

This method is general, and will extend to all equations that involve three unknown quantities; but there are often eaſier and ſhorter methods, to deduce an equation, involving only one unknown quantity, which is beſt learned from practice.

To ſolve quadratic EQUATIONS.

1. If, after the equation is reduced, as directed above, and the unknown quantity brought to ſtand on one ſide, it is found to be a ſimple ſquare power, all that you have to do is to evolve both ſides of the equation, by which means you will find the value of the ſimple unknown quantity. Thus, if $xx=36$; then, by evolution or extraction, $x=6$. As before.

2. In the ſolution of any queſtion, where you have got an equation that involves only one unknown quantity, but involves at the ſame time the ſquare of that quantity, and the product of it multiplied by ſome known quantity; then you have what is called an *adfected quadratic equation*, which may be reſolved by the following rules:

1. Tranſpoſe all the terms that involve the unknown quantity to one ſide, and the known terms to the other ſide of the equation.

2. If

2. If the ſquare of the unknown quantity is multiplied by any coefficient, you are to divide all the terms by that coefficient, that the coefficient of the ſquare of the unknown quantity may be unit.

3. Add to both ſides the ſquare of half the coefficient prefixed to the unknown quantity itſelf, and the ſide of the equation that involves the unknown quantity will then be a complete ſquare.

4. Extract the ſquare root from both ſides of the equation, which you will find, on one ſide, always to be the unknown quantity with half the foreſaid coefficient ſubjoined to it; ſo that by tranſpoſing this half, you may obtain the value of the unknown quantity expreſſed in known terms.

Example.

Suppoſe the *quadratic* to equation be,

$$y^2+ay=b$$

Add the ſquare of $\frac{a}{2}$ to both ſides, $\quad y^2+ay+\frac{a^2}{4}=b+\frac{a^2}{4}.$

Extract the root, $\quad y+\frac{a}{2}=\pm\sqrt{b+\frac{a^2}{4}}.$

Tranſpoſe $\frac{a}{2}$, and $\quad y=\sqrt{b+\frac{a^2}{4}}-\frac{a}{2}.$

Here is to be obſerved, that the ſquare root of any quantity, as $+a^2$, may be $+a$, or $-a$; and hence all *quadratic* equations admit of two ſolutions. Alſo, ſince the ſquares of all quantities are poſitive, it is evident that the ſquare root of a negative quantity is imaginary, and cannot be aſſigned.

However, the following examples will illuſtrate the rules for quadratic equations.

Example I.

The ſum of two quantities is 32, and their product 240; required the quantities themſelves. Suppoſe them to be x and y; then

$$x+y=32;\ \text{and}\ x=32-y$$
$$xy=240;\ \text{and}\ x=\frac{240}{y}$$

therefore $32-y=\frac{240}{y}$

and $32y-y^2=240$

tranſpoſe, $y^2-32y=-240$

add 16^2, $y^2-32y+256=-240+256$

extract $\sqrt{}$, $y-16=\pm\sqrt{16}$

and $y=\pm\sqrt{16}+16=20$

$x\ (=32-y)=12$

Example II.

Three merchants join ſtocks; the ſtock of the firſt was leſs than that of the ſecond by 13 *l.* and the ſum of the ſecond and third man's ſtock amounted to 175 *l.* In trading they gained 48 *l.* more than their whole ſtock was; and the firſt man's ſhare of the gain was 78 *l.* required each man's ſtock and ſhare of the gain?

Suppoſe	1	x, y, z, to repreſent each man's ſtock,
Then	2	$x+y+z=s=$ the whole ſtock,
	3	$s+48=$ the whole gain.
By the queſtion	4	$x+13=y$
	5	$y+z=175$
$5+x$	6	$x+y+z=175+x$
2, 6	7	$s=175+x$
7, 3	8	$s+48=223+x$
By the queſtion	9	$175+x:223+x::x:78$
$9\times$	10	$x^2+223x=78x+13650$
$10-78x$	11	$x^2+145x=13650$
11 □	12	$x^2+145x+5256,25=18906,25$
12 ω^2	13	$x+72,5=\sqrt{18906,25}=137,5$
$13-72,5$	14	$x=137,5-72,5=65$
14, 4	15	$y=x+13=78$
5, 15	16	$z=175-y=97$
Then	17	$65+78+97+48=288$ the whole gain
And	18	y's gain $=93\,l.\ 12\,s.$ and z's $=116\,l.\ 8\,s.$

To solve cubic EQUATIONS.

The second term of a cubic equation can be taken away, so that it will be transformed to this form $x^3 * + qx + r = 0$.

Let us suppose that $x = a + b$; and $x^3 + qx + r = a^3 + 3a^2b + 3ab^2 + b^3 + qx + r = a^3 + 3ab \times \overline{a+b} + b^3 + qx + r = a^3 + 3abx + b^3 + qx + r =$ (by supposing $3ab = -q$) $a^3 + b^3 + r = 0$. But $b = -\frac{q}{3a}$, and $b^3 = -\frac{q^3}{27a}$, and consequently $a^3 - \frac{q^3}{27a^3} + r = 0$; or, $a^6 + ra^3 = \frac{q^3}{27}$. Suppose $a^3 = z$; and you have $z^2 + rz = \frac{q^3}{27}$; which is a *quadratic*, the resolution whereof gives

$$z = -\tfrac{1}{2}r \pm \sqrt{\tfrac{1}{4}r^2 + \frac{q^3}{27}} = a^3, \text{ and}$$

$$a = \sqrt[3]{-\tfrac{1}{2}r \pm \sqrt[2]{\tfrac{1}{4}r^2 + \frac{q^3}{27}}};$$

$$x = a + b = a - \frac{q}{3a} = \sqrt[3]{-\tfrac{1}{2}r \pm \sqrt[2]{\tfrac{1}{4}r^2 + \frac{q^3}{27}}} - \frac{q}{3 \times \sqrt[3]{-\tfrac{1}{2}r \pm \sqrt[2]{\tfrac{1}{4}r + \frac{q^3}{27}}}}.$$

in which expressions there are only known quantities: and this method is commonly called *Cardan*'s rule.

But when, in a *cubic* equation $x^3 - qx \pm r$, q is s negative; in this case the expression $\sqrt{\frac{1}{4}r^2 + \frac{1}{27}q^3}$, will be transformed into $\sqrt{\frac{1}{4}r^2 - \frac{1}{27}q^3}$; which root becomes impossible, or imaginary, when $\frac{1}{27}q^3$ is greater than $\frac{1}{4}r^2$, as being the square root of a negative quantity. And yet, even in this case, the root x may be a real quantity; though *algebraists* have not, hitherto, been able to find a real expression of its value.

Again, any *cubic equation* may be reduced to this form, and the value of x discovered without exterminating the second term.

$$\left.\begin{array}{r} x^3 - 3px^2 - 3qx - 2r \\ +3p^2x - p^3 \\ +pq \end{array}\right\} = 0; \text{ which}$$

by supposing $x = z + p$, will be reduced to $z^3 * - 3qz - 2r = 0$, in which the second term is wanting. But, from what is advanced above, it follows that $z = \sqrt[3]{r + \sqrt{r^2 - q^3}} + \sqrt[3]{r - \sqrt{r^2 - q^3}}$ = (if you suppose that the *cubic* root of the binomial $r + \sqrt{r^2 - q^3}$ is $m + \sqrt{n}$) $= m + \sqrt{n} + m - \sqrt{n} = 2m$. And, since $x = z + p$, it follows that $x = p + 2m$. But, as the *square root* of any quantity is twofold, so the *cubic root* is threefold, and can be expressed three different ways.

Example I.

Let it be required to find the roots of the equation $x^3 - 12x^2 + 41x - 42 = 0$.

Comparing the coefficients of this equation with these of the general equation, *viz.*

$$x^3 - 3px^2 \left.\begin{array}{r} -3q \\ +3p^2 \end{array}\right\} x \left.\begin{array}{r} -2r \\ -p^3 \\ +3pq \end{array}\right\} = 0, \text{ you}$$

will find $3p = 12$, so that $p = 4$; $3p^2 - 3q$ $(= 48 - 3q) = 41$, so that $q = \frac{7}{3}$; and $3pq - p^3 - 2r$ $(= -36 - 2r) = 42$ so that $r = 3$. And consequently $r^2 - q^3 = 9 - \frac{343}{27} = -\frac{100}{27}$, and $r + \sqrt{r^2 - q^3} = 3 + \sqrt{-\frac{100}{27}}$. Now the cubic root of this binominal is found to be $-1 + \sqrt[2]{-\frac{1}{3}}$ $(= m + \sqrt{n})$; whence

$$1°.\ x = p + 2m = 4 - 2 = 2,$$
$$2°.\ x = p - m - \sqrt{-3n} = 4 + 1 - \sqrt{4} = 5 - 2 = 3.$$
$$3°.\ x = p - m + \sqrt{-3n} = 5 + 2 = 7$$

So that the three roots of the proposed equation are 2, 3, and 7.

To solve Biquadratic EQUATIONS.

The roots of these may be found by reducing them to cubic ones, thus:

Let the second term be taken away,

And let the equation that results, be $x^4 * + qx^2 + rx + s = 0$. Suppose this biquadratic to be the product of these two quadratic questions.

$$x^2 + ex + f = 0.$$
$$\underline{x^2 - ex + g = 0.}$$
$$x^4 * \left.\begin{array}{r} +f \\ +g \\ -e^2 \end{array}\right\} \times x^2 \left.\begin{array}{r} +eg \\ -ef \end{array}\right\} \times x + fg = 0.$$

Where e is the coefficient of x in both equations, but affected with contrary signs; because when the second term is wanting in an equation, the sum of the affirmative roots must be equal to the sum of the negative.

Compare now the proposed equation with the above product, and the respective terms put equal to each other, will give $f + g - e^2 = q$, $eg - ef = r$, and $fg = s$. Whence it follows, that $f + g = q + e^2$, and $g - f = \frac{r}{e}$; and consequently, $f + g$

+ g

$+ g - f (= 2g) = q + e^2 + \frac{r}{e}$, and $g = \frac{q + e^2 + \frac{r}{e}}{2}$.

In the ſame manner you will find, by ſubtraction, &c. $f = \frac{q + e^2 - \frac{r}{e}}{2}$, and $f \times g\ (= s) = \overline{\tfrac{1}{4} \times q^2 + 2\,q\,e^2 + e^4 - \frac{r^2}{e^2}}$; and, multiplying by $4\,e^2$, and ranging the terms, you have this equation, $e^6 + 2\,q\,e^4 + \overline{q^2 - 4s} \times e^2 - r^2 = 0$.

Suppoſe $e^2 = y$, and it becomes $y^3 + 2\,q\,y^2 + \overline{q^2 - 4s} \times y - r^2 = 0$, an equation whoſe roots are to be diſcovered by the method of reſolving *cubic equations.*

Then the values of y being found, their ſquare roots will give e (ſince $y = e^2$;) and having e, you will find f and g, from the equations $f = \frac{q + e^2 - \frac{r}{e}}{2}$, and $g = \frac{q + e^2 + \frac{r}{e}}{2}$.

Laſtly, extracting the roots of the roots of the equations $x^2 + ex + f = 0$, and $x^2 - ex + g = 0$, you will find the four roots of the biquadratic $x^4 * + q\,x^2 + r\,x + s = 0$; for either $x = -\frac{1}{2}\,e \pm \sqrt{\tfrac{1}{4}\,e^2 - f}$, or $x = +\frac{1}{2}\,e \pm \sqrt{\tfrac{1}{4}\,e^2 - g}$.

Or you may find the roots of a *biquadratic,* without taking away the ſecond term.

Example.

Suppoſe it to be of this form,

$$x^4 - 4\,p\,x^3 \left.\begin{matrix} -2\,q \\ +4\,p^2 \end{matrix}\right\} x^2 \left.\begin{matrix} -8\,r \\ +4\,p\,q \end{matrix}\right\} x \left.\begin{matrix} -4s \\ +q^2 \end{matrix}\right\} = 0.$$

then the values of x will be

$$\left.\begin{matrix} x = p - a \pm \sqrt{p^2 + q - a^2 - \frac{2r}{a}} \\ \text{and } x = p + a \pm \sqrt{p^2 + q - a^2 + \frac{2r}{a}} \end{matrix}\right\}$$

where a^2 is equal to the root of the cubic equation

$$\left.\begin{matrix} y^3 - p^2 \\ -q \end{matrix}\right\} y^2 \left.\begin{matrix} +2\,p\,r \\ +s \end{matrix}\right\} y - r^2 = 0.$$

By Fluxion.

Fluxion denotes the velocity by which the the *fluents* or *flowing* quantities increaſe or decreaſe: So that all this doctrine may be conſidered as poſitive, or negative; according as it relates to an improvement or decrement.

Foreigners uſually define the method of *fluxions.* The arithmetic, or analyſis of infinitely, or rather indefinitely, ſmall variable quantities; or, the method of finding an infinite ſmall or an indefinitely ſmall quantity, which being taken, an infinite number of times, becomes equal to a given quantity.

Sir *Iſaac Newton* and his followers call theſe infinitely ſmall quantities, *moments*; as conſidering them the momentary increments and decrements of variable quantities of a *line* or a *ſurface,* &c. conſidered as generated by the flux of a *point,* or by the flux of a *line.*

Hence the variable quantities are called *fluent,* or flowing quantities; and the method of finding either the *fluxion* or *fluent,* is the method of *fluxions.*

M. *Leibnitz* conſiders the ſame infinitely ſmall quantities as the differences of two quantities, and names the moments of finding thoſe differences, the *differential calculus.*

Both theſe ways of conſidering and denominating have their advantages. But there is not only a difference in the name but alſo in the notation.

Sir *Iſaac Newton* expreſſes the *fluxion* of a quantity, as, x by a, a dot being placed over it, as $\dot{x}$.

M. *Leibnitz* expreſſes the differential of the ſame x by prefixing *a d,* as, $d\,x$. Both of which notations have their advantage likewiſe.

In all other reſpects the two methods practiſed by the followers of *Newton* and *Leibnitz,* are the ſame.

The advantages derived from this doctrine of *fluxions* are moſt ſublime. It opens a new world, and extends our knowledge, as it were to infinity, or beyond the bounds that ſeemed to be deſcribed to the human mind.

A diſcovery reſerved by the Almighty for the latter ages of the world; yet, though of ſo modern a date as within the memory of man, it is not clear to whom we are indebted for its invention. Sir *Iſaac Newton* and M. *Leibnitz* ſeparately lay in their claim for the honour. Let the reader from the facts before him determine to whom the merit of ſo noble a diſcovery is due.

M. *Leibnitz* in 1684 gave the rules for *fluxions* in the *Acta Lipſienſia,* or literary tranſactions of the univerſity of *Leipſic* for that year, without publiſhing the demonſtrations.

This ſet the learned world to work; and the two brothers, the *Benoulli,* never reſted till they conquered the difficulty, found the demonſtrations, and practiſed them with ſurpriſing ſucceſs.

Nor was it till the year 1687 that Sir *Iſaac Newton* attempted any thing, this way, in public. In that year he publiſhed his admirable *Principia,* which is almoſt wholly founded on the ſame *calculus.*

It does not appear that either of theſe great men arrogated any peculiar claim to this invention.

Nor

Nor did the learned world, at that time, declare any opinion in that matter, otherwise than giving due applause to both those happy genius's, for both their inventions of the same doctrine about the same time: being convinced that neither of them had copied from the other; because they did not mention one another; and because, though they agreed in the substance of the thing, they differed in their way of conceiving; called it by different names, and used different characters,

However each had his partisans: foreign nations adopted the character invented by *Leibnitz*, as more commodious. And as his character gained acceptance, the geometricians on the continent of *Europe* were insensibly led to look upon him to be the sole author and principal inventor of *Fluxions.*

In the year 1699 M *Fatio*, who followed the *Newtonian* practice opposed that opinion. And in a treatise *on the line of swiftest descent*, advanced that Sir *Isaac Newton* was not only the inventor, but was the first that practised the *differential calculus* for many years; and mentioned Mr. *Leibnitz* only as the second inventor. Which precise distinction between *first* and *second* inventor, with the suspicion it insinuated, (though hitherto the two great authors themselves enjoyed the glorious prospect of the progresses made continually under their auspices without any concern or dispute, as to the property of the invention) awakened M. *Leibnitz*, and his editors at *Leipsic* maintained his priority of the invention of fluxions against the *English geometricians*, who declared for Sir *Isaac Newton.*

Sir *Isaac* took no part in this controversy; contented with the attitude in which he was placed by the learned world above the glory of all that went before him in philosophical discoveries. But his countrymen could not be reasoned into silence. They persisted in their claim of the priority of Sir *Isaac*'s invention to M. *Leibnitz*: till at last M. *Leibnitz* in the year 1711, laid a formal complaint before the *Royal Society* in London against Dr. *Keil* for accusing him of publishing the method of Fluxions, *invented* by Sir *Isaac Newton*, under other names and characters. At the same time ap pealing to Sir *Isaac* himself for an attestation of his innocence; and insisting that Dr. *Keil* should publickly disavow the ill construction, which might be put upon his words.

This appeal to the *Royal Society*, as judges, brought the controversy to an issue. On the one part *Leibnitz* stands to the award of their tribunal: on the other part the *Society*, after due examination of the merits of both the claimants, from the best vouchers they could find in old letters, papers, &c. and the strictest examination of all the evidences, that could be produced, gave this report or verdict, *viz.*

"That it did not appear that M. *Leibnitz* knew "any thing of the *Differential Calculus* before a "letter wrote him by Sir *Isaac Newton*, and sent "to him at *Paris*, in the year 1672; wherein "the method of *Fluxions* was sufficiently explained "to let a man of his sagacity into the whole matter; and that Sir *Isaac Newton* had even in"vented his method before the year 1669; and "in consequence fifteen years before M. *Leibnitz* "had given any thing on the subject in the *Leipsic* "*Acts*:" concluding,

That Doctor *Keil* had not at all injured M. *Leibnitz* in what he had advanced and said.

This, nevertheless, did not silence the foreign advocates and admirers of M. *Leibnitz.* For, though this censure, with all the pieces relating thereunto, were printed in one collection under the title of *Commercium Epistolicum de Analysi promota*, London, 1712, and carefully circulated all over *Europe*, in vindication of the Title of the *English* nation to so useful a discovery, M. *Leibnitz* and his friends could not brook the name of a *Plagiary*, with which the censure, &c. plainly stigmatized him. So that soon after we find a loose sheet printed at *Paris*, and also at *Bremen* with much fire, in behalf of *Leibnitz*, maintaining boldly, That the method of *Fluxions* did not precede that of *Differences*; and insinuates, that it might have arisen from it. M. *Leibnitz* himself is said to have been employed in an elaborate answer to the *Commercium Epistolicum*, when death took him off the stage of contention.

They, who reason cooly upon the merits of these claimants, (though it is a fact without the least doubt, that Sir *Isaac Newton* was the *first inventor* of *Fluxions)* can't be so harsh as to declare M: *Leibnitz* to be a *Plagiary*. If they would but recollect that M. *Leibnitz* in his *Theory of Abstract Motions*, dedicated to the *Royal Academy* in 1671, did then suppose, infinitely small quantities, some greater than others (which is one of the great principles of *Fluxions)* it might go a great way towards acquitting him of *Plagiarism*, and to convince us that M. *Leibnitz* did not take the doctrine of *Fluxions* from Sir *Isaac Newton*; but that he accidentally fell upon the same thing with him.

These things premised it will be necessary to add somewhat more on the subject of *notation of Fluxions.*

Invariable quantities, or those which neither increase nor decrease, are represented by the first letters of the alphabet, as a, b. c, d, &c. and the variable or flowing quantities by the last letters, as v, w, x, y, z: thus, the diameter of a given circle may be denoted by a; and the sine of any arch thereof, considered as variable, by x. The fluxion of a quantity represented by a *single* letter, is expressed

preſſed by the ſame letter with a *dot* or full point over it: thus, the fluxion of x is repreſented by $\dot{x}$, and that of y by $\dot{y}$.

And, becauſe theſe fluxions are themſelves often variable quantities, the velocities with which they either increaſe or decreaſe, are the fluxions of the former fluxions, which may be called *ſecond* fluxions, and are denoted by the ſame letters with *two dots* over them, as $\ddot{x}\ \ddot{y}$.

In the ſame manner the fluxions of *ſecond* fluxions are called *third* fluxions, and denoted by the ſame letters with *three dots* over them, as $\dddot{x}$, $\dddot{y}$; and ſo on for *fourth*, *fifth*, &c. fluxions, which are expreſſed by the ſame letters, with four, five, &c: dots over them, as $\ddddot{x}$, $\ddddot{y}$; and $\ddddot{x}$, $\ddddot{y}$, &c.

If the flowing quantity be a fraction, as $\frac{xx}{d-y}$, its firſt, ſecond, third, &c. fluxions are expreſſed by one, two, three, &c. dots placed in the break of the line that ſeparates the numerator from the denominator, thus $\frac{xx}{d-y}$, $\frac{xx}{d-y}$, $\frac{xx}{d-y}$, &c.

The fluxions of *ſurds* are denoted in the ſame manner, by one, two or more dots placed in the break of the vinculum of the radical character: thus, if the *ſurd* quantity be $\sqrt{x-y}$, then will its firſt, ſecond, third, &c. fluxions be $\sqrt{x-y}$, $\sqrt{x-y}$, $\sqrt{x-y}$, &c.

The whole doctrine of fluxions conſiſts in ſolving the two following Problems, *viz.* 1. From the fluent, or variable flowing quantity given, to find the fluxion; which conſtitutes what is called the *direct method of fluxions.* 2. From the fluxion given, to find the fluent, or flowing quantity; which makes the *inverſe method* of *fluxions.*

The latter is directly oppoſite to the former, and is a ſequel to it. Both of them are adopted into the new *Geometry*, and make reigning methods therein.

The *firſt* deſcends from finite to infinite. The *ſecond* aſcends from infinitely ſmall to finites. The one decompounds a magnitude; the other re-eſtabliſhes it.

The foundation of the *direct method* of *fluxions* amounts to this Problem. The length of the ſquare deſcribed being continually, or at all times, given to find the velocity at any time propoſed.

The foundation of the *inverſe method* amounts to this Problem. The velocity of the motion being continually given, to find the ſpace deſcribed by it at any time propoſed.

The Doctrine of the *direct method of* FLUXIONS is compriſed in theſe rules.

1. To find the fluxion of any ſimple variable quantity, the rule is to place a dot over it: thus, the fluxion of x is $\dot{x}$, and of y, $\dot{y}$. Again, the fluxion of the compound quantity $x+y$, is $\dot{x}+\dot{y}$; alſo the fluxion of $x-y$ is $\dot{x}-\dot{y}$.

2. To find the fluxion of any given power of a variable quantity, multiply the fluxion of the root by the exponent of the power, and the product by that power of the ſame root; whoſe exponent is leſs by unity than the given exponent.

This rule is expreſſed more briefly, in *algebraical* characters, by $n\,x^{n-1}\,\dot{x}=$ the fluxion of x^n.

Thus, the fluxion of x^3 is $\dot{x}\times 3\times x^2 = 3x^2\dot{x}$; and the fluxion of x^5 is $\dot{x}\times 5\times x^4 = 5x^4\dot{x}$. In the ſame manner the fluxion of $\overline{a+y}|^7$ is $7\dot{y}\times\overline{a+y}|^6$; for the quantity a being conſtant, $\dot{y}$ is the true fluxion of the root $a+y$.

Again, the fluxion of $\overline{a^2+z^2}|^{\frac{3}{2}}$ will be $\frac{3}{2}\times 2z\dot{z}\times\overline{a^2+z^2}|^{\frac{1}{2}}$: for here, x being put $=a^2+z^2$, we have $\dot{x}=2z\dot{z}$; and therefore $\frac{3}{2}x^{\frac{1}{2}}\dot{x}$, for the fluxion of $x^{\frac{3}{2}}$ (or $\overline{a^2+z^2}|^{\frac{3}{2}}$, is $=3z\dot{z}\sqrt{a^2+z^2}$.

3. To find the fluxion of the product of ſeveral variable quantities, multiply the fluxion of each, by the product of the reſt of the quantities; and the ſum of the products, thus ariſing, will be the fluxion ſought.

Thus the fluxion of xy is $\dot{x}y+\dot{y}x$; that of xyz is $\dot{x}yz+\dot{y}xz+\dot{z}xy$; and that of $vxyz$ is $\dot{v}xyz+\dot{x}vyz+\dot{y}vxz+\dot{z}vxy$. Again, the fluxion of $\overline{a+x}\times\overline{b-y}=ab+bx-ay-xy$, is $b\dot{x}-a\dot{y}-\dot{x}y-\dot{y}x$

4. To find the fluxion of a *fraction*, the rule is, from the fluxion of the numerator multiplied by the denominator, ſubtract the fluxion of the denominator multiplied by the numerator, and divide the remainder by the ſquare of the denominator.

Thus the fluxion of $\frac{x}{y}$, is $\frac{\dot{y}x-x\dot{y}}{y^2}$; that of $\frac{x}{x+y}$, is $\frac{\dot{x}\times\overline{x+y}-\overline{\dot{x}+\dot{y}}\times x}{\overline{x+y}|^2}=\frac{y\dot{x}-x\dot{y}}{\overline{x+y}|^2}$; and that of $\frac{x+y+z}{x+y}$, or $1+\frac{z}{x+y}$, is $\frac{\dot{z}\times\overline{x+y}-\overline{\dot{x}+\dot{y}}\times z}{\overline{x\times y}|^2}$ and ſo of others.

In the examples hitherto given, each is reſolved by its own particular rule; but in thoſe that follow,

low, the use of two or more of the above rules is requisite: thus (by rule 2. and 3.) the fluxion of $x^2 y^2$ is found to be $2x^2 y\dot{y} + 2y^2 x\dot{x}$; that of $\frac{x^2}{y^2}$, is found (by rule 2, and 4.) to be $\frac{2y^2 x\dot{x} - 2x^2 y\dot{y}}{y^4}$; and that of $\frac{x^2 y^2}{z}$, is (by rule 2, 3, and 4.) found to be $\frac{2x^2 y\dot{y} + 2y^2 x\dot{x} \times z - x^2 y^2 \dot{z}}{z^2}$.

5. When the proposed quantity is affected by a coefficient, or constant multiplicator, the fluxion, found as above, must be multiplied by that coefficient or multiplicator: thus, the fluxion of $5x^3$, is $15x^2\dot{x}$, for the fluxion of x^3 is $3x^2\dot{x}$, which multiplied by 5, gives $15x^2\dot{x}$. And in the very same manner, the fluxion of ax^n will be $nax^{n-1}\dot{x}$.

Having thus explained the manner of determining the *first fluxions of variable quantities*, it remains to say something of *second*, *third*, *&c. fluxions*.

We have already observed, that the second fluxion of a quantity, is the fluxion of the first fluxion; and by the third fluxion is meant the fluxion of the second; the fourth, of the third; and so on. The fluxions, therefore, of every order are only the measure of the velocities, by which their respective flowing quantities, *viz.* the fluxions of the immediately preceding order, are generated.

Hence it appears, that a second fluxion always shews the rate of the increase or decrease of the first fluxion; and that the third, fourth, &c. fluxions differ in nothing, except their order and notation, from first fluxions; and therefore are also determinable in the very same manner, by the rules already laid down.

Thus, (by rule 4.) the (first) fluxion of x^3 is $3x^2\dot{x}$: and if $\dot{x}$ is supposed constant, that is, if the root x be generated with an equable or uniform velocity, the fluxion of $3x^2\dot{x}$ (or $3\dot{x} \times x^2$) again taken (by the same rule) will be $3\dot{x} \times 2x\dot{x}$, or $6x\dot{x}^2$; which therefore is the second fluxion of x^3. Again, the third fluxion of x^3, or the fluxion of $6x\dot{x}^2$, is found to be $6\dot{x}^3$; further than which we cannot go in this case, because the last fluxion, $6\dot{x}^3$, is here a constant quantity.

In the preceding example, the root x is supposed to be generated with an equable velocity: but if the velocity be an increasing or decreasing one, then $\dot{x}$, expressing the measure thereof, being variable, will also have its fluxion, which is denoted, as said above, by $\ddot{x}$; and the fluxion of $\ddot{x}$ by $\dddot{x}$, and so on with respect to higher orders.

Examples, wherein the root x (or y) is supposed to be generated with a variable velocity.

Thus, the fluxion of x^3 being $3x^2\dot{x}$ (or $3x^2 \times \dot{x}$) the fluxion of $3x^2 \times \dot{x}$, considered as a rectangle, will (by rule 3.) be found to be $6x\dot{x} \times \dot{x} + 3x^2 \times \ddot{x} = 6x\dot{x}^2 + 3x^2\ddot{x}$; which is the second fluxion of x^3. Moreover, from the fluxion last found, we shall in like manner get $6\dot{x} \times x^2 + 6x \times 2\dot{x}\ddot{x} + 6x\dot{x} \times \ddot{x} + 3x^2 \times \dddot{x}$ (or $6x^3 + 18x\dot{x}\ddot{x} + 3x^2\dddot{x}$) for the third fluxion of x^3. Thus also, if $\dot{y} = n\dot{x}^{n-1}x$, then will $\ddot{y} = n \times \overline{n-1} \times x^{n-2} x^2 + n\ddot{x}x^{n-1}$; and if $\dot{z}^2 = \dot{x}\dot{y}$, then will $2\dot{z}\ddot{z} = \dot{x}\ddot{y} + \dot{y}\ddot{x}$: and so of others.

Once for all, take particular notice, that the fluxions of all kinds and orders whatever, are contemporaneous, or such as may be generated together, with their respective velocities, in one and the same time.

The doctrine of the *inverse methods* of Fluxions, or *Calculus integralis*, (which consists in finding finite magnitudes from the infinitely small parts thereof, or in determining the *fluents* of given *Fluxions*) is to proceed from infinitely small quantities to *finite*, and to recompound and sum up, what the other had resolved; whence this method of *Fluxions* is also called, *the summatory Calculus*.

Yet, this does not always re-establish what has been decompounded: for, as there is no method for deducing the fluent from the fluxion *a priori*, by a direct investigation; so it is impossible to lay down rules for any other forms of fluxions, than those particular ones that we know, from the direct method, belong to such kinds of flowing quantities. For example, the fluent of $2x\dot{x}$ is known to be x^2; because, by the direct method, the fluxion of x^2 is found to be $2x\dot{x}$: but the fluent of $y\dot{x}$ is unknown, since no expression has been discovered that produces $y\dot{x}$ for its fluxion. However, the following rules are used by the best *mathematicians* for finding the *fluents* of given *fluxions*.

1. To find the fluent of any simple fluxion, you need only write the letters without the dots over them: thus, the fluent of $\dot{x}$ is x, and that of $ax + b\dot{y}$, is $ax + by$.

2. To assign the fluent of any power of a variable quantity, multiplied by the fluxion of the root; first divide by the fluxion of the root; add unity to the exponent of the power, and divide by the exponent so increased; for dividing the fluxion $nx^{n-1}\dot{x}$ by $\dot{x}$, it becomes nx^{n-1}; and adding 1 to the exponent $(n-1)$ we have nx^n; which divided by n, gives x^n, the true fluent of $nx^{n-1}\dot{x}$.

Hence, by the same rule, the fluent of $3x^2 x$ will

will be $= x^3$; that of $2x^5\dot{x} = \frac{x^6}{3}$; that of $y^{\frac{1}{2}}\dot{y} = \frac{2}{3}y^{\frac{3}{2}}$; that of $ay^{\frac{5}{3}}\dot{y} = \frac{3ay^{\frac{8}{3}}}{8}$ and that of $y^{\frac{m}{n}}\dot{y} = \frac{y^{\frac{m}{n}+1}}{\frac{m}{n}+1} = \frac{ny^{\frac{m+n}{n}}}{m+n}$; that of $\frac{a\dot{x}}{x^n}$, or $a\dot{x}x^{-n}$ $= \frac{ax^{1-n}}{1-n}$; that of $\overline{a+z}|^3 \times \dot{z} = \frac{\overline{a+z}|^4}{4}$; and that of $\overline{a^m+z^m}|^n \times z^{m-1}\dot{z} = \frac{\overline{a^m+z^m}|^{n+1}}{m\times\overline{n+1}}$.

In assigning the fluents of given fluxions, it ought to be considered, whether the flowing quantity, found as above, requires the *addition* or *subtraction* of some constant quantity, to render it complete: for instance. the fluent of $nx^{n-1}\dot{x}$ may be either represented by x^n or by $x^n \pm a$, for a being a constant quantity the fluxion $x^n \pm a$, as well as of x^n, is $nx^{n-1}\dot{x}$.

Hence it appears, that the variable part of a fluent only can be assigned by the common method, the constant part being only assignable from the particular nature of the problem.

Now to do this, the best way is to consider how much the variable part of the fluent, first found, differs from the truth, when the quantity, which the whole fluent ought to express, is equal to nothing; then that difference, *added* to, or *subtracted* from, the said variable part, as occasion requires, will give the fluent truly corrected.

To make this plainer by an example or two, let $\dot{y} = \overline{a+x}|^3 \times \dot{x}$. Here we first find $y = \frac{\overline{a+x}|^4}{4}$; but when $y = 0$, then $\frac{\overline{a+x}|^4}{4}$ becomes $= \frac{a^4}{4}$; since x, by hypothesis, is then $= 0$, therefore $\frac{\overline{a+x}|^4}{4}$ always exceeds y by $\frac{a^4}{4}$; and so the fluent properly corrected, will be $y = \frac{\overline{a+x}|^4 - a^4}{4} = a^3x + \frac{3a^2x^2}{2} + ax^3 + \frac{x^4}{4}$.

Again, let $\dot{y} = \overline{a^m+x^m}|^n \times x^{m-1}\dot{x}$: here we first have $y = \frac{\overline{a^m+x^m}|^{n+1}}{m\times\overline{a+1}}$; and making $y=0$, the latter part of the equation becomes $\frac{\overline{a^m}|^{n+1}}{m\times\overline{n+1}} = \frac{a^{mn+m}}{m\times\overline{n+1}}$ whence the equation or fluent, properly corrected is $y = \frac{\overline{a^m+x^m}|^{n+1} - a^{mn+m}}{m\times\overline{n+1}}$.

Hitherto x and y are both supposed equal to nothing, at the same time; which will not always be the case; for instance, though the sine and tangent of an arch are both equal to nothing, when the arch itself is so; yet the secant is then equal to the radius.

It will therefore be proper to add some examples, wherein the value of y is equal to nothing, when that of x is equal to any given quantity a.

Thus let the equation $\dot{y} = x^2\dot{x}$, be proposed; whereof the fluent first found is $y = \frac{x^3}{3}$; but when $y = 0$, then $\frac{x^3}{3} = \frac{a^3}{3}$, by the hypothesis; therefore the fluent corrected is $y = \frac{x^3 - a^3}{3}$.

Again, suppose $\dot{y} = x^n\dot{x}$; then will $y = \frac{x^{n+1}}{n+1}$; which, corrected, becomes $y = \frac{a^{n+1} - x^{n+1}}{n+1}$.

Lastly, if $\dot{y} = \overline{c^3+bx^2}|^{\frac{1}{2}} \times x\dot{x}$; then, first, $y = \frac{\overline{c^3+bx^2}|^{\frac{3}{2}}}{3b}$; therefore the fluent corrected is $y = \frac{\overline{c^3+bx^2}|^{\frac{3}{2}} - \overline{c^3+ba^2}|^{\frac{3}{2}}}{3b}$.

3. To find the fluents of such *fluxionary* expressions, as involve two or more variable quantities, substitute, instead of such fluxion, its respective *flowing quantity*; and, *adding* all the terms together, *divide* the sum by the number of terms, and the quotient will be the fluent.

Thus the fluent of $\dot{x}y + \dot{y}x = \frac{xy+xy}{2} = \frac{2xy}{2} = xy$; and the fluent of $\dot{x}yz + \dot{y}xz + \dot{z}yx = \frac{xyz+xyz+xyz}{3} = \frac{3xyz}{3} = xyz$.

Having thus shewn the manner of finding such fluents as can be truly exhibited in *algebraic* terms, it remains now to say something with regard to those other forms of expressions involving one variable quantity only; which yet are so affected by *compound divisors* and *radical quantities*, that their *fluents* cannot be accurately determined by any method whatsoever.

The only method with regard to these, of which there are innumerable kinds, is to find their fluents, by *approximation*, which, by the method of *infinite series*, may be done to any degree of exactness.

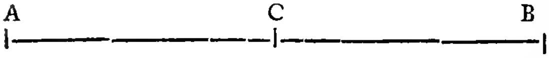
Thus, if it were propoſed to find rhe fluent of $\frac{a\dot{x}}{a-x}$, it becomes neceſſary to throw the fluxion into an infinite ſeries, by dividing $a\dot{x}$ hy $a-x$; thus, $a\dot{x} \div \overline{a-x} = \dot{x} + \frac{x\dot{x}}{a} + \frac{x^2\dot{x}}{a^2} + \frac{x^3\dot{x}}{a^3} + \frac{x^4\dot{x}}{a^4} +$, &c.

Now the fluent of each term of this ſeries, may he found by the foregoing rules to be $x + \frac{x^2}{2a} + \frac{x^3}{3a^2} + \frac{x^4}{4a^3} + \frac{x^5}{5a^4} +$ &c.

Again, to *approximate* the fluent of $\frac{\overline{a^2-x^2}|^{\frac{1}{2}} \times x^n\dot{x}}{\overline{c^2-x^2}|^{\frac{1}{2}}}$, we firſt find the value of $\frac{\overline{a^2-x^2}|^{\frac{1}{2}}}{\overline{c^2-x^2}|^{\frac{1}{2}}}$ expreſſed in a ſeries to be $\frac{a}{c} + \overline{\frac{a}{2c^3} - \frac{1}{2ac}} \times x^2 + \overline{\frac{3a}{8c^5} - \frac{1}{4ac^3} - \frac{1}{8a^3c}} \times x^4 + \overline{\frac{5a}{16c^7} - \frac{3}{16ac^5} - \frac{1}{16a^3c^3} - \frac{1}{16a^5c}} \times x^6 +$, *&c.* which value being multiplied by $x^n\dot{x}$, and the *fluent* taken by the rules above laid down, we get $\frac{ax^{n+1}}{\overline{n+1} \times c} + \overline{\frac{a}{2c^3} - \frac{1}{2ac}} \times \frac{x^{n+3}}{n+3} + \overline{\frac{3a}{8c^5} - \frac{1}{4ac^3} - \frac{1}{8a^3c}} \times \frac{x^{n+5}}{n+5} + \overline{\frac{5a}{16c^7} - \frac{3}{16ac^5} - \frac{1}{16a^3c^3} - \frac{1}{16a^5c}} \times \frac{x^{n+7}}{n+7}$ +, &c.

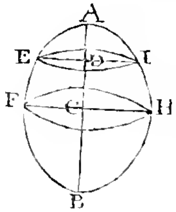
To ſhew the *uſefulneſs* of *fluxions* more accurately, we ſhall give an example or two.

Suppoſe it were required to divide the given right line A B into two ſuch parts, A B, C B, that their



products or rectangles, may be the greateſt poſſible. Let $AB = a$, and let the part A C, conſidered as variable (by the motion of C towards B) be denoted by x. Then B C being $= a - x$, we have $AC \times BC = ax - xx$, whoſe fluxion $a\dot{x} - 2x\dot{x}$ being put $= 0$, we get $a\dot{x} = 2x\dot{x}$; and, conſequently, $x = \frac{1}{2}a$. Hence it appears that A C (or x) muſt be exactly one half of A B.

Again, ſuppoſe it were required to find the ſolid contents of a ſpheroid A F B H.



Let the axis A B, about which the ſolid is generated, be $= a$, the radius $= p = 1$, and the other axis F H, of the generating ellipſis $= b$; then, from the property of the ellipſis, we have $a^2 : b^2 :: AD \times BD$ $(x \times \overline{a-x})$: DE^2 (y^2). Hence $y^2 = \frac{b^2}{a^2} \times \overline{ax - xx}$; and the fluxion of the ſolid $\dot{s}$ $(= py^2\dot{x}) = \frac{pb^2}{a^2} \times \overline{ax\dot{x} - x^2\dot{x}}$; and the ſolidity $s = \frac{pb^2}{a^2} \times \overline{\frac{1}{2}axx - \frac{1}{3}x^3}$ = the ſegment A I E; which, when AD (x) = A B (a), becomes $\left(\frac{pb^2}{a^2} \times \overline{\frac{1}{2}a^3 - \frac{1}{3}a^3}\right)$ $\frac{1}{6}pab^2$ = the content of the whole ſpheroid. Where, if b (F H) be taken $= a$ (A B,) we ſhall alſo get $\frac{1}{6}pa^3$ for the true content of the ſphere, whoſe diameter is a. Hence a ſphere or ſpheroid is $\frac{2}{3}$ of its circumſcribing cylinder: for the area of the circle F H being expreſſed by $\frac{pb^2}{4}$, the content of the cylinder, whoſe diameter is F H, and altitude A B, will be $\frac{pb^2a}{4}$; of which $\frac{1}{6}pab^2$ is evidently two third parts.

Before we take our leave of *Fluxions*, it is neceſſary to explain what is underſtood, and what is to be done by that part of ALGEBRA called *Maximum*, and *Minimum*.

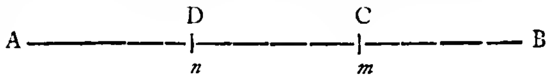
MAXIMUM denotes the *greateſt* Quantity attainable in any given caſe.

MINIMUM denotes the *leaſt* Quantity attainable in any given caſe.

The method *de maximis et minimis* is, therefore, the way, whereby *mathematicians* arrive at the *greateſt* or *leaſt* poſſible Quantity attainable in any caſe.

If a quantity conceived to be generated by motion, *increaſes* or *decreaſes*, till it arrives at a certain magnitude or poſition, and then, on the contrary, grows *leſſer* or *greater*, and it be required to determine the ſaid magnitude or poſition, the queſtion is called a problem *de maximis et minimis*.

Thus; let a point m move uniformly in a right line, from A towards B, and let another point n move after it, with a velocity, either *increaſing* or *decreaſing*, but ſo that it may, at a certain poſition, D, become equal to that of the former point m, moving uniformly. Then let the motion of n be firſt conſidered, as an *increaſing* one, in which caſe the diſtance of n behind m will conti-



nually *increaſe* till the two points arrive at the cotemporary poſitions C and D; but afterwards it will again *decreaſe*; for the motion of n, till then being ſlower than at D, it is alſo ſlower than that of the preceding point m (by the hypotheſis;) but becoming quicker afterwards, than that of m, the diſtance mn, (as has been already ſaid) will again *decreaſe*: and therefore is a *maximum*, or the *greateſt* of of all, when the celerities of the two points are equal to each other.

But, if n arrives at D with a *decreasing* celerity, then its motion being first swifter, and afterwards slower than that of m, the distance $m\,n$ will first *decrease* and then *increase*; and therefore is a *minimum*, or the *least* of all, in the forementioned circumstance.

Since then the distance $m\,n$ is a *maximum*, or a *minimum*, when the velocities of m and n are equal, or when that distance *increases* as fast through the motion of m, as it *decreases* by that of n, its fluxion, at that instant, is evidently equal to nothing. Therefore, as the motion of the points m and n may be conceived such, that their distance m and n may express the measure of any variable quantity whatever, it follows, that the *fluxion* of any variable quantity whatever, when a *maximum* or a *minimum*, is equal to nothing.

The rule, therefore, to determine any flowing quantity in an *equation* proposed, to an extreme value, is, Having put the *equation* into *fluids*, let the *fluxion* of that quantity (whose extreme value is sought) be supposed equal to nothing; by which means all those members of the *equation* in which it is found, will vanish, and the remaining ones will give the determination of the *maximum* or *minimum* required.

Problem I.

To divide a given *right line* into two such parts, that their product or rectangle may be the greatest possible.

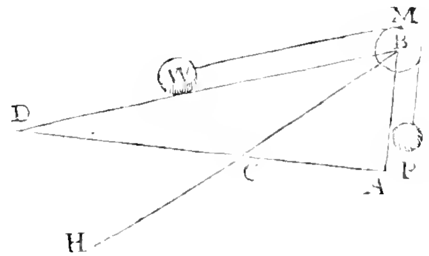
This is the case, when the line is bissected, or divided into equal parts, as has been shewn under FLUXION.

In any *mechanical* engine the *proportion* of the *power* to the *weight*, when they ballance each other, is found by supposing the engine to move and reducing their velocities to the respective directions in which they act; for the *inverse ratio* of those velocities is that of the *power* to the *weight* according to the general principle of *mechanics*. But it is of use to determine likewise the *proportion* they ought to bear to each other, that when the *power* prevails, and the engine is in motion, it may produce the *greatest* effect in a given time. When the *power* prevails, the *weight* moves at first with an accelerated motion; and when the velocity of the *power* is invariable, its action upon the *weight* decreases, while the velocity of the weight increases.

Thus the action of a stream of water, or air, upon a wheel, is to be estimated from the excess of the velocity of the fluid above the velocity of the part of the engine, which it strikes, or from their *relative* velocity only. The motion of the engine ceases to be accelerated when this *relative* velocity is so far diminished, that the action of the *power* becomes equal to the resistance of the engine arising from the gravity of the matter that is elevated by it, and from friction; for when these ballance each other, the engine proceeds with the uniform motion it has required.

Let a denote the velocity of a stream, u the velocity of the part of the engine, which it strikes, when the motion of the machine is uniform, and $a-u$ will represent their *relative* velocity. Let A represent the weight, which would balance the force of the stream, when its velocity is a, and p the weight, which would balance the force of the same stream, if its velocity was only $a-u$; Then $p : A :: \overline{a-u}^2 : a^2$, or $p = A \times \frac{\overline{a-u}^2}{aa}$, and p shall represent the action of the stream upon the wheel. If we abstract from friction, and have regard to the quantity of the weight only, let it be equal to qA (or be to A as q to 1) and because the motion of the machine is supposed uniform, $p = q \times A = \frac{A \times \overline{a-u}^2}{aa}$, or $q = \frac{\overline{a-u}^2}{aa}$. The momentum of this weight is $qAu = \frac{Au \times \overline{a-u}^2}{aa}$; which is a *maximum* when the fluxion of $\frac{u \times \overline{a-u}^2}{aa}$ vanishes, that is, when $u \times \overline{a-u}^2 - 2uu \times \overline{a-u} = 0$, or $a - 3u = 0$. Therefore, in this case the machine will have the *greatest* effect, if $u = \frac{a}{3}$, or the weight $qA = \frac{A \times \overline{a-u}^2}{aa} = \frac{4A}{9}$. That is, if the weight, that is raised by the engine be less than the weight, which would balance the power in the proportion of 4 to 9; and the momentum of the weight is $\frac{4Aa}{27}$.

Problem II.



Suppose that the given weight P, descending by its gravity into the vertical line, raises a given weight W by the cord PMW (that passes over the pulley M)

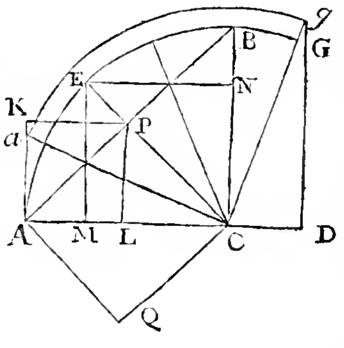
M) along the inclined plane BD, the height of which BA is given; and let the position of the plane BD be required, along which W will be raised in the least time from the horizontal line AD to B.

Let $AB = a$, $BD = x$, $t =$ time in which W describes DB, then the force which accelerates the motion of W is $P - \frac{aW}{x}$. tt is as $\frac{xx}{Px - aW}$, and if we suppose the fluxion of this quantity to vanish, we shall find $x = \frac{2aW}{P}$ or $P = \frac{2aW}{x}$; consequently the plane BD required is that upon which a weight equal to 2 W would be sustained by P; or if BC be the plane upon which W would sustain P, then $BD = 2BC$.

But if the position of the plane BD be given, and W being supposed variable, it be required to find the *ratio* of W to P, when the *greatest momentum* is produced in W along the given plane BD; in this case, W ought to be to P as BD to $BA + \sqrt{BD + BA} + \sqrt{BA}$.

Questions of this kind may be likewise demonstrated from the common elementary geometry: of which the following may serve as an example.

Problem III.



Let a fluid moving with the velocity and direction A C strike the plane C E, and suppose that this plane moves parallel to itself in the direction CB, perpendicular to CA, or that it cannot move in any other direction; then let it be required to find the most advantageous position of the plane CE, that it may receive the greatest impulse from the action of the fluid.

Let A P be perpendicular to CE in P, draw AK parallel to CB, and let PK be perpendicular upon it in K; and AK will measure the force, with which any particle of the fluid impels the plane EC, in the direction CB. For the force of any such particle being represented by AC, let this force be resolved into AQ, parallel to EC, and AP perpendicular to it; and it is manifest, that the latter AP only has any effect upon the plane CE.

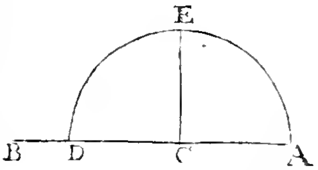
Let this force AP be resolved into the force AL perpendicular to CB, and the force AK parallel to it; then it is manifest, that the former, AL, has no effect in promoting the motion of the plane in the direction CB; so that the latter, AK, only, measures the effort by which the particle promotes the motion of the plane CE, in the direction CB.

Let EM and EN be perpendicular to CA and CB, in M and N; and the number of particles, moving with directions parallel to AC, incident upon the plane CE, will be as EM.

Therefore the effort of the fluid upon CE, being as the force of each particle, and the number of particles together, it will be as $AK \times EM$; or because AK is to AP ($= EM$) as EN to CE, as $\frac{EM^2\, EM \times EN}{CE}$; so that CE being given, the problem is reduced to this, to find when $EM^2 \times EN$ is the greatest possible. or a *maximum*.

But because the sum of EM^2 and of EN^2 ($= CM^2$) is given, being always equal to CE^2, it follows that $EN^2 \times EM^4$ is *greatest* when $EN^2 = \frac{1}{3} CE^2$; for when the sum of two quantities AC and CB was given, $AC \times CB^2$ is *greatest* when $AC = \frac{1}{3} AB$, as will be very evident if a semicircle is described upon AD. But when $EN^2 \times EM^4$ is *greatest*, its square root $EN \times EM^2$ is of necessity at the same time greatest. Therefore the action of the fluid upon the plane CE in the direction CB is *greatest* when $EN^2 = \frac{1}{3} CE^2$, and consequently $EM^2 = \frac{2}{3} CE^2$; that is, when EM the sine of the angle ACE, in which the stream strikes the plane, is to the *radius*, as $\sqrt{2}$ to $\sqrt{3}$; in which case it easily appears, from the *trigonometrical* tables, that this angle is of 54° 44′.

Several useful Problems in *mechanics* may be resolved by what we have just now shewn.



If we represent the velocity of the wind as in this figure, by AC, a section of the sail of a windmill, perpendicular to its length by CE, as it follows from the nature of the engine, that its axis ought to be turned directly to the wind, and the sail can only move in a direction perpendicular to the axis, it appears, that, when the motion begins, the wind will have the *greatest* effect to produce this motion, when the angle ACE in which the wind strikes the sail, is of 54° 44′.

In the same manner, if CB represent the direction of the motion of a ship, or the position of her keel, abstracting from her lee-way, and AC be the direction of the wind, perpendicular to her way, then the most advantageous position of the sail CE, to promote her motion in the direction CB, CB, is when the angle ACE, in which the wind ſtrikes the ſail, is of 54° 44′.

The beſt poſition of the rudder, where it may have the *greateſt* effect in turning round the ſhip, is determined in like manner.

Much might be added in this place concerning *tangents* and *ſubtangents* in an *Algebraic* curve; whoſe method is one of the great reſults of the *calculus differentialis*: but as its deſcription and uſe comes more naturally under the title GEOMETRY, it ſhall be deferred till we treat of that *ſcience*.

A N A T O M Y.

ANATOMY, in a ſtrict *Phyſical Senſe*, is the art of *diſſecting*, or taking to pieces the ſeveral *ſolid* parts of *animal* Bodies, with a view to diſcover their *Structure* and *Uſes*.

This Art in reſpect of its ſubject is *divided* into *human* and *comparative*.

Human ANATOMY is confined to operations on the *Human Body*: *Comparative* is employed in the diſſection of *other animals*, to obtain a more accurate diſtinction of ſeveral parts, and to ſupply the defects of human ſubjects.

The *firſt* great uſe of this SCIENCE is to bring us acquainted with the work of the CREATOR in the compoſition of the human frame. In this view, it is properly called *Philoſophical* or *Theological Anatomy*; becauſe an intimate knowledge of the figure, connections, actions and uſes of the ſeveral parts of the human body, is one of the ſtrongeſt arguments againſt *Atheiſm*.

The *ſecond* is the *preſervation* and *reſtoration* of *health*. In this view it is ſtyled *medical Anatomy*: becauſe nothing is more neceſſary than a true knowledge of the ſtructure of that frame ſubject to infirmity and injury, to preſerve health, to cure diſeaſes or to prevent them, and to heal fractures and wounds. Therefore this uſe has been commonly underſtood to be the *primary* object of this *Science*.

Thirdly, ANATOMY is of the greateſt uſe in determining the cauſe and manner of the death of diſtempered perſons, from a ſubſequent diſſection of the body. A practice of the utmoſt conſequence in *Phyſic*: for, thereby only is it poſſible to diſcover the latent cauſes of many diſeaſes.

Neither is this SCIENCE confined to the bounds of *Medicine* alone. The Philoſopher and the Magiſtrate: the Painter and Sculptor are in their reſpective employments more or leſs qualified, in proportion to their knowledge of ANATOMY. But the *Phyſician* and the *Surgeon* can't, without a perfect knowledge of it, do juſtice to their patients in their ſeveral profeſſions: nay, we might venture to ſay that any one, who attempts the practice of either faculty without the aſſiſtance of ANATOMY, muſt do more harm than good to mankind.

From this view of the *uſes* we have reaſon to ſuppoſe that ANATOMY is a ſtudy of very ancient date. But the oldeſt writings on this ſubject run no higher than HIPPOCRATES, who, notwithſtanding he has left us no particular treatiſe on this ſubject, has given a multitude of obſervations relative to the *ſtructure* of the human body. Beſides he conſecrated a *Brazen* SKELETON of admirable contrivance to *Apollo* of *Delphos*; for an eternal monument of his labours in this ſtudy.

In this HIPPOCRATES was imitated by ARISTOTLE; who to all other branches of his ſtudies, added the *diſſection* of human bodies: though ſubjects of this kind, were, in thoſe times, very rare.

GALEN, commonly acknowledged to be the father of *Anatomiſts*, carried this art infinitely beyond what others had diſcovered before his time. His great judgment, penetration and dexterity of hand enabled him to deliver it down to poſterity in the perfection we now enjoy it; except ſome few diſcoveries made by modern *Anatomiſts*: and even ſome of them are taken from *Galen*'s works.

After this the invaſions of the *Goths* and *Vandals* drove ANATOMY, with the other ſciences, out of *Europe*; and, as Doctor *Friend* expreſſes himſelf, it ſunk into total *Barbariſm*; till MUNDINUS the *Milaneſe* Profeſſor, whoſe ſyſtem is ſtill in eſteem and read in ſome of the principal *Academies* in *Italy*, reſtored this ſtudy and publiſhed his lectures, *Anno Domini* 1315, in an uncouth ſtyle.

MUNDINUS's ſyſtem was publiſhed two hundred years after with the comments of *Jac. Berengarius*, alias CARPUS or *Carpenſis*. Who afterwards wrote a much better treatiſe of his own, on the ſubject.

CARPUS is ſaid to have diſſected above one hundred bodies with his own hands, and ſome of them live ſubjects. For which it is ſaid he was at laſt baniſhed his country.

But VESALIUS has the honour of being accepted for the reformer and improver of ANATOMY, as we now enjoy it. His inclination to this *Science* was ſo great, that, in his childhood, he could not forbear diſſecting *moles*, *dormice*, *cats*, &c. This innate paſſion increaſed with his years: ſo that, at laſt he ſcrupled not to ſteal bodies off Gibbets, when they

they could not be procured by other means: and thoſe that were dug out of graves, he uſed to keep ſeveral weeks in his bed-chamber.

He publiſhed his famous work on the *ſtructure of the human body*, at twenty-eight years of age. Yet he has not eſcaped ſevere cenſures from the learned. Our countryman *Caius* accuſes him of corrupting *Galen*'s Text. Others tax him with miſtaking, or of impoſing wrong and imaginary ſentiments and conſtructions on that author, when he was entruſted by *Aldus* to reviſe his works. *Columbus* writes, that he had given the deſcription of *brutes* for *men*, as the larynx, tongue and eye of an *ox*, and of giving *muſcles* to the *epiglottis*, which is proper only to *brutes*. *Euſtachius* ſhews that he has deſcribed the kidney of a *dog*, for the *human* kidney: and *Arantius* taxes him with giving the *pudendum* of a *brute* inſtead of a *woman*'s, for want of a female ſubject.

Vesalius, with all theſe cenſures, has deſerved well of the ſtudents in *phyſic* and *ſurgery*. He was chief *phyſician* to the Emperor *Charles* V. and to *Philip* the *ſecond* King of *Spain*. But growing weary of a court life, he obtained leave to viſit the holy ſepulchre at *Jeruſalem* by way of atonement for the many murders committed in his darling ſtudy; and he died *Anno Domini* 1564, in his return.

From this age the world has abounded with *anatomical* authors. But ſome of them have wrote on this ſubject only *occaſionally*, while others have treated on it *profeſſedly*.

Under the *occaſional* writers we may rank phyſicians, natural hiſtorians, and thoſe, who treat of human nature and of brutes.

Under the *profeſſed* writers are numbered ſuch as treat on the whole ſubject; or on any part of *Anatomy*.

The Treatiſes on the whole ſubject, in greateſt repute, are the works of *Winſlow*, Doctor *George Douglas*, *Albinus*, *Cheſelden*, and the excellent *compendium* of Anatomy by *Heiſter*.

They, who have merited moſt in *particular* branches of the *human ſtructure*, are Mr. Monro upon the *bones*: Mr. Cowper and Brown upon the *muſcles*: Dryander upon the *head*: Galen, Hoffman, and Rudius upon the *uſes* of the parts: Rufus *Epheſius* and Camerarius upon the *names* of the parts: Galen, Cappivaccius, Hippolitus, Boscus and Lacuna upon the art of *diſſecting*: and Horstius upon the *art of preſerving* carcaſſes.

Assellius, in the year 1622, diſcovered the *lacteal* veſſels: the immortal Harvey in 1628 publiſhed his diſcovery of the *circulation* of the *blood*: Becket in 1651 diſcovered the *reſervoir* of the *chyle*, and the *thoracic duct*. In 1650 and 1651 Rudbecks, a *Swede*, and Bartholine, a *Dane*, diſcovered the *lymphatic* veſſels: Mr. Cartor in 1655 diſcovered the lower *ſalival* ducts: in 1661 Steno deſcribed the upper *ſalival* ducts, thoſe of the *palate*, the *noſtrils* and the *eyes*: Wirtsungus in 1662 diſcovered the *pancreatick* duct: Willis, who ſucceeded him, publiſhed an Anatomy of the *brain* and *nerves*; which was improved conſiderably by Vieussens: Glisson treated of the *liver*: Graaf of the *pancreatick* juice and the *parts of generation*: Lower on the *motion* of the *heart*: Thurston upon *reſpiration*: Peyer upon the *glands* of the *inteſtines*: Drelincourt upon the *conception* of the *ova* in women, the *placenta*, and the *membranes* of the *fœtus*. We muſt not forget Malpighi, who died in 1694. Anatomy is greatly indebted to his diſcoveries in the *lungs*, *brain*, *liver*, *ſpleen*, *glands* and *lymphaticks* by the help of the microſcope, &c. Nor ſhall we do juſtice to the memory of Ruythe, who died 1727, if we don't give him the merit of inventing *injections*; by which means great light has been thrown into many of the finer and more intricate parts of the human frame; particularly the *glands*.

We might add Manget and Le Clerc, *Phyſicians* of *Geneva*, who have publiſhed a *Bibliotheca Anatomica*, containing all the new diſcoveries in Anatomy: but till the numerous miſtakes noted in that work by Mongagni in his *Adverſaria Anatomica* ſhall be corrected, it will not be proper to place it amongſt the claſſical authors in this ſcience.

So that after reading Heister, Winslow, Malpighi, Cheselden, and conſulting the *Tables* of Vessalius and Albinus, a ſtudent may conſider other books more, as curious, than neceſſary. And from theſe we acknowledge the adopting of the following Extracts.

It is evident from the Premiſſes that Anatomy is by ſome treated of only as an Art; by others, as a Science. The former conſider it as an *artificial* diſſection of a body: the latter, as a means to diſcover the *ſtructure* and *uſes* of the whole, and of every part of the body.

In both acceptations it is divided principally into Osteology, or a diſſection of the *Bones* and *Cartilages*; and Sarcology, or a diſſection of the *Fleſh* and other *tender parts*.

Of Osteology.

Osteology, (a compound of ὀςέον λόγος, a *diſcourſe* on *bones*) contains an exact diſquiſition of what belongs to bones in common, and what is proper to each bone in particular. But before we enter into this diſquiſition, it will be proper to conſider their *definition*, *differences*, *articulations*, *cauſes*, *parts* and *number*.

A Bone is the hardeſt, drieſt and moſt ſolid and earthy part of the whole animal body: and is cloathed with a membrane externally, called the *Perioſteum.*

The *Perioſteum* is divided into *layers* of fibres. The *external layers* are compoſed of fibres of the muſcles connected to the *bones*; but vary in their number, ſize and direction; ſo as to occaſion a very great difference in the thickneſs and ſtrength of the *perioſteum* of different *bones*, and even of the different parts of the ſame *bone*. The *internal layer* is nearly of a ſimilar ſtructure, and its fibres are in the ſame direction with thoſe of the *bone*, to which they are connected.

This connection is made by their cellular membranes, (except where the muſcles are inſerted into the *perioſteum*) which collapſe into ſuch a ſmall ſpace, when they are cut or broken in taking out a *bone*, that the external ſurface of the *perioſteum* ſeems very ſmooth and equal.

When the *perioſteum* is torn from the *bone*, we obſerve a great number of white threads produced from the membrane into the *bone*: and after a ſucceſsful injection of the *arteries* with a red liquor, according to Ruysch, numerous veſſels are not only ſeen on the *perioſteum*; but moſt of the fibres going from the membrane to the *bone*, ſhew themſelves to be veſſels entering the *bone*, with the injected liquor in them.

The *Veins* correſponding to theſe arteries, though they are not to be diſcovered by injection of liquor, are ſometimes to be ſeen in ſubjects, that die with their veſſels full of blood.

The great ſenſibility of the *perioſteum* in ſeveral caſes is a proof of its being well provided with *nerves*; though they are too ſmall to be traced.

Veſſels alſo paſs through the *perioſteum* to the *marrow*; and the *muſcles* frequently pierce through the *perioſteum* to be inſerted into the *bones*.

The chief uſes of the *perioſteum*, according to *Monro*, are,

1. To allow the *muſcles*, when they contract or are ſtretched, to move and ſlide eaſily upon the *bones*: the ſmooth ſurface of this membrane preventing any ill effects of their friction upon each other.

2. To keep in due order, and to ſupport the veſſels in their paſſage to the *bones*.

3. To aſſiſt in ſetting limits to the increaſe of the *bones*, and to check their over growth, by firmly bracing them.

4. To ſtrengthen the conjunction of the *bones* with their *epiphyſes*, ligaments and cartilages.

5. To afford a convenient origin and inſertion to ſeveral muſcles, which are fixed to this membrane.

6. To warn us, when any injury is offered to the parts it covers, which, being *inſenſible*, might otherwiſe be deſtroyed without our knowledge, or endeavour to procure a remedy.

When the cellular ſubſtance connecting the *perioſteum* to the ſurrounding parts is deſtroyed, theſe parts are fixed to that membrane, and looſe the ſliding motion they had upon it; as we ſee in *iſſues*, and other tedious ſuppurations near the *bone*. And when the veſſels, which go from the *perioſteum* to the *bones*, are broken or eroded, a collection of their liquids is made between the membrane and the bone, which produces a ſordid ulcer, or a rotten bone; as appears often in *fractures* of the *bones* and *inflammations* of the *perioſteum*.

The leſs and fewer the veſſels are under the ſurface, and the thicker and firmer the bony ſurface covering the veſſels, is, the *bones* will appear *whiter*, ſo that the *white* colour of *bones* will always be in proportion to their ſolidity and veſſels. A circumſtance that requires the attention of the *Surgeon*, when he is to judge of the condition of bones laid bare.

Bones differ much in their ſubſtance, quantity, figure, ſituation, uſes, motion, ſenſe, generation, cavities, &c.

Some are very hard, which nature has aſſigned to thoſe parts of the animal ſtructure, as require moſt ſtrength, *viz.* the *tibia*; --- others are ſofter, as the *vertebræ*; and ſome are very ſoft and ſpongy, as the *ſternum*.

They differ greatly in their quantity, both as to their number and equality. It is ſurpriſing to find ſuch a number of bones within the compaſs of a foot or a hand, and ſo few in a leg or an arm. And of theſe ſome are large, as thoſe of the *legs* and *arms*: others are ſmaller, as thoſe in the *head*; and thoſe in the *fingers* and *toes* are very ſmall.

Their figure alſo varies in theſe proportions and ſhapes. The *femur* and *tibia* requires long *bones*: the *wriſt* ſhort *bones*. Some again are *flat*, as that of the *palate*: others *round*, as the *rotula*: others *ſquare*, as the *oſſa parietalia*: and ſome *triangular*, as the firſt *bone* of the *ſternum*.

Doctor Monro treating of this diſtinction, writes; --- the *broad bones* have thin ſides, occaſioned by the *plates* (or *laminæ*, of which bones are compoſed) being ſoon and equally ſent off to form the *cancelli*; and this *lattice-work* is thicker and nearer of an equal form all through: and by this ſtructure they are well adapted to their uſes of affording a ſufficient ſurface for the muſcles to riſe from, and to move upon, and of defending the parts, which they incloſe.

The *round* Bones have thick ſtrong walls in the middle, and become very thin towards the ends; occaſioned

occasioned by very few plates separating at their middle; where the *cancelli* is so fine and small as scarce to be perceived. But such bones are said to have a large reservoir of oil in this place. Towards the extremities the *lattice-work* becomes very thick, and rather more complete than in the other sort of *bones*. These *round bones* having strong forces naturally applied to them, and being otherwise exposed to violent injuries, have need of a *cylindrical* figure, to resist external pressure; and of a considerable quantity of oil, to preserve them from becoming too brittle. Moreover they are provided with thick sides towards the middle, where the greatest forces are applied to injure them; while their hollowness increases their diameter, and consequently their strength to resist forces applied to break them transversely, as is demonstrated by Galilæus in *Mechanic. Dialog.* 2.

Therefore, as the *strength* of *bones* depends on their number of fibres or quantity of matter, and the largeness of their diameters; it follows, that the part of a *bone* formerly fractured, and re-united by a *callus* must be stronger than it was before the accident happened. *See* Monro *Anat.* of Bones, p. 24.

Before we dismiss this subject of the figure of Bones; it will be proper to say something about the *apiphysis* or *processes*, or *protuberances* of *bones*. If a *process* rises out of a bone, like a *ball*; it is called *caput* or a *head*. *See* D. in the *skeletons* on the plate of *Osteology*. If the *head* is flatened; it is called *condyle*. *See* E. *ib*. If the *process* be rough or unequal, it is a *tuberosity*. If it rises narrow and grows large at the extremity, it is named *cervix* or *neck*. *See* F. *ib*. Where it spreads into long ridges, are called *spines*. *Coronoid* or *coronæ* is a common name for such *processes* as terminate in a sharp point: but they receive particular names (as *mastoid*, *styloid*, *anchocoid*, *coracoid*, *spinal*, &c. according to the real or imagined resemblance they have to other substances. *See* G. *ib*. and such *processes* as form brims of cavities are called *supercilia* and *labra*.

These deformities have also their uses: for *processes* serve for the advantageous origin and insertion of *muscles*, and render the *articulations* firmer and more stable.

The greatest number of what are called *processes* in *adult bones*, discover themselves in *children* to be *epiphysis*. or *distinct bones*, to be affixed afterwards; as the *styloid* or the *temporal bones*, and the *processes* of the *vertebræ*, *trochanters* of the *thigh*, &c. *See* H *ib*.

As the *Apophysis* is a *protuberance* that rises on the superficies of the bones, with which it has the very same continuity, such as we find in the prominence of the *os potrosum*, called *apophysis mastoides*; *See* B. *ib*. So

The *epiphyses*, or *appendages* are *additional bones* joined to the principal bone by a simple connection, or cartilage; as the prominence on the *os tarsi*. *See* C *ib*.

Some bones have one; others two, or more of the *appendages* annexed by means of cartilages, which are of a considerable thickness in children; but by age become thinner, the *ossification* proceeding from the extremity of the bone on one side, and from the *epiphyses* on the other, till the place of their conjunction in adults can scarce be perceived on the external surface.

The *epiphyses* are chiefly united to such *bones* as are destined for frequent and violent motion; and for this purpose are of a larger diameter than the bone they belong to. Thus they strengthen the articulations, and also secure the ligaments of the articulations, which rise out from between the bones and them.

It may not be useless to consider Bones in regard to their *situation*. For, though every one knows that some are placed in the *head*; others in the *trunk*; and others in the extremities of the body; they may not have observed that among those in the *head*, some have a *deeper* situation, as the three *ossicula* of the *hearing*; and others a more *superficial*, as those of the *cranium*.

The *uses* of the *bones* are to support, and to contain parts, as those of the thighs and legs, and *costæ*: others both to contain and defend, as the bones of the *cranium*.

Bones also have their *motion*, either *manifest*; as in the great bones of the extremities: or, *secret*, as in the wrist and heel. But it must be allowed that the *bones* of the head and some others have no motion at all.

No Bones except the Teeth have any sense.

The *generation* of *bones* is a subject of some consideration. For, those that lie in the cavities of the ears are perfected in the womb: all others receive their increase and strength by time and nourishment. But of these some, as the *lower mandible*, harden sooner; some later, as those of the *vertex* or *top of the head*.

The *cavities* of *bones* are very singular, some are very capacious and replete with marrow, as the *tibia*: some are only porous, as the *calcaneum*, containing a medullary juice. Others have holes for transmission of the vessels, as the *bones* of the basis of the *cranium*. *See* K. *ib*. and *Vertebræ*. Others have only a hollowness, as the *os sternum*.: others have *sinus's*, as the *ossa frontis* and *temporum*. *See* M. *ib*. And some consist of abundance of little holes like a sieve, as the *os ethmoides*.

If these *cavities* are deep with large brims, they are called *cotylæ*; if only superficial, *glenæ* or *glenoid*. And these general *classes* are divided into particular *species*; as,

Pits,

Pits, or ſmall roundiſh channels ſunk perpendicularly into the bone. See L *ib.*

Furrows, or long narrow channels formed in the ſurface.

Notches, or ſmall breaches in the bone.

Sinuoſities, or broad ſuperficial depreſſions without brims.

Sinuſes, or large cavities within the ſubſtance of the bones with ſmall apertures.

Foramina, holes or channels, which pierce quite through the ſubſtance of the bore. *N. B.* When this laſt ſort extends any long way within a bone, the middle part is called *canal*, and its extremities *holes*.

The uſes of the cavities are many, ſuch as, to allow the heads of the bones to play in; to lodge and defend other ſofter parts, to give a ſafe paſſage for veſſels, muſcles, &c. as ſhall be ſhewn more fully hereafter.

Our next conſideration is to enquire into the *conjunction* of BONES. This is performed either by *articulation* or *ſymphyſis*.

ARTICULATION is a natural conjunction of two *bones* touching one another by their extremities.

This conjunction is *twofold:* one is named *diarthroſis*; the other *ſynarthroſis*.

Diarthroſis is the articulation, in which the motion is manifeſt, or in which the *bones* are ſo looſely connected as to allow a large motion; and is ſubdivided into the *enarthroſis*, *arthrodia*, and *ginglymus*.

Enarthroſis is the ball or ſocket, when a large long head is received into a cavity, as the head of the *os fremoris* into the *acetabulum coxendicis*. (C) See plate OSTEOL. *fig.* I.

Arthrodia is when a round head is received into a ſuperficial cavity; as in the articulation of the *arm bone* and *ſcapula*; where the head of the *humerus* is received into the *glenoid* cavity of the *ſcapula*; and the heads of the *metacarpus* or *metatarſus* are received into the cavities of the firſt *phalanx*. See D. *ib*.

Ginglymus (which properly ſignifies the hinge of a door) is that ſort of articulation, where two bones receive each other mutually, allowing motion two ways. Thus the bone of the *carpus* is received into that of the *cubitus*, and that of the *cubitus* into that of the *carpus*. See E. *ib.* This is what workmen call *charnal*.

This *ginglymus* is generally divided into *proximus*, *longus*, and *compoſitus*.

Proximus is when a *bone* has ſeveral protuberances and cavities, which anſwer to as many cavities and proceſſes of the other bone, with which it is articulated; as in the conjunction of the *femur* with the *tibia*. See O. *ib.*

Longus is when a bone receives another at one end, and is received by the *ſame* bone at the other extremity, as in the *radius* and *ulna*. See P. *ib.*

Compoſitus is when a bone receives another, and is received by a third, as in the oblique proceſſes of the *vertebræ*.

I ſhall add Dr. MONRO's opinion on the *ginglymus*. I would, (ſays the *Doctor*) reckon that articulation, by the form of which, the motion of the joined bones muſt be chiefly confined to two directions, in the manner that the hinges of a door are confined.

The firſt ſpecies of which is the *trochoides*, when the one bone turns on the other, as a wheel does on its axis; or the *firſt vertebræ* of the neck moves on the tooth-like proceſs of the *ſecond*; which is a moſt proper kind of *ginglymus*, though commonly neglected by the modern writers.

The ſecond ſpecies ſhould be eſteemed that articulation, where ſeveral prominent and hollow ſurfaces of two bones move on each other within the ſame common ligament; as in the *knee*, *elbow*, &c.

The third ſort is when two bones are articulated to each other at different parts, with a diſtinct *apparatus* of the motory machines at each; ſuch as the articulation of the *os occipitis* with the firſt *vertebra* of the neck, and of the *aſtragalus* with the *calcaneum*, &c.

SYNARTHROSIS, the ſecond part of articulation, is ſo firm and ſo ſtrong that it has no diſtinct motion. See G. *ib.*

It is ſubdivided into *ſuture*, *harmonia*, *gomphoſis*, and *ſchyndyleſis*.

Suture is that articulation where two bones are mutually indented into each other, or as if they were ſewed together. A ſuture may be either true or genuine; a falſe or a baſtard ſuture. The true ſuture is when two bones are joined like two ſaws, whoſe teeth meet cloſe together, as the *oſſa parietalia* with the *os coronale*. See H. *ib.* The falſe ſuture is when two bones are articulated in form of plates or *lamina* placed over one another, as the *parietalia* with the *os temporum*. See I. *ib.*

Harmonia is when the bones are joined in a ſimple ſtreight, or a circular line, as the bones of the face, noſe and palate. See K. *ib.*

Gomphoſis is a compact articulation, on the fixing of one bone into another, as a nail is fixed in a board; thus the *teeth* are ſecured in their ſockets. See L. *ib.*

Schyndyleſis or *plough*, is when a thin *lamella* of one bone is received into a long narrow furrow of another, as the *proceſſus azygos* of the *ſphænoid* bone, and the naſal proceſs of the *ethmoid* bone, are received by the *vomer. Ib.*

To theſe ſome add the *amphiarthroſis* or articulation. which cannot be reduced either under *diarthroſis* or *ſynarthroſis*; becauſe it has not a manifeſt motion; and yet it is not totally void of motion. Of this kind they mention the articulation of the *coſtæ* with the *vertebræ* of the back, and of the bones of the *carpus* and *tarſus* with one another. See M. M. *ib.*

Symphysis properly ſignifies the concretion or growing together of parts, when uſed to expreſs the articulation of bones. Dr. Munro ſays, it does not ſeem to comprehend under the meaning generally given to it, any thing relating to the form or motion of the conjoined bones; but by it moſt authors only denote the bones to be connected by ſome other ſubſtance. We ſhall define it, a *natural union or adheſion*, as when bones that were, at firſt, plainly diſtinct, ſeem to be grown together, as one bone.

This union being made either by ſome intermediate ſubſtance or without it, and there being different ſubſtances ſerving to this purpoſe, the *ſymphyſis* is divided into *three* ſpecies, *viz.*

Synchondroſis, where a *cartilage* is the connecting ſubſtance joining the *ribs* to the *ſternum*; as it is alſo in the connection of the *vertebræ*, and of the *oſſa pubis.*

Synneuroſis or *Syndeſmoſis*, when *ligaments* are the connecting bodies: as in all moveable articulations.

Syſſarcoſis or *ſyſurcoſis*, where bones have no other ligaments but the fleſh; and the muſcles are ſtretched from one bone to another.

If we enquire into the *cauſe* or *origin* of Bones, it will be found that they are generated from the ſeminal liquor elaborated by natural heat, as are all the other parts of the human body.

Here it will be neceſſary to reviſe what has been ſaid concerning the *perioſteum*, the *generation* and *figure* of Bones on page 40, and to ſay ſomewhat of the *cartilages* and *ligaments*, ſo frequently mentioned,

Cartilages are ſolid, ſmooth, white, elaſtic ſubſtances, and almoſt of the ſame nature with *bones*; from which they differ only, in more or leſs; and are covered with a membrane named *perichondrium*, of the ſame ſtructure and uſe of the *perioſteum* in *bones.*

The *cartilages* are compoſed of plates: which are formed of fibres diſpoſed much in the ſame way, as thoſe of *bones* are, and *blood veſſels* and *nerves* are alſo diſtributed to the *cartilages*, in much the ſame manner as to the *bones.*

They are of three ſorts: ſome are hard and become quite bony in time; as thoſe, which compoſe the *ſternum*, and thoſe that connect the *appendages* to the principal *bone*; others are ſofter, and contribute to the compoſition of the parts, as in the *noſe*, *ears*, *xiphoides* and *coccix:* and others are very ſoft, of the nature of *ligaments* and called *ligamentary cartilages.*

They are different in *figure*, taking the name of ſuch things as they reſemble; as, *annular*, when ſhaped like a *ring: xiphoides*, when reſembling a *ſword*, &c.

Their ſituation is commonly in contact with the bones; but thoſe of the *larynx* and the eye lids don't touch them.

They have neither *ſenſation* nor *cavities*, and inſtead of marrow they have a viſcous flexible ſubſtance that preſerves them,

But as the ſpecefic gravity of *cartilages* is near one third leſs than that of *bones*; ſo the coheſion of the ſeveral plates, is not ſo ſtrong as in *bones:* whence it is to be remarked, that *cartilages* laid bare in wounds or ulcers, are not only more liable to corrupt, but exfoliate much ſooner than *bones.*

Cartilages ſeem to be principally kept from *oſſifying* either by being ſubject to alternate motions of flexion and extenſion; or being conſtantly moiſtened. They that oſſify begin the *metamorphoſis* or their external ſurface, and the oſſification proceeds internally, till the *cancelli* are at laſt formed. Then we may find a ſort of *marrow* depoſited in them; and that the *blood veſſels* decreaſe on the external, and grow more viſible towards their internal ſubſtance.

This change is always made ſooneſt and moſt remarkably where the preſſure is greateſt, *i. e.* at their external ſurface. But the cartilage ſtill retains its former dimenſions. Becauſe what is loſt is the coheſion of the plates, is recovered by a cavity formed in the middle for to receive the marrow.

The *cartilages*, which are ſubſervient to *bones*, are ſometimes found the extremities of *bones*, which are joined to no other; but are never wanting on the ends and in the cavities of ſuch bones as are deſigned for motion. Beſides we find them interpoſed between ſuch other cartilages, as cover the heads and cavities of *articulated bones*, and ſometimes between *immoveable bones.*

The *uſes* of *cartilages* are to hinder the *bones* from hurting one another by mutual colliſion; to join them together in divers places by *ſynchondroſis*, and

and to contribute much to the better ſhape of many parts, as may be ſeen in the *noſe*, *ears*, *trachæa*, *eye-lids*, *&c.*

LIGAMENTS are a ſolid white ſubſtance, thicker and firmer than the nerves or membranes, and not ſo hard and firm as the cartilages or griſtles, without any remarkable cavity in their ſubſtance, ſtretched with difficulty and with little elaſticity; ſerving to connect one part to another, or to prevent the parts, to which they are fixed, from being moved out of that ſituation, which is uſeful and ſafe.

Some of them are ſtrong placed within between the bones. Some are thick and round, called *cartilaginous ligaments*; and others that cover the *bones* outwardly, are thin. and of a membranous nature. Others are called *membranous* and *nervous ligaments*, only from the reſemblance they bear, in their figure, to a *membrane* or *nerve*.

It is allowed that *ligaments* are void of motion; and ſome would have it that they are void of ſenſation alſo. But they, who aſſert their inſenſibility would do well to conſider from whence comes all that excruciating pain, felt on the leaſt motion of a joint labouring under a *rheumatiſm*, the ſeat of which diſeaſe ſeems often to be in the *ligaments*; and whence that inſufferable torture occaſioned by a collection of acrid matter in a joint, or by *tophi* in the *gout*. In both caſes it is evident that *ligaments* are abundantly ſupplied with *nerves*, and ſubject to diſeaſes.

Ligaments are compoſed of *layers*, and each layer of fibres, the largeſt of which are diſpoſed in a longitudinal direction. Into this compoſition there enter *arteries* diſcoverable by injection; and *veins*, which ſometimes diſtend with blood. Beſides, as it is certain that ſuch *ligaments*, as form the ſides of cavities, have numerous orifices of their *arteries* opening upon their internal ſurface, which keep it always moiſt with an ouzing liquor from ſmall pores; theſe exhalent arteries muſt have correſponding abſolvent *veins*; otherwiſe the cavities would ſoon be too full of liquor,

It is obſerved that in whatever articulation the *ligaments* are few, long, and weak, motion will be more free and quick; and luxations more frequent: But where the ligaments are numerous, ſhort and ſtrong, the motion will be more confined and the luxations more rare.

Sometimes *ligaments* ſupply the place of *bones*; thus the parts of the *pelvis* are more ſafely ſupported below by ligaments than they would have been by a bone. They afford convenient origin for *muſcles* placed between the *bones* of the fore-arm and the leg, and in the great holes of the *oſſa innominata*. Again the *oſſa innominata* and the *os ſacrum* ſhew that the immoveable bones are more firmly connected by them; and they make a ſocket for moveable bones to play in; as we ſee part of the *aſtragalus* does on the *ligaments* ſtretched from the *heel bone* to the *ſcaphoid bone*.

The liquor, which principally ſerves to moiſten the *ligaments* and *cartilages* of the articulations, is ſupplied by *glands*, commonly ſituated in the joint; in ſuch manner as to be gently preſſed, but not deſtroyed by its motion. Thus, when there is moſt need for this liquor, *i. e.* when the greateſt motions are performed, the greateſt quantity of it will be ſeperated.

Theſe *glands* are ſoft and pappy, but not friable. They are moſtly of the conglomerate kind, or a great number of ſmall glandules are wrapt up in one common membrane. Their excretory ducts are long and hang looſe, like ſo many fringes, within the articulation.

But beſides theſe glands, *Morgagni* has obſerved, that here are alſo certain ſmall ſimple *folliculi* full of liquor.

This mucilaginous liquor preſſed out of the glands reſembles the white of an egg, or *ſerum* of blood, and is ſalt to the palate; and of all diſcharges of wounds and ulcers this mucillage makes a conſiderable part.

Thoſe *glands*, in a ſtate of ſanity, don't ſeem to have any ſenſe; but when inflamed and ſuppurated, they ſuffer moſt racking pain; which is a proof that they alſo have *nerves*. And when this liquor of the articulation becomes too thin, and unſerviceable by being conſtantly pounded and rubbed between the moving bones, it is reaſſumed into the maſs of blood by the abſorbent veſſels. On the other hand, it will inſpiſſate (for want of rubbing between the *bones* of the articulation) ſo much, that when the head of a *bone* has been long out of its cavity, this liquor will fill up the place of the bone, and hinder its reduction; and if the joint has continued long unmoved, it will cement the bones of the articulation, and cauſe a true *anchyloſis*. If it becomes too acrid, the cartilages and bones will be eroded, as in the *ſcurvy*, *pox*, *&c.* When it ſeperates in too ſmall a quantity, the joint becomes ſtiff; and when with difficulty it is moved, a crackling noiſe is heard: as they, who are advanced in years, frequently experience. If it be depoſited in too great a quantity, and the abſorbent veſſels do not perform their office ſufficiently, it may occaſion a dropſy of the joints; or it becomes acrid and occaſions ſwellings or pains in the joints, long ſinuous ulcers or *fiſtulæ*, rotten bones, and immobility of the joints. See theſe caſes in *Chirurgie* de AMBR. PARE lib. 15. c. 18. HILDANUS *obſervat.* cent. 3. obſ. 77. *De Ichore & melicerie* *liceria acri Celſi.* Galen *de uſu part.* lib. 12. c. 2. Aquependente *de articul. part. utilitat. pars.* 3. and Hippocrates *de locis in homine et de articul.*

I ſhall conclude this general deſcription of the *bones*, &c. with an account of their *number*.

It is the moſt received opinion, that makes the number of bones 249 in the whole *human body*, *viz.*

In the *head* ſixty.
In the *trunk* ſixty-ſeven.
In the *arms* and *hands* ſixty-two.
In the *thighs* and *legs* ſixty.

The Bones in the Head are

In the Cranium fourteen; which are the *os coronale*, *os occipitis*, the two *bregmas* or *parietalia*, the two *temporal*, the *os ethmoides*, *ſpenoides*, the ſix *auditory bones*, or the *incus*, *ſtapus* and *malleus* on each ſide.

In the Face are the *os hyoides*, twenty-ſeven in the *upper mandible*, the *cheek* bone, the *nail* bone, the *maxillary* or *jaw* bone, the bone of the *noſe*, and the ſame number on the other ſide. The *eleventh*, which is ſingle, having no fellow, is like a *plough ſhare*. There are ſixteen upper *teeth*, and eighteen in the lower *mandible*, *viz.* two *bones* and ſixteen *teeth*.

The Bones in the Trunk are

Thirty-two in the *ſpine* and twenty-nine in the *breaſt*; thoſe of the *ſpine* are ſeven in the *neck*, twelve in the *back*, five in the *loins*, five in the *os ſacrum*, and three in the *coccix* or *rump bone*. Thoſe of the back are the four and twenty *ribs*, the two *clavicules*, and three in the *ſternum*. There are alſo ſix *oſſa innominata*, which are the two *ilia*, the two *iſchia*, and the two *oſſa pubis*.

The Bones in the Arms and Hands are

Thirty-one in each *hand* and *arm*, *viz.* the *ſhoulder-blade*, the *humerus*, *cubitus*, *radius*; eight in the *wriſt*, four in the *metacarpus*, and fifteen in the *fingers*. The ſame number in the other arm and hand.

The Bones in the Thighs, Legs and Feet are

Thirty on each ſide; as the *femur*, *rotula*, *tibia*, *fibula*, ſeven in the *tarſus*, five in the *metatarſus*, and fourteen in the *toes*.

The Anatomy of the Human Bones.

Here we ſhall treat of the *ſkeleton*, which we define the arrangement of the bones of a dead animal, dried, cleanſed, and diſpoſed in their natural ſituation by art

The human *ſkeleton* of which we treat is generally divided into the *head*, the *trunk*, the *limbs*, or the *ſuperior* and *inferior extremities*.

Of the Head.

The Head is defined by *Hippocrates*, a bony part, conſiſting of two tables, woven together with the *diploe* between them, and covered outwardly with the *pericranium*, and lined inwardly with the *dura mater*.

The Head is all that ſpheroidal part placed above the firſt *vertebra* of the neck, and comprehends the *cranium* which is covered with hairs, and the bones of the *face*.

The *cranium*, (gr. the helmet or brain caſe) conſiſts of ſeveral pieces, which joined, form a vaulted cavity for lodging and defending the brain, *cerebellum*, membranes and veſſels: and it is divided into two tables, like two *lamina* laid upon one another. Between theſe tables is the *diploe* or a medullary ſubſtance, full of little cells of different ſizes, which receive the arteries from the brain, and tranſmit the veins into the ſinus of the *dura mater*. Between thoſe tables is lodged the blood, which nouriſhes the *cranium*, and drops through upon boring the firſt table with the *trepan*.

The *cavity* of the *cranium* is proportionate to its contents; and its *roundiſh* figure is chiefly formed by the equal preſſure of the contents, as they grow and increaſe, before it is entirely oſſified; but ſome what alſo to the management of nurſes: to whoſe bandages it is owing that, amongſt the *Turks* we commonly find the ſcull globular; in *Germany* the *occiput* is broad and flat: and the *Dutch* and *Engliſh* are known by their oblong ſhapes. A form moſt to be deſired; becauſe it enlarges the ſphere of viſion, and ſerves both to help the hearing and to cover the ears from external injuries.

The external ſurface of the upper part of the *cranium* is ſmooth, and equally covered with the *pericranium*, the thin frontal and occipital muſcles, their tendinous *aponeuroſis*, and with the common tegaments of the body. But the external ſurface of the lower part is all full of riſings, depreſſions, and holes.

The internal ſuperface of the upper part of the *ſcull* is commonly ſmooth, except where the veſſels that creep upon the *dura mater* have made it otherwiſe, while the bones were ſoft, or the *cranium* moiſt and cartilaginous. Therefore care muſt be taken when we trapan here, that we don't wound the veſſels of the *dura mater* by that operation.

In the upper part of the internal ſurface of ſeveral *ſculls* are found pits of different ſizes and figures. There the *ſcull* is ſo much thinner than in other parts, and it is often rendered diaphorous; the two tables in ſuch caſes being cloſely compacted with a *diploe*; whoſe deficiency is ſupplied by veſſels going from the *dura mater* into a great many holes obſervable in the pits. Therefore in performing the *trepan* great care ought to be taken not to hurry too much; becauſe in ſuch a patient the brain may be injured before the inſtrument has pierced near the ordinary thickneſs of the *ſcull*.

The holes of the *cranium* give paſſage to the *medulla ſpinalis*, and to the nerves, arteries, and veins; which fill up thoſe holes ſo exactly, that neither vapours nor fumes, can come into them, nor go through them, but by means of the veſſels themſelves.

The *diploe* found between the tables of the *cranium* has much the ſame texture as the *cancelli* of the bones, and contains marrow, which ſeems bloody, on account of the numerous veſſels ſpread on its membranes, and its uſe is here the ſame as the *cancelli* and marrow in other bones. But the *diploe* is ſcarce to be found in ſome old ſubjects, nor in ſome of the hard craggy bones at the baſe of the ſcull. Therefore let not the operator of a trapan truſt to the bleeding, want of reſiſtance, and change of ſound, for knowing when his inſtrument has ſawed through the firſt table, and reached the *diploe*.

The bones of the *cranium* are already numbered. Theſe are diſtinguiſhed by the junctures called *ſutures*, known by the names of the *coronal*, *lambdoid*, *ſagittal*, and the true *ſquamous*.

The *three* firſt are indented like the teeth of a *ſaw*, and are therefore termed *true ſut res*.

The *ſquamous* are called *falſe ſutures*, becauſe they join like the *ſcales* of fiſh.

Beſides theſe *five*, called *proper ſutures*, anatomiſts have deſcribed *four* more called *common ſutures*, namely, the *tranſverſal*, *ethmoidal*, *ſphenoidal*, and *zygomatick*; which ſeparate the bones of the *cranium* from thoſe of the face.

The *coronal* ſuture is ſo called from its circular figure, and it extends itſelf over the head, from within an inch or ſo of the external canthus of the eye, to the like diſtance from the other; thus, joining the *os frontis* with the bones of the *ſinciput*. See plate Osteol. A. on the *ſcull*.

The *lamdoid* ſuture, formed in the ſhape of the *Greek* letter Λ *lambda* begins below and further back than the *vertex* or crown of the head; whence its two legs are ſtretched obliquely downwards, and to each ſide as far as the *baſe* of the *ſcull*. See B. *ib.*

The *ſagittal* ſuture reſembles an arrow by its ſtraitneſs, goes from the *coronal* on the upper part of the head to the *lamdoid*, and joins the two bones of the ſinciput in their uppermoſt part. This ſuture is ſometimes continued through the middle of the *os frontis* down to the noſe. See C. *ib.* And it is found by *Veſſalius* and others, ſometimes to divide the *occipital* bone, as far down as the great hole, through which the *medulla ſpinalis* paſſes. See *Veſſalius* in lib. I. c. 6. *Paaw* in Celſ. de *remedic.* c. I. and *Laurent.* in hiſt. anat. l. 2. c. 16.

In old ſculls theſe three ſutures are ſometimes ſo ſtrongly united, that they ſeem to be but one entire piece.

The *ſquamous* ſutures join the upper and ſmaller parts of the *os petroſum* with the *parietalia*, or bones of the *ſinciput*. See D. *ib.* Theſe ſutures are one on each ſide of the ſcull, ſeated a little above the ear, of a ſemicircular figure, formed by the overlapping (like one ſcale upon another) of the upper part of the *temporal* bones on the lower part of the *parietal*. *Note*, In both bones there are a great many ſmall riſings and furrows indented into each other; though theſe inequalites don't appear till the bones are ſeperated; except in ſome few ſubjects; and always in the poſterior part of this ſuture.

Veſſalius and *Winſlow* remark, that the true *ſquamous* ſutures join all the edges of the bones, on which the *temporal* muſcles are placed, and are not confined to the conjunction of the temporal and parietal bones. See *Veſſalius*'s anat. l. I. c. 6. and the *Memoires de l'acadam. des ſciences* 1720.

The *tranſverſal* or tranſverſe ſuture takes its name from its croſſing the face from ſide to ſide; from the external *canthus* of one orbit to the ſame place of the other, by ſinking from the *canthus* down the outſide of the orbit to its bottom; then mounting upon the inſide, it is continued by the root of the noſe down the internal part of the other orbit, and up again to the other *canthus*; though not without ſome interruption in its courſe.

The *ethmoidal* is ſo called from incircling the *os ethmoides*, which it ſeperates from the adjacent bones. See E. *ib.*

The *ſphæroidal* ſuture is ſo named from its encompaſſing the *os ſphæroides*, which it ſeperates from the *os coronale*, *os petroſum* and *os occipitis*. See F. *ib.*

The *zigomatick* ſutures derive their name from their ſituation in the *zigoma*; they are very ſmall and ſeperate the *os petroſum* from the cheek bones. See G. *ib.* They are ſhort and ſlanting from above obliquely downwards and backwards to join the poſterior proceſs of the cheek bone to the proceſs of the *os temporum*, which advanceth towards the face. Thus the two proceſſes united form a kind of

bridge

bridge or *jugum*, under which the temporal muſcles paſſes.

It muſt be obſerved, ſays *Monro*, that the indentations of the ſutures do not appear on the inſide of the *cranium*, near ſo ſtrong as on the outſide: but the bones ſeem almoſt joined in a ſtreight line; and in ſome ſculls the internal ſurface is found entire, though the ſutures are manifeſt without.

The principal *uſes* of thoſe *ſutures* are reduced to the following particulars. 1. For the adheſion of the ligaments, which tie the *dura mater*. 2. For a paſſage to the veſſels, which go in and come out of the *diploe*. 3. To help perſpiration; for where the ſutures of the *cranium* are too much cloſed, there the head is ſubject to intolerable pains; for want of a due perſpiration. For further ſatisfaction conſult *Monro*'s anatomy of the bones, page 71.

The Bones of the Cranium are next to be conſidered and explained.

They are divided into *proper* and *common*.

The *proper bones* are the *os coronale*, or *frontis*, *os occipitis*, the two bones of the *ſinciput*, and the two *parietal* bones.

The *common bones* are the *os ſphænoides* and *os ethmoides*.

The *os coronale* or *frontis* takes its name from its ſituation. It is placed in the uppermoſt part of the face, and the foremoſt of the *cranium*, and makes the forehead or front: and it is bounded above by the coronal ſuture, and below by the tranſverſe. By the firſt it is joined with the bones of the *ſinciput*, and by the ſecond to thoſe of the noſe and cheek; as well as to the *ſphænoides* by the *ſphænoid* ſuture.

This bone has ſome reſemblance in its ſhape to the ſhell of a cockle; for the greateſt part of it is convex externally and concave internally, with a ſerrated circular edge; though the ſmaller part has proceſſes and depreſſions, which make it of an irregular figure.

Its *external* ſurface is perfectly ſmooth at its upper convex part; but ſeveral proceſſes and cavities are obſervable below; for at each angle of each orbit the bone juts out, to form four proceſſes, two internal and two external; which from this ſituation may be named *angular*. Between the internal and external angular proceſſes of each ſide an arched ridge is extended, on which the eye brows are placed. Juſt above the internal extremity of thoſe *ſuperciliary* ridges is a protuberance in moſt ſculls, where the bone is protruded to make a room for two large cavities. Between the internal regular proceſſes riſes a ſmall proceſs, which helps to form the noſe, and ſo is called *naſal*. From the under part of the *ſuperciliary* ridges, the *os frontis* runs a great way backward, and hence thoſe parts are termed *orbitar* proceſſes; and theſe, contrary to the reſt of this bone, are concave externally, for receiving the globes of the eyes, with their muſcles, fat, *&c.*

In each of the *orbitar* proceſſes, behind the middle of the *ſuperciliary* ridges a conſiderable ſinuoſity is obſerved, where the *glandula innominata Galeni*, or *lacrymalis*, is lodged.

Behind the internal angular proceſſes a ſmall pit may be remarked, where the cartilaginous pully of the *muſculus obliquus major* is fixed

Between theſe two *orbitar* proceſſes a large diſcontinuation of this bone is to be ſeen, into which the cribriform part of the *os ethmoides* is incaſed, and the *frontal* bone, where it is joined to the *ethmoid* has frequently [illegible] formed in it.

Behind the external angular proceſſes the ſurface of the *frontal* bone is conſiderably depreſſed, where part of the temporal muſcles are placed.

The *foramina* or holes obſervable on the external ſurface of the *os frontis* are three in each ſide.

One in each *ſuperciliary* ridge, a little remove from its middle towards the noſe; through which a twig of the *ophthalmick* branch of the fifth pair of nerves paſſes out of the orbit, with a ſmall artery from the *carotid*, to be diſtributed to the teguments and muſcles of the forehead.

In ſome ſubjects inſtead of a hole, only a notch is to be ſeen. And in others nothing of the hole is left: But in others both hole and notch are obſerved, when the nerve and artery run ſeparate. Sometimes a hole is found on one ſide and a notch on the other: Again ſometimes there are two holes; or one common hole without, and two diſtinct entries internally. Near the middle of the inſide of each orbit, near or in the *tranſverſe ſuture* there is a ſmall hole left for the paſſage of the *naſal* twig of the firſt branch of the fifth pair of nerves. This hole is ſometimes entirely formed in the *os frontis*; ſometimes the ſides of it are compoſed of this laſt bone and the *os planum*; and it is commonly known by the name of *os orbitarium internum*, tho' *poſterius*, ſays Dr. *Monro* ſhould be added, becauſe of the next which is generally omitted.

This which may be called *os orbitarium internum poſterius* is like the former, only ſmaller, and about an inch deeper in the orbit. Through this a ſmall branch of the internal *carotid* artery, ſent off before it pierces the *dura mater*, paſſes to the noſe.

Beſides theſe ſix there are a great number of ſmall holes obſervable on the outward ſurface of this bone, as on the eye brow; under which the *ſinuſes* are. But few of theſe penetrate further than the *ſinuſes*, or than the *diploe*, where the *ſinuſes* *es* are wanting. Dr. *Monro* writes that he has ſeen the *os frontis* ſo perforated by a vaſt number of theſe ſmall holes, that placed between the eye and a clear light, it appeared like a ſieve; and he adds, that in the orbit of the generality of *ſkeletons*, we may obſerve, are two or more holes, which allow a paſſage to a hog's briſtle through the ſcull; that their number is uncertain, and that they generally ſerve for the tranſmiſſion of ſmall arteries or nerves.

The *internal ſurface* of the *os frontis* is concave, except at the *orbitar* proceſſes, which are convex to ſupport the *anterior* lobes of the *brain*. This ſurface is not ſo ſmooth as the external.

The *ſinuoſities* from the luxuriant riſings of the *brain* are often obſerved on its upper parts; and its lower or fore parts are marked with the contorſions of the anterior lobes of the *brain*.

Through the middle of this internal ſurface, where always in children and frequently in old people the bone is divided, either a ridge ſtands out, to which the upper edge of the *falx* is faſtened, or a furrow runs, in which the upper ſide of the ſuperior longitudinal *ſinus* is lodged: therefore, on both theſe accounts chirurgical authors juſtly diſcharge the application of the *trepan* here. *Monro* is of opinion that this variety may be owing to the different times of a complete oſſification of theſe parts in different ſubjects. (*ib.* 78.)

Immediately at the root of this ridge or furrow is a ſmall hole, which ſometimes pierces through the firſt table, and in other ſculls opens into the ſuperior *ſinus* of the *ethmoid* bone within the noſe. In this is lodged a little proceſs of the *falx*, and a ſmall artery, and ſometimes a vein runs; and the ſuperior longitudinal *ſinus* begins here.

This hole however in ſome ſculls is found with its lower part formed in the ſuperior part of the baſe of the *criſta galli*, which is a proceſs of the *os ethmoides*.

The *diploe* is alſo exhauſted in that part above the eye brows where the two tables of the bone ſeparate by the external's being protruded outwards to form two large cavities, called *ſinus frontales*, which are divided by a long perpendicular partition. But their capacities are ſeldom equal in the ſame ſubjects; and in different bones they ſometimes are not to be found.

Each *ſinus* commonly opens by a roundiſh ſmall hole, at the inner and lower part of the internal angular proceſſes, into a *ſinus* form'd in the *noſe*, at the upper and back part of the *os unguis*; near to which, according to COWPER, there are ſome other ſmall *ſinuſes* of this ſame bone, the greater part of which open ſeparately near the *ſeptum narium*, and often terminate in the ſame common channel with the large ones.

In a natural and ſound ſtate the cavities are of great advantage; by this enlargement of the organ of *ſmelling*, the effluvia of odoriferous bodies will with more difficulty eſcape it. Again, theſe and other cavities, which open into the noſe increaſe the ſound of the voice, and render it more melodious, by ſerving as ſo many vaults to reſound the notes: and the want of theſe cavities is ordinarily the cauſe of a diſagreeable voice.

This is ſufficient to ſhew the danger of applying the *trepan* on this part of the ſcull; becauſe inſtead of penetrating to the ſcull, it could reach only to the *ſinuſſes*: beſides other inconveniencies and dangers.

The upper circular part of the *os frontis* is joined to the *oſſa parietalia* from one temple to the other, by the *coronal* ſuture: and from the end of the *coronal* ſuture to the external angular proceſſes it is connected to the *ſphænoid* by the *ſphænoidal* ſuture. At the external *canthi* of the eyes, its angular proceſſes are joined by the *tranſverſe* ſuture to the *oſſa malarum*, to which it adheres one third down the outſide of the orbits: whence to the bottom of theſe cavities, and a little upon the internal ſides, thoſe orbitar proceſſes are connected to the *ſphænoidal* bone by that ſame ſuture in moſt ſubjects.

On the inſide of each orbit the orbitar proceſs is indented between the cribriform part of the *ethmoid* bone, and the *os planum* and *unguis*: the *tranſverſe* ſuture afterwards joins the *frontal* bone to the ſuperior *naſal* proceſſes of the *oſſa maxillaria ſuperiora*, and to the *oſſa naſi*. And finally, its *naſal* proceſs is connected to the naſal lamella of the *ethmoid* bone.

The *ſecond bone* of the CRANIUM is OS OCCIPITIS. This bone is oppoſite to the *os frontis* or *coronale*: and is the hardeſt in the ſcull. It is of an oblong figure, compoſed of five ſides or two circular lines that terminate in a point; placed on and incloſing all the hinder part of the head; bounded by the *lambdoid* and *ſphænoidal* ſutures; by which it is joined to the bones of the *ſinciput* and the *os ſphænoides*.

The ſolid parts of this bone are two proceſſes received into the *glanoide* cavities of the firſt *vertebra*, and join the head with the ſpine by *ſynarthroſis*.

The hollow parts are divided into two *common*, and five *proper* holes. The *common holes* are found, one on each ſide the *os petroſum*, and give paſſage to the *nervi vagi*, and to the internal jugular veins. The *proper holes* are, firſt, that ſingle large hole through which the *medulla ſpinalis* paſſes, and alſo

 the

the *vertebral arteries*, which ſlip into a little notch behind the *condyli* of the *os occipitis*, as they pierce the *dura mater:* two others give paſſage to the ninth pair of nerves, which diſtribute themſelves wholly in the tongue; and the two laſt are an opening to let the vertebral veins come out.

The *os occipitis* hath four *pits*, two lower ones, which are the greateſt, and ſerve to lodge the *cerebellum*; and two upper and ſmaller, and contains the poſterior lobes of the *brain*, ſeparated from the *cerebellum*, by a *tranſverſe* incloſure, formed by the *dura mater*; to hinder the *cerebellum* from ſuffering compreſſion.

The *third* and *fourth* bones of the *cranium*, are thoſe of the Sinciput, and called *oſſa parietalia*. from their being a kind of *wall* to the *head*; the ſides whereof they poſſeſs entirely; they ſurpaſs in magnitude all the other bones of the head; are of a ſquare figure, and joined together in their upper part, by the *ſagittal* ſuture; in their anterior part to the *os frontis*, by the coronal to the *os occipitis*; in their under part, by the *lambdoide*, and to the *os petroſum*, in their lower, by the *ſquamous* ſuture.

Theſe bones have their external ſurface very ſmooth; but their internal is unequal, by reaſon of the impreſſions that repreſent the upper ſide of a fig-leaf, and which have been made by a branch of the external *carotid*, which makes a kind of wrought-work on the *dura mater*, that covers all which lies under theſe bones. See *ib.* M. on the *ſcull*, and M on the *fig.* at the tip of the *jaw*.

They have each a little hole near the *ſagittal* ſuture, through which paſs the branches of the external *jugular*, to receive the ſuperfluous blood that could not be uſed in nouriſhing the teguments, and to diſpoſe it into the longitudinal *ſinus* of the *dura mater*.

The *fifth* and the *laſt* bones of the *cranium*, are thoſe of the *temples*, (NN *ib.*) divided, by the *Anatomiſts*, into an upper part, whieh is ſemicircular; and an under part, which reſembles a rock. They are placed on the ſide, and the lower part of the head, and circumſcribed upward by a ſuture, called *falſe* ſuture, and thereby united to the bones of the *ſinciput*; behind, to the *os occipitis*, by the *lambdoide* ſuture; and forward and below, with the *os ſphænoides*, by the *ſphænoidal*. *See* the *fig.* of the *ſcull* and the *piece* marked N.

The parts of theſe bones are *prominent* and *hollow*. The protuberant parts of the *os petroſum*, are their internal or external proceſſes. The internal are two, one on each ſide like a great rock, in which are the *auditory* cavities, and the four little bones that belong to it. The external proceſſes are three, the *maſtoides*, the *apophyſis ſtyloides*, and the *zigomatick* proceſſes, which by advancing outwardly, and joining to the eminence of the *os malum*, form the *zigoma*.

The bone of the *temples* hath five holes, four externals and one internal: This laſt is internal, and called the internal *auditory* hole. The firſt of the external holes, is the external *auditory*, otherwiſe the conduct of *hearing*. The ſecond is called the oblique hole, it is large and of an oval figure, it opens obliquely into the canal or bony *ſinus*. The third is a little hole found at the bottom of two proceſſes, between the *apophyſes*, *maſtoides*, and the *ſtyloides*, through which comes forth the hard part of the *auditory* nerve; and the fourth of the external holes, is the canal of communication, which opens to the barrel of the *tympanum*.

The *pits* are likewiſe *internal* and *external*; the internal are two, and make the middle cavities of the *baſis* of the brain. The *external*, which are two alſo, ſerve for the articulation of the lower *mandible*. The *Sinuſes* are two; one in each of the *apophyſes maſtoides*.

In this rock which forms the *os petroſum*, there are four little bones, as you will find by the figure *ib.* marked O. P. Q. the *malleus*, (O) *incus* (P) *ſtapes* (Q) and the *os orbiculare*, which are thought as hard and as big *at firſt*, as ever they will be during the whole life; nevertheleſs they grow ſtronger with age, and are really harder at the end than they were at their firſt formation; though all of a *cartilaginous* nature.

In this rock there are three cavities, the *drum*, the *labyrinth*, and the *ſhell*. In the firſt of theſe cavities are placed thoſe four little bones which are articulated together, ſo that the proceſs of the *malleus* is tied to the *tympanum*, and articulated by its head in the cavity of the *incus*. The *incus* or anvil hath two legs, whereof the ſhorteſt is placed on the *tympanum*, and the longeſt on the *ſtapes* or ſtirrop. The *ſtapes*, whoſe two branches are placed on a large *baſis*, receive the little tubercle of the *incus* by its ſharp and external part. In infants is found a bone called *orbiculare*, (R in the piece under the foregoing *piece*.) It is circular like a ring, on which the *tympanum* or drum is ſtretched, as the ſkin of a drum is ſtretched on a barrel. This bone, diſcovered by *Silvius de la Boe*, is tied by a ſmall ligament to the *lateral* and upper part of the *ſtapes*.

The *os ſphænoides* (S in ths *fig.* on the upper right hand corner) is the firſt of the two bones that are common to the *ſcalp* and the *face*. It is thick in its *baſis*, and very thin in the cavity of the *temples*; it is ſufficiently large and hard, and accounted but one bone, although in infants it may be divided into four. It is of ſuch an extent that it touches all

all the bones of the *head*, and many of the upper *mandible*, with which it is united by a part of its future. The *sphænoides* hath, like the other bones of the head, its holes, pits and *sinus*.

It hath six holes. The *optick* through which the optick nerve passes. The great cleft in the *orbit*, through which the nervous branches of the 3d, 4th, 5th and 6th pass, together with the blood-branches of the *carotide* and *jugular*. Its third hole is under the aforesaid cleft; it is round, and gives passage to some of the branches of the fifth pair of nerves, but they are its lower branches. The fourth is a bony channel dug into the *os petrosum*, which goes obliquely to the saddle of the *os sphænoides*. In this channel or bony *sinus* the internal *carotide* lies, which rises thence towards the saddle. The fifth hole is the oval cleft, that lets the great branch of the fifth pair of nerves, which is the hinder branch, come forth. The sixth hole is a little round one, through which passes a branch of the external *carotide*, that make the resemblance of a Fig-leaf on the *dura mater*, under the bone of the *sinciput*.

Its pits are three in number, one internal on the saddle of the *os sphænoides*, and which serve as a basis for the *glandula pituitaria*; and two external placed in the *apophyses pterygoides*.

In the middle of the *os sphænoides*, under the saddle, are found two *sinuses* separated by a bony *lamina*, which open in the nose. These two *sinuses* are invested with a membrane altogether glandulous, and always covered with a *mucus*, because the little glands of this membrane separate from the blood a *serum*, which acquires consistence by its continuance in the *sinus*, and when they are full of it, this *mucus* is thrown out at the apertures into the hole, by mixing with the snivel it there meets.

The *Ethmoides* (T *ibid.*) is the last of the bones that are common to the scalp and face. It is the smallest of all the bones that compose the *cranium*, and is joined to the *os caronale* in its upper part by a common future called *ethmoidal*; and by the *sphænoidal* to the *sphænoides*. It is divided into three parts; the upper or sieve-like part, which hath abundance of little holes; the lower, which is spungy, and separates the cavity of the nostrils in two; and into lateral parts which are full and flat, and make part of the *orbit*.

This bone hath a prominence called *crista galli*; because it resembles the *comb of a cock*; it is very hard, and part of the *dura mater* is tied to this place called *falx*, which *falx* or *scythe* divides the *brain* into two parts.

From the Bones of the Head we proceed to those of the Face.

The Face consists of two *mandibles* or *jaws*, *viz.* the upper jaw which comprehends all from the eye to the bottom of the upper lip; and the lower jaw which extends from the top of the under lip to the end of the chin.

The upper jaw hath no motion, the lower, on the contrary, is moveable, since mastification is its office.

There are eleven bones in the upper jaw, five on each side, and one in the middle, *viz.* the bone of the nose, the *os unguis*, the *pomettæ*, the jaw-bone, the bone of the palate or roof of the mouth, and the share-bone. These bones are separated from the *cranium* by common futures, and joined together by *harmonia*, which is the cause that they have no motion.

The bones of the nose, (A in the *head* at the feet of the *first Skeleton*, ib.) tho' they be very thin, are of a solid substance; they are very small, and of a pyramidal figure; they are placed on the upper part of the nose, and compose what is called its *bridge*. These bones are terminated above by the transversal future, whereby they are joined with the *os frontis*, and on the sides by two *harmonia's*, that is, one of those futures joins them together, and is in the middle of the nose; and the other unites them with the two jaw-bones. These bones are smoother in their outward surface than they are in the inward, and their lower part is unequal and in slits, that the cartilages may the better stick to them.

The *French* call *os unguis* (B *ibid.*) two bones of the bigness and figure of a nail, placed at the great *corner* of the *eye*; they are of a thin substance like a scale, and the smallest bones of the upper jaw. These bones touch four other bones, the *os frontis*, the bone of the nose, the jaw-bone, and that part of the *os ethmoides*, which forms the orbit of the eye, though they hold fast to neither of those bones, and are seldom found in a *skeleton*; being easily lost in the boiling.

The *bones* of the *cheeks* which are the fifth and sixth bones, are very large, and of a hard and solid substance; their figure is triangular, their middle part is a little prominent outwards, and round like an apple. These bones compose the cheek and the lower part of the *orbit*; and are fastened to the *os frontis*, the *sphænoides*, the jaw-bone, and the *os petrosum*. Each of them hath three processes, one forms an eminence, which, rising upwards, makes the little corner of the eye; another advancing toward the nose, makes the greatest part of the lower eyebrow of the *orbit*, and the third joining with a prominence of the *os petrosum*, helps towards the formation of the *zigoma*.

The *jaw bones* (D *ibid.*) are the greatest of all the bones of the face, and the most spungy. They make some part of the cheek, contribute to the formation of the inferior part of the orbit; compose the greatest part of the palate, and articulate all the upper teeth. They are situated on the side, and under the bones of the *os malæ*, possessing the inferior part of the upper jaw; and they touch the bones of the nose, the palate, the *os malæ*, and those of the *orbita*.

These bones have also their holes, pits, and *sinus*. Their holes are internal and external; of the internal, which are four in number, two are called incisives, because directly under the teeth *incisores*; and the two others are placed on the lateral and posterior parts: the two external ones are called holes of the orbit, the nerves of the fifth pair pass through them, and are distributed into the face. There are sixteen pits in each jaw, which are the *alveoli*, in which sixteen teeth are fastened; and two *sinus* in each, situated along the extremities of the roots of the teeth.

The two bones of the *palate*, (E in the adjoining *fig*. of the internal structure of the face) which are the ninth and tenth bones of the upper jaw, are situated at the bottom of the palate, and make the deepest part of the roof of the mouth; they are joined together by the suture of the palate, which advancing forward near the *dentes incisores*, unite also the two jaw-bones: they are likewise fastened to the *apophyses*, *pterigoides*, by the *sphænoidal* suture. Each of them hath a hole called *foramen gustavium*, through which passes a branch of the fifth pair of the nerves: these bones are very hard, but so small that they make but the least part of the palate; they are almost square, being a little bigger than they are long.

The bone which divides the nostrils into two, is called the *plough-bone* (F *ibid.*) from its resemblance to the coulter of the plough; it is the eleventh bone of the upper jaw, is placed in the middle, above the palate, is hard and small, is a single bone, and is joined with the *os ethmoides* and *sphænoides*, which have both some small eminences that are received in the cavities of the plough-bone, and which thereby strengthen in its position.

The Orbits (GG in the *fig*. of the *outside*) of the eye, situated at the lower part of the forehead, appointed for a mansion to the eyes, and to defend them against all that may offer to hurt them; are of a pyramidal figure, and composed of six different bones, which, altogether, form their extent and depth. Of these bones there is one proper to the *orbit*, which is the orbitary-bone, situated in the great corner of the eye; and five common, as the *os frontis*, which forms the superior part of the *orbit*, and serves for an arch to it; the *ethmoides*, which makes the lateral part of it, towards the nose; and the *sphænoides*, which form the most inward part of it; these three bones belong to the *cranium*. The bone *de la pomette*, makes that part which is near the little corner of the eye; and the jaw-bone, that which is next the great corner.

The Zigoma (HH in the *fig*. of the *inside* face) is a union or coalition of two prominences of bones, whereof one comes from the temporal-bone, and the other from the cheek-bone: these prominences are joined by a small oblique suture; these two bones form an arcade, which hath two very considerable uses; one is to give passage to the muscle *crotaphytes*, and to serve for a defence to it; and the other is to give rise to the muscle *masseter*, whose office is, with the crotaphites, to help the mastication.

The lower jaw (II in the outside face and the separate bone marked I. L. L.) consists of two bones until the seventh year of age, after which they turn into one, joining together in their anterior and middle part by *symphysis* without a medium. They serve for *basis* to sixteen teeth articulated into them; their substance is very hard, that they may be strong enough to bite and chew.

The Teeth (L *ibid.*) are defined small hard bones, white and smooth, articulated in the jaws by *Gomphosis*.

They have no *periosteum*, and therefore have no sense of pain, but only at their root where the nerve enters.

Although the *teeth* exceed all the bones of the body in point of hardness, they nevertheless consume by their continual action and friction against one another; for which, cautious nature has given them vessels to convey them a matter, to nourish and repair them.

The time is not certainly fixed by nature for the expulsion of the teeth; some infants have had some teeth from their birth, and some not till they are a year or two old. Neither do the teeth come forth all at a time. Nature expels them one or two at a time; if they come three or four together, it is always very dangerous.

The infants have commonly twenty teeth in twenty months, which is all they ought to have at that age, the rest not coming forth for some years after.

The twenty first *teeth* are called the *milk-teeth*; they commonly fall, toward the sixth or seventh year, and then four more appear behind the former: at fourteen there comes four more; and four more at twenty; which put together, make up the whole number of *thirty-two*.

All the *teeth* are ranged in order, one by another, although sometimes there will happen a double row of them, which is a vicious confirmation, because it is both a deformity, and inconvenient.

Every

Every tooth hath its cavity in the middle, where the nerve is inserted. In that cavity a certain acrimony is sometimes found, which corrodes and spoils the tooth; and not worms, as vulgarly supposed.

The *teeth* have three different uses; the first and chiefest is for mastication; the second, to distinguish the voice; and the third for ornament.

The TEETH are divided into *incisores*, *dog-teeth* and *grinders*.

The INCISORES, (MM in distinct pieces under the *small* Skeleton A.) so called, because they cut the meat like a knife, are eight; four in each jaw, placed before the rest outwardly, and in the middle of the others. Their outward surface is like an arch; and the anterior is hollow; they are sharper and shorter than the rest; and each hath but one single root which terminate in a point.

There are four DOG-TEETH, (N in the adjoining *fig.*) two in each jaw; they are called dog-teeth, because they break the hardest bodies. Their situation is next to the *incisores*, one on each side; they are thick, strong, and solid, fastened in their *alveoli*, by single roots, like the *incisores*, but deeper; for they exceed all the rest in length. The upper *dog-teeth* are called *eye-teeth*; because part of the nerve, which moves the eye, is ramified, or branched toward them.

There are twenty *grinders*, (OO *ibid.*) ten in each jaw, and five on each side; they are large and hard, and encrease in bulk, according to their deeper situation in the mouth; they have divers roots, which serve the better to fasten them in their *alveoli*. The lower *grinders* have but two or three roots, and the upper ones three or four; because those upper ones being in a hanging position above, have occasion of a greater quantity to keep them fixed and firm.

The *os hyoides*, (P in the single piece or bone marked P only) the last of the sixty bones of the head, is placed at the *basis* of the tongue, upon the *larynx*, and kept in its place by ten muscles. It touches no other bone, but is tied above by bones. called its superior *cornua*, to the two *apophyses styloides* of the bone of the temples, by small *ligaments*; and below, at is inferior *cornua*, it its joined unto the two wings of the *cartilage theoroides* of the *larynx*, by ligaments of the same nature with those that tied its upper part, which is a true *syneurosis*. This bone is composed of five others, the greatest of which makes the *basis*. It resembles the *Greek* υ; and the *basis* is arched outwardly, and hollow within. Two other lesser bones are united to this, one on each side; and two very small ones are joined at the end of these last; which four bones makes the sides of the *os hyoides*, and what we call the *cornua*.

The principal use of this bone, is to facilitate the admittance of air into the *aspera arteria*, and the passage of meat and drink into the *œsophagus*, by keeping the *pharynx* in that just bigness it ought to have for the free passage of the nourishment.

Of the TRUNK.

From the bones of the *cranium*, I descend gradually to those of the SPINE.

The SPINE, is a complex of many bones articulated together, to serve for habitation and rampire to the marrow. It is divided into five parts, the neck, the back, the loins, the *os sacrum*, and the *coccyx*. If the *spine* be considered before, or behind, it appears direct and strait; but if on either side, it falls inward, or outward, both for its better support, and to remove from, or to approach to the part of the *thorax*, and the *abdomen*.

The sharp end of the *spine*, at the neck, bends inwards, the better to sustain the head which is there placed, as on a *pivot*.

The *spine* (A in *fig.* of the *back-bone*) serves to support the body, for the insertion of several muscles, and for the conveyance of the marrow. The parts it is composed of are called *Vertebræ*, from *verto* to turn, because the body turns several ways by their means.

Each of the *vertebræ* hath its body in its internal part, wherewith they support one another. They have all a great *foramen*, through which the *medulla spinalis* passes; all three sorts of processes, four oblique, two transverse, and one acute; and all five *epiphyses*, or appendages, *viz.* two at their body, two at the extremities of their transverse processes, and one at the end of their acute process. They are likewise all pierced through on their sides, for the passage of the nerves, that come through them; *i. e.* that two *vertebræ* make a hole between them, but one half of the hole appearing in each of them, the other half being hidden in the cartilage, which ties two *vertebræ* together.

There are seven VERTEBRÆ in the *Neck* (B *ib.*) more solid and harder than those of the back, (because their office is to support the head, which is a very weighty part) though they are smaller, for were they as big as those of the back and loins, the neck had not been able to move so easily as it does.

The first of these seven *vertebræ* is called ATLAS, (C in the *fig.* adjoining marked C) because it supports the head, which being of a round figure resembles the world, which the ancient poets have feigned to be borne by Mount *Atlas*. This *vertebra* hath no acute process, because the head don't move upon it, but upon the second; and

because

becauſe it being obliged to turn as often as the head has a circular motion, an acute proceſs would have diſcommoded the poſterior muſcles of the head, eſpecially the two little right muſcles which riſe from the ſecond *vertebra*, and are inſerted in the *occiput*.

This differs from the other *vertebra*, in that it is of a more delicate, thinner, and harder ſubſtance, and that it receives at both its extremities while the others receive on one ſide, and are received on the other; for two prominences of the *occiput* enter into its two ſuperior cavities, whereby it is articulated with the head; and, at the ſame time, two other prominences of the ſecond *Vertebra* enter its two inferior cavities, which join them both.

The articulation of the head is made on the anterior part of this *vertebra*, not on its poſterior, that it may be the better ſupported, and the better kept in its *æquilibrium*. This *atlas* giving paſſage to the *medulla ſpinalis*, as all the other *vertebræ* do, and receiving beſides the tooth of the ſecond, which paſſing thro' it, unites itſelf to the *os occipitis*; its aperture muſt be greater than that of the reſt.

The head and the firſt *vertebra* turning upon the ſecond as on a pivot, it is called for that reaſon the wheeling *vertebra*, (*ſee* the next *fig.* marked D) and from the proceſs, which riſes from the middle of its body, in the form of a tooth, *dentata*. This proceſs would expoſe the *medulla ſpinalis* to ſome dangerous compreſſion, was not the ſecond *vertebra* invironed with a ſtrong, ſolid and curious ligament; other particular ligaments join it with the firſt *vertebra*, and tie them both ſtrongly to the head.

The third *vertebra* is called the *axis*, (*ſee* the next *fig.* marked E) becauſe it begins to form a body, on which the two former *vertebræ* and the head are ſupported, as on an axle-tree. The four following have no particular name. There is only this to be obſerved, that the laſt hath no acute proceſs forked like the others, and that it begins to aſſume the figure of the *back*, (F in *fig.* of the *Back Bone*) which is compoſed of twelve *vertebræ*, larger than thoſe of the neck, and ſmaller than thoſe of the loins; tho' they are not at all equal, becoming larger and ſtronger in proportion as they deſcend lower. They are all of a pyramidal figure; have their proceſſes ſpiney, ſimple and acute, which reſt upon one another; their tranverſe proceſſes very large, for the articulation of the ribs faſtened to them; for each *vertebra* of the back articulates two ribs, both by its body and its tranſverſe proceſſes.

The firſt of theſe *vertebræ* (G in fig. adjoining marked G) being higher than the reſt is called *eminent*; the ſecond *axillary*, from its being neareſt to the arm-pit. The eight following, articulating thoſe ribs inwardly inveſted with the *pleura*, are called both coſtal and pleuretical. The eleventh (H in the next *fig.* marked H) is called the Direct, becauſe its acute proceſs don't bend downwards to reſt upon the next below; and the twelfth, Girdler, from its being ſituated in the place where girdles are worn.

The *vertebræ* of the *loins*, (I in the *fig.* of *Back. Bone*) becauſe they ſupport all the reſt, are thicker and larger than thoſe of the back; have not their articulations ſo cloſe and compact, that they may be free in their motions, and we able to ſtoop with more eaſe: have their proceſſes longer and finer, which ſerve there inſtead of ribs, the firſt and fifth of them excepted, which have them ſhorter. Thoſe proceſſes are nine in number, the aſcending ones which articulate them together being double. Their ſpines are alſo thicker and larger, the better to faſten them to the muſcles and ligaments of the back.

The *reins* or *kidneys* being placed on the ſide of the firſt of theſe *vertebræ*; or becauſe, perhaps it is in that place that the *nephretick* pain begins to be felt, is called *nephretick* (L in the next *fig.* marked L) or Renal. The three following next have no particular name; and the fifth, which is the prop and ſupport of the whole ſpine, is called Ασφαλτίτις.

If the OS SACRUM (M in *fig.* of *back bone*) derives its name from its being offered in ſacrifice to the Pagan divinities, or from its bigneſs, or from its encloſing the *pudenda*, is what muſt be very indifferent to us. The truth is, that the *os ſacrum* is a great, large, and immoveable bone, which ſerves for a baſis to the ſpine. Its figure is triangular; its being hollow within ſerves to form the *pelvis*, a cavity ſituated in the lower part of the *hypogaſtrium*; and, for the better inſertion of the muſcles, its poſterior part is convex and unequal. This bone hath three different articulations; the firſt with the laſt *vertebra* of the loin, like that of the other *vertebra*; the ſecond by *ſynchondroſis*, with the *coccyx*, and the third with the *oſſa innominata* by an indenting.

The *Os Sacrum* (N in the ſeperate adjoining *fig.* marked N) is divided into five *vertebræ* of a different bigneſs, the ſuperior thereof is the biggeſt, and which in adults are ſo ſtrongly united, that they make but one bone, the better to ſupport the whole ſpine, and to articulate the *oſſa innominata*.

The *Coccyx*, (P in the *fig.* of *Back-Bone*) ſo called,

called, becauſe it reſembles the beak of a cuckow, is the laſt extremity of the *ſpine*, it is compoſed of three bones, the greateſt of which touch the *Os Sacrum*, the ſecond is leſs than the former, and the third is very ſmall, at the whole end is faſtened a ſmall cartilage; they are all three joined together by a very looſe connection, which makes them pliant, and to draw back eaſily behind. In women they jet outward more than they do in men, becauſe they want a greater cavity to incloſe the *matrix*, and to contain the infant during their pregnancy. The end of theſe bones (Q, in the adjoining *fig.* marked Q.) always bends inwards, that it may be no inconvenience in ſetting, but they draw backwards a little, for the better extruſion of the excrements, as they do in women at the time of their delivery, (R *ib.*) to facilitate a paſſage to the infant.

From the *Coccyx* we come by a neceſſary retrogradation to the THORAX, or *Breaſt*, from ἀπὸ τοῦ θορῶ, which is that part of the human body which forms the capacity of the *Breaſt:* Its figure is oval, eſpecially when the *diaphragma* moves downwards, terminated above by the *clavicles*, before by the *Sternum*, behind by the *vertebræ* of the back; on the ſides by four and twenty ribs; and below by the cartilages of the *coſtæ nothæ*, and the cartilage *xiphoides*.

The larger and deeper is the cavity of the *thorax*, the parts contained therein move with greater facility, and we are ſuppoſed to live longer. It is compoſed with the *ſternum*, the ribs, and the clavicles.

The STERNUM (A ſee the *fig.* of the ribs, &c. under the face) is all that anterior part of the *thorax*. which, above, touches the *clavicles*, and ends below at the *cartilago xiphoides*, and laterally both on the right and left is joined to the ends of the ribs before. Its body proceeds forward, but bends towards the ribs, in order to form the round and oval figure of the *breaſt*, on which it appears, as if couched.

In Adults it conſiſts of one ſingle piece or bone, but in infants of ſeveral, according to the diverſity of age; if we believe *Kirkringius*, it never exceeds ſix, though Mr. *Dionis* pretends he has found eight, in ſome infants, which, by growing together, are reduced to four, and commonly to three.

The firſt of thoſe three bones (B) is the ſuperior one, larger and thicker than the reſt. It hath a *ſinus* on each ſide of its upper part, which receives the head of the clavicle, to which it is joined by a cartilage; and the other ſinous cavity found in the middle of its internal and ſuperior part makes room for the *trachea*. The ſecond (C) is placed under the former, is ſtraiter, and thinner, but longer, with divers ſinus's on both ſides, which receive the cartilages of the ribs that articulate in them. The third (D) is ſtill leſs in length, but thicker; it is placed under the two former, and ends at the *cartilago xiphoides*.

This CARTILAGE, (E) ſo called, becauſe it ends like the point of a ſword, is commonly triangular and oblong; ſometimes it is round, and ſometimes divided in two: whenever it ſinks inwardly by ſome ſtroke or fall, it occaſions vomiting, which ceaſes not until it is reſtored to its proper place. This cartilage ſerves to defend the ſtomach, to tie and faſten the *diaphragma*, and to ſupport the liver before by a large ligament that's tied unto it. Theſe three bones are joined together by cartilages, which ſerve inſtead of ligaments to them. They alſo form a cavity, which appears outwardly, and is called by the vulgar, *the pit of the heart*.

The *ſternum* forms the anterior and middle part of the breaſt, joins and articulates the *coſtæ* and the clavicles, contains and defends the heart and the parts for reſpiration, and faſtens all along its middle and internal part to the *mediaſtinum*, which is a membrane that divides the breaſt into two parts.

The COSTÆ or *Ribs* (FF *ibid.*) form the two ſides of the breaſt. Their ſubſtance is partly bony and partly cartilaginous, which cartilages ſerve them inſtead of *epiphyſes*. Their figure is concave within to form the capacity of the breaſt, and convex without to reſiſt any accicent. The further they are diſtanced from the *ſternum*, they become narrower and round: flatten, and are larger the nearer they approach unto it. The upper *ribs* are ſhorter than the middle ones, and the lower very ſmall, which difference is neceſſary to form the arch of the breaſt. The *ribs* are articulated at the extremities of their anterior part with the *ſternum*, by *ſynchondroſis*, and by *anthrodia* at their poſterior with the *vertebræ*.

There are twenty-four *ribs*; twelve on each ſide; and divided into *true* and *falſe ribs*. The *true ribs* are the ſeven upper, and the laſt five are the *falſe* ones. The *true ribs* touch the *ſternum*, (H *ibid.*) with which they have a ſtrong articulation, and the *falſe ones* below don't touch the *ſternum*, and have but a very ſlack articulation, though they are faſtened to the *vertebræ* behind; but, before, they terminate in long and ſoft cartilages.

The uſe of the *ribs* is to form the capacity of the *breaſt*, to defend the parts they incloſe, and to give origin and inſertion to ſeveral muſcles.

The two bones, which ſhut the ſuperior part of the *thorax*, and faſten the *ſternum* to the ſhoulders

ders, are called Clavicles (LL *ibid.*) There is one on each ſide, and they both have a tranſverſe ſituation at the lower part of the neck, and upper part of the breaſt a little above the firſt rib. Their ſubſtance is thick but porous and fungous; whence it is that they are often fractured, and when fractured, ſooner reunited than any other bone. Their figure is like an , convex outwardly towards the neck, and a little concave inwardly, that the veſſels under them may not ſuffer compreſſion. The *clavicles* help the different motions of the arms, which move eaſier backwards and forwards, becauſe ſupported on theſe bones, as upon a baſis; they are likewiſe of great uſe to hinder the arms from too great an extenſion forwards.

The Hip-Bones, (NN *ibid.*) or *Oſſa innominata*, form the laſt part of the trunk of the body. There are two *hip-bones* one on each ſide, articulated at their poſterior part by *ginglymus* with the *os ſacrum*; and at their lateral with the *femur* by *enarthroſis*.

Theſe bones have this common with all the other bones, that, like them, they ſerve for the inſertion of the muſcles, and for ſupport to the whole body; with this difference that they ſerve alſo to tie the inferior extremities with the trunk, to ſupport the ſpine, to help to form the capacity of the *abdomen*; and for a baſis to the parts, and couch to the parts contained in the *hypogaſtrium*.

Theſe bones conſiſt of three different bones, which are the *os ilium*, *iſchium*, and *os pubis*, joined together by cartilages, which remain ſuch till about the tenth or twelfth year of age, but grow drier with time, till they become ſo bony that they ſeem to make but one bone with the others in adult perſons.

The Os Ilium (O ſee the *fig.* mark'd O,P,Q,) ſo called, becauſe it contains the inteſtine, *Ilium*, being the greateſt of the three, offers itſelf firſt; it is articulated with the *os ſacrum* by *ginglymus*, ſtrengthened by a cartilage, and a very ſtrong membranous ligament.—Its figure is ſemicircular, having two ſurfaces, the one internal, filled with one of the *muſculi flexores femoris*; and the one external where the *muſculi extenſores femoris* are inſerted.

The *coſta* placed between theſe two ſurfaces is bordered with two lips, one whereof is likewiſe internal, and the other external. The two extremities of this *rib* end with two prominences called *ſpines*, of which the upper is much greater than the lower. Near to this laſt, which is placed before, is ſeen an indenting or notching that facilitates the paſſage of the tendons of the *muſculi iliaci* and *pſoas*; of the crural veins and arteries, and of the ſpermatic veſſels.—With its lower part it forms a part of the cavities, which receives the head of the *os femoris*.

This bone is larger in women than men, for the ſupport of the infant in the *matrix*; and near this bone women with child often feel a pain, occaſioned by the weight of the infant.

There are three parts to be conſidered in the Os Ischium (P. *ibid.*) Its upper, which makes the greateſt part of the *cotyla*; its anterior, which makes part of the *foramen ovale*; and the lower, in which two proceſſes are obſerved, the one behind, called the *Spine Proceſs*; and the other before, and below.—There is likewiſe ſeen a *ſinus* or cleft, which gives paſſage to the *obturator internus*.

This bone is annexed to the *os ſacrum* by a double ligament that riſes from it; one is inſerted in the acute proceſs of the hip; and the other behind at its appendage, which ſupports the *rectum inteſtinum*.— Its extremity, called the tuberous part of the *iſchium*, gives riſe to the muſcles of the *penis*, the *levatores ani*, and many of the *flexores femoris*.

The Os Pubis (Q, *ibid.* and alſo in the *firſt Skeleton*) called alſo *Os Pectinis*, is ſituated at the middle and anterior part of the trunk. Its fore part is joined by means of a cartilage with its fellow; its back part forms one part of the *cotyla*. Between this part and the extremity of the *os ilium*, the *ſinus* is placed, thro' which the tendons of the *muſculi lumbares* and *iliaci* paſs. The muſcles of the *abdomen* are inſerted in the upper part, otherwiſe called the *ſpine*; and the lower is joined with a prominence made by the tuberous part of the *iſchium*, both which prominences make the *foramen ovale*; into which prominences there are many muſcles inſerted. The *muſculi obturatores femoris*, which ſerve to move the thigh ſemicircularly inward or outward, are annexed to a ſtrong, tendinous membrane, that ſhuts intirely this hole.

The *oſſa pubis* are ſlenderer and larger in women than men; and thoſe, who have them advanced more outwardly, undergo their labour the eaſier; the cartilage, which joins the two *oſſa pubis* together, is of a pliable ſubſtance, and in hard and painful labours may be diſtended a little, but not to facilitate alone the delivery of the *Fœtus*.

Of the Extremities.

The extremities are upper and under, both the one and the other are like ſo many branches ſpringing from the trunk, and growing to it; the firſt

are

are the hands, and the ſecond the feet. We'll begin with the BONES of the HANDS.

The HANDS are divided into three parts, the *arm*, the *cubit*, and the *hand*.

The *arm* conſiſts of one bone only; the *cubit* of two; and the *hand* of twenty ſeven.

But we muſt examine, *firſt*, the *ſcapula*, or *ſhoulder-blades*, comprehended in the number of the ſixty-two bones that compoſe the arms.

The SCAPULA, (A *ſee* the *fig.* of the Arm and Hand) or ſhoulder-blade, is the bone that forms the ſhoulder, defined, a large and ſlender bone, eſpecially in the middle, and thick in the proceſſes: It is ſituated at the hind part of the upper ribs, where it ſerves inſtead of a buckler to them.

There are four things to be obſerved in it; its figure, connections, parts and uſes.

The *figure* of the *ſcapula* (ſee the *fig.* B adjoining) is triangular; of which, two angles are poſterior, and the third anterior. It is convex without, and concave within, both for its better appoſition in the ribs, and for containing a muſcle, of which I ſhall ſpeak hereafter.

It hath three ſorts of *connections*, one by *arthrodia*, with the *humerus*, having at its anterior angle, a glenoide cavity, which receives the head of the *humerus*. This cavity is covered over with a cartilage, that facilitates the motion, and it hath a ligamentous brim, which, by making the cavity deeper, and embracing the head of the *humerus*, ſtrengthens its articulation. The other is made by *ſynchondroſis*, with the clavicle, by means of a cartilage, that unites this bone with the clavicle; and the third is made by *ſyſſarcoſis*, with the *vertebræ* and the ribs; there being nothing but muſcles in all the poſterior part, that unite it with the adjoining bones.

There are a great many parts to be conſidered in this bone. Firſt, its *baſis*, which is in its hind part, ends next to the *vertebræ* of the back; this *baſis*, and with two angles, the one upper, and the other lower. The parts coming from theſe angles towards the neck, are called the *coſtæ* of the *ſcapula*; of which there are alſo two, the one called the upper *coſta*, which is the ſlendereſt and ſhorteſt; and the other the lower *coſta*, which is thicker and longer.

The *two ſurfaces* of this bone differ one from the other; the internal is hollow, to lodge the ſcapular muſcle; the external is elevated, to form a conſiderable eminence, which from the bottom of the *baſis*, riſes ſtrait upwards, called the ſpine of the ſhoulder-blade, the end thereof is called *acromium*, from its reſemblance to an anchor.

On each ſide of this ſame ſpine, there are two pits, one above, called *foſſa ſupra ſpinata*; and the other underneath, called *foſſa infra ſpinata*, greater than the former; becauſe, beſides the *muſculi infra ſpinati*, it contains ſome other muſcles, which ſerve for the motion of the arm; and in the middle of the ſpine, there is a crooked eminence, called the creſt, or the wing of a *batt*, from its reſemblance to it.

The proceſs *caracoides*, placed at the ſuperior part of the neck, and which advances above the head of the ſhoulder-bone, ſtrengthens the articulation of the ſhoulder, and gives riſe to one of the muſcles of the arm, called alſo *carocoides*.

The two other cavities, one between the neck of the *acromium*, and the other between its ſuperior *coſta*, and the *apophyſis carocoides*, ſerve for the paſſage of veſſels; and that cavity which is at the end of the exterior angle, is called the glenoide cavity.

The *uſes* of the ſhoulder-blade, are, 1. To give origin and inſertion to the muſcles, like all the other bones. 2. To faſten the arm to the body. 3. To ſupport the arm, that it may more conveniently make its motions. And 4. To make the ſhoulder, and defend the internal parts, with its bulk and largeneſs.

The *arm* is compoſed only of the HUMERUS (C *ſee fig.* of the arm and hand.) This bone is articulated at both its ends; the upper end with the *ſcapula*, by *arthrodia*; and the lower part by *ginglymus*, with the *cubitus*; and by *arthrodia*, with the *radius*. The *humerus* is alſo joined with the *radius* by *arthrodia*, having a prominence at its end, which is received into the cavity placed at the end of the *radius*. —— This articulation cauſes the motions of the *cubitus* inwards, and outwards.

The *humerus* is often divided into its body, (D) and its *extremities*; which are two, the one ſuperior, the other inferior. —— The body of the *humerus* is long and round; it hath an internal cavity all its length, which contains the marrow; its figure is not abſolutely ſtrait, but a little hollow on the inſide, and raiſed on the outſide, for the ſtrengthening of it in its actions. The line obſerved in it, to deſcend and terminate in two *condyles*, ſerve to faſten more ſtrongly, the muſcles inſerted in this bone. —— The upper end of the *humerus* (E *ibid.*) is much larger, and more ſpungy than the lower; it contains a medullary juice, and is called the head of the *humerus*. A little from under this head, is the neck, which is a round, and ſomewhat ſtrait part; and as the fore-part of this head appears a pretty long cleft, which goes to the middle part of the bone, and made like a gutter, to make room for one of the tendons of the muſcle *biceps*. This head is not only invironed on all ſides, with ligaments and membranes, which come from the *glenoide* cavity of the *ſcapula*, but is likewiſe involved with four *aponeuroſes* of the muſcles that compaſs it.

The lower part of the *humerus* (F *ibid.*) is ſmaller, flatter, and harder, than the other; it is alſo bigger, becauſe it is joined with the two bones of the *cubitus*, placed on the ſide of one another, and which have two different motions. In this place there are three proceſſes and two cavities; the firſt called the ſuperior proceſs, is a round head, articulated with the *radius*. The ſecond, which is the inferior, articulate with no bone, becauſe it only ſerves for the origin of the *muſculi flexores* of the hand. This is ſmaller than the former, and is called *apophyſis condiloides* In the middle of theſe two *condyli*, is a third proceſs that is ſmooth, oblong, and made in the form of a pully, round which the *cubitus* hath its motions. The two cavities are near this proceſs, one internal and ſmaller; the other external and greater; they receive the *apophyſes coronoides* of the *cubitus*, and the pully is received into the cavity *ſigmatoides* of the *cubitus*.

The *elbow* conſiſts of two bones, which are not ſo long nor ſo big as the *humerus*, but both of them much of the ſame magnitude, though the *cubitus* is a little larger than the other; they are removed from one another in their middle, for the more convenient ſituation of their muſcles, for the paſſage of the veſſels, and eſpecially for their eaſier motion; one is called the *cubitus*, and the other the *radius*.

The Cubitus, (G, *ibid.*) or *bone of the elbow*, is articulated at both ends, at its upper end two ways; with the lower end of the *humerus*, by *ginglymus*, and with the upper part of the *radius*, by *arthrodia*. At its lower end, it is alſo joined two ways, by *arthrodia*; by its end with the *os carpi*, and with the lower part of the *radius*, by its lateral, or ſide-part.

The *cubitus* is divided into its ſuperior, (H, *ibid*,) middle, (I, *ibid.*) and inferior part (K, *ibid.*) Its ſuperior part has two proceſſes, and two cavities; the ſmalleſt of theſe proceſſes, which has no particular name, is ſituated before, and the other (called *olecranum*, and is larger than the former) behind. The *carpus* is ſupported on this proceſs; it makes an acute angle, when the arm is bent, and hinders it from bending backwards. Theſe two proceſſes enter into the two cavities, ſituated on the lower end of the *humerus*. Of the two cavities, at the ſuperior part of the *cubitus*, the greateſt, called *ſinus ſigmatoides*, is placed between the two proceſſes, and receives the end of the *humerus*. There is a line, or eminence in the middle of this cavity, which goes from one proceſs to the other, and enters into the *ſinus* of that part, which is at the lower end of the *humerus*. The other cavity, ſituated on the lateral and internal part of the *cubitus*, (which is very ſmall) by receiving the *radius*, joins them together.—There are three angles at the middle part of the *cubitus*, one internal, and very ſharp, called the ſpine; two others not ſo keen, one before, and the other behind.

Two prominences, and a cavity are diſcovered at the inferior part: The firſt of theſe prominences ſituated at the lateral and inferior part, is received into the *glenoide* cavity of the *radius*; the ſecond, called *ſtyloides*, and placed externally at the end of this bone, ſerves to fortify the joint; and the cavity at the end of the bone helps to make an *arthrodia*, with the *carpus*.

The ſecond bone of the elbow, called Radius, (L, *ibid.*) is articulated like the *cubitus* in its ſuperior, and inferior part; in its ſuperior part two ways, both by *arthrodia*, the one with the external *condylus* of the *humerus*, and the other with the *cubitus*; in its inferior part, either with the *os carpi*, or with the *cubitus*, and both ways by *arthrodia*.

The *radius* is alſo divided into three parts, the ſuperior (M, *ibid.*) the middle (N, *ibid.*) and the inferior (O, *ibid.*) It has in its ſuperior part, a head, a neck, and a tuberoſity: the head is round and ſmooth, for its better motion, and over it a *glenoide* cavity, that receives the ſuperior *condylus* of the *humerus*; the neck is very long for oblique motions; under this neck is ſituated the tuberoſity or eminence, into which the *muſculus profundus*, and one of the *flexores* of the thumb are inſerted. There is an acute angle in its middle, called the ſpine, which grows ſtill bigger, as it comes nearer to the wriſt, contrary to the *cubitus*, that leſſens according as it is elongated from the elbow.

There are many ſinuoſities and inequalities obſerved at its inferior part, made to avoid hurting the tendons, that go to the outward part of the hand. There are likewiſe two cavities, one at its extremity, which receives the bones of the *carpus*; and the other at its lateral and internal part; but ſmaller, for a prominence of the *cubitus*. The prominence at the external part of its extremity, form, with the *apophyſis ſtyloides*, a great cavity, which receives the bones of the *carpus*, and hinders their luxation.

The Hand is made up of the *carpus* or *wriſt*, the *metacarpus*, and the *fingers*. It begins where the bones of the elbow end, and it terminates with the ends of the fingers.

The *carpus* (P, *ibid.*) or *wriſt*, which is the firſt part of the hand, is a heap of bones, ſituated between the inferior articulation of the elbow, and the *metacarpus*. Theſe bones are eight in number, placed in two rows, (Q, *ibid.*) four in each row.—

Of

Of the four bones of the firſt row, the two greateſt are received into the cavity of the *radius*, by their upper part, for the motion of the hand; and touch the three firſt bones of the ſecond rank, by their lower part. The th rd, next to this in bigneſs, is placed in the cavity, at the end of the *cubitus*, joining to its *apophyſes ſtyloides*; and united in its lower part, with the fourth bone of the ſecond rank. The fourth bone of the firſt rank, (the ſmalleſt of them all) is ſituated upon the third, on the inſide of the hand, making a prominence, like unto the crooked proceſs of the fourth bone of the ſecond rank.

The firſt bone of the ſecond row, is placed more within the hand than without, that it may the better ſupport the thumb, and anſwer to the crooked proceſs of the fourth bone of the ſame rank. The ſecond and the third, ſupport the firſt and ſecond bones of the *metacarpus*; and the fourth and laſt bone of the *carpus*, ſupports, by its two ſmall glenoide cavities, the third and fourth bones of the *metacarpus*. —— The figure of the bones of the *carpus*, joined together, is round, and raiſed on the outſide, but it is unequal and hollow on the inſide, for the facility of the motion.

There are three ſorts of articulations in the bones of the *carpus*; the firſt, with the bones of the elbow, by the *arthrodia*; the ſecond, with the bones of the *metacarpus*, by *amphiartroſis*; and the third by *ſyneuroſis*, between themſelves. ——— None of theſe articulations has a manifeſt motion but the firſt.

The METACARPUS, (R. *ibid.*) which is the ſecond part of the hand, makes its palm, by its internal part; and its back, by its external. ——— The *metacarpus* is compoſed of four long, ſlender, and unequal bones, each of them having a cavity that contains a marrow. Theſe four bones are joined with the *carpus*, by a ſtrong connection, by means of many cartilaginous ligaments, which allows them but an obſcure motion; and with the fingers, by *arthrodia*; each of them having a round head at their end, which enters into the glenoide cavity, placed at the end of the firſt bone of the fingers. ——— Beſides theſe two articulations, they mutually touch, and are united together by their lateral part, very near the place where they are joined to the *carpus*, and this for their greater ſtrength. —— They afterwards ſeparate towards the middle, in order to leave a convenient ſpace to the *muſculi interoſſei*.

The middle part of theſe bones is of a round figure, though a little convex outwardly, for ſtrength-ſake; and a little hollow inwardly, for the better taking up things. ——— Their ſuperior extremity, whereby they are united with the *carpus*, is their largeſt part; and their lower extremity, which ends with a head that joins them with the fingers, their ſmaller part. —— Theſe four bones are not equally large; that which ſupports the *index*, is larger than the others; the next to it is leſs; the next to that leſſer; and the fourth the ſmalleſt of all. This laſt is the ſupporter of the little finger, and has a more apparent motion than the three others.

There are five FINGERS (S. *ibid.*) which differ from one another, both in bigneſs and length. —— The firſt, (I. *ibid.*) called the *thumb*, is bigger and ſtronger than the others, and the only one oppoſite to the reſt in the matter of apprehenſion. —— The ſecond is called the *index*, (V. *ibid.*) becauſe we make uſe of it when we ſhew, or point at ſomething; the third, the *middle finger*, (X. *ibid.*) by reaſon of its ſituation, and is the longeſt of them all; the fourth, *annularis*, (Y. *ibid.*) becauſe the ring is worn upon it; and the fifth, (Z, *ibid.*) *auricularis*, becauſe being little and pointed, ſome commonly uſe it to cleanſe their ears of *ſordes*. —— The bones of the fingers are fifteen, three in each finger, placed in three ranks, called *phalanxes*, from their reſemblance to the ranks in battle-array. —— The firſt rank is of larger bones than the ſecond, and the ſecond than the third, which is the ſmalleſt; and whoſe extremities end in a ſemi-circle or creſcent. The figure of theſe bones is hollow on the inſide, for the convenience of flexion; convex on the outſide, for ſtrength ſake, and a little flattened on the inſide, that they might not hurt the tendons of the *flexores*, and for the better bending the fiſt. —— They are joined together by *ginglymus*, all of them having both little bones, and little cavities, which reciprocally receive one another; their articulation with the *metacarpus*, is by *arthrodia*. —— Each finger has likewiſe ligaments the whole length, on the inſide; and theſe ligaments tie theſe bones mutually together.

We will conclude our *Oſteology* with the BONES of the LOWER LIMBS, which are thoſe of the *leg*, and comprehends all from the *os illium* unto the ends of the *toes*.

The *leg* is divided into the *thigh*, the *leg*, and the *foot*. See the *figure* of the *thigh*, *leg* and *foot*.

The FEMUR (A in that figure) or *thigh*, is made like the *humerus* of one bone only, the greateſt and ſtrongeſt of all the bones of a human body; and which alone bears the burthen or weight of the whole. — This bone has two ſtrong articulations at both its ends; the firſt and upper, called *enarthroſis*, is made by the means of a very large head received into a great cavity. The head is at the end

end of the *femur*, and the cavity at the lateral part of the *os ilium*; this cavity has a cartilaginous brim for the better incloſing this head, and to hinder it from luxation; which head is tied beſides by a ſtrong ligament to the bottom of the cavity. —— The ſecond connection is made at its lower end by *ginglymus*, having two heads which are received into two cavities, ſituated at the upper and extreme part of the *tibia*. Between theſe two heads there is a cavity, which receives a prominence of the ſame *tibia*, and makes the *ginglymus*.

The *femur* is divided into an upper, middle, and lower part. See the *bone* marked B. C. D.

The upper has a *head*, *neck*, and two *proceſſes*. The *head*, (B) which is large and round, is formed of that proceſs which is inſerted into the *cotila* of the hips, from the little pit that is in its middle riſe, the ligament that ties it unto the *os illium*. The neck, for the ſupport of this large head, is alſo very large, and long, inclining outwardly, not only for the convenient ſituation of the parts of the thigh, but for the ſtronger going. This neck is oblique, becauſe the cavity of the *iſchium* not being ſituated in a ſtrait line, the head of the *femur* had not been able otherwiſe to enter well into it. Moreover this neck ſtretching thus outwardly, ſeparates theſe two bones from one anoeher, and cauſes the reſt of the bones to deſcend in a ſtrait line, and the body to be more conveniently and ſurely ſupported.

The two proceſſes behind the neck of the *femur* are called *trochanters*, divided into the great and leſſer *trochanter*. — The great *trochanter*, which is alſo the ſuperior, gives inſertion to the *muſculi extenſores* of the thigh, and for this reaſon its exterior part is rough and unequal, that they may inſert the better; and at its internal part, which regards the neck, there is a cavity, over which there is found a kind of *ſinus*. This bone has a great cavity, its whole length (C) which contains marrow; it is convex outwardly, and a little crooked or concave on the inſide, inſomuch that it ſerves for a buttreſs to our body, to hinder it from falling and from inclining too much forward.

At the lower part of the *femur* (D) there are two proceſſes called *condyli*, covered with a large cartilage, as all the other extremities of bones. — Between theſe *condyli*'s there is a cavity which receives the prominence of the *tibia*. Likewiſe at the upper part of the *femur*, there is a vacuity, which gives a paſſage to the veſſels that go down to the leg. This vacuity is inveſted like all other cavities, as well as the proceſſes, which ſerve for the connexion of the bones. They are plaiſtered over with a ſmooth and ſlippery cartilage, in the maſs of which there are ſmall glands, each of them having a *ſecretory duct*, through which runs that ſlimy liquor, which ſerves to facilitate the motion of the joint.

The Knee, placed at the lower end of the thigh, and at the upper part of the *leg*, has a round and large bone that lies at the articulation of the *femur* with the *tibia*, and called the Rotula, (E. ſee *fig.* of the leg, &c.) or *knee-pan*.—Its ſubſtance in infants is cartilaginous for ſome time, afterwards it comes to be bony. Its figure is like the circular boſs of a buckler, its middle part being thicker, and more prominent than its brims. The *rotula* is moveable, and articulated by a kind of *ginglymus*; it is covered with the *aponeuroſes* of the four *extenſores* of the leg, inſerted at its external part and its brims. It is inveſted at its internal part with a ſlippery cartilage to facillitate its motion, and ſerves to ſtrengthen the extenſor muſcles of the leg.

The Leg, which is the ſecond part of the lower limbs, comprehends the whole ſpace from the knee down to the foot, and has two bones, one whereof is very big, called the *Tibia*, and the other ſmaller, called the *Fibula*.—Theſe two bones differ only in bigneſs, being of the ſame length; for if the *tibia* riſes higher, the *fibula* deſcends the lower; both of them have a triangular figure, though that of the *fibula* is more irregular; they are united together at their end, but ſeparated aſunder in their middle to give room to the muſcles, and a paſſage to the veſſels. They alſo each of them make a *malleolus*, or ankle-bone, the *tibia* making the inward ancle, and the *fibula* the outward.

The Tibia (F, *ibid.*) is the largeſt bone of the leg, hollow within, its whole length (to contain the marrow) ſituated on the inſide of the leg, articulated at both its ends by *ginglymus*, above with the *femur*, and below with one of the bones of the *tarſus*, called *aſtragalus*. It is alſo joined at both its ends, but laterally with the *fibula*, by *arthrodia*.—The *fibula* has a ſmall cavity in its ſuperior part that receives the *tibia*, and below a ſmall prominence received into the *tibia*, which *tibia* has alſo three parts, the ſuperior, middle, and inferior part.

The ſuperior part of the *tibia* (G, ſee the bone G. I.) has a proceſs in its middle, received into the cavity, which is at the end of the *femur*. There are on both ſides of this proceſs two ſmall cavities, which receive the heads of the *femur*. Their depth is increaſed by a *cartilago lunata*, which is not deprived of motion, altho' it be faſtened by ligaments.—The middle part of the *tibia* has three angles, the moſt remarkable thereof is the *ſhin*, being long and ſharp before like the edge of a knife; whence it happens that blows received upon that part are very much felt, by reaſon that the *periosteum*, which covers it, is often cut with the blow: According as this bone approaches to the foot, it lessens in bigness, but in recompence it grows harder as it descends.—The inferior part of the *tibia* (I, *ibid.*) terminates in two little cavities for the insertion of the prominences of the *astragalus*; and from the middle of these cavities there rises a small protuberance, inserted into the cavity found at the upper part of the *astragalus*; and from the side of this cavity there is a pretty large prominence which forms the internal ankle.

The FIBULA (K, see the fig. of the whole leg) is the least of the bones of the leg, situated at its external part, and articulated at both its ends by a kind of more compact *arthrodia*, fortified by a ligament both above and below it.—This bone has also three parts, an upper, middle, and lower part. See the bone marked L. M. N.—The upper (L) is a round head, which don't touch the knee, ending a little under it at the place where it is articulated with the *tibia*.—The middle (M) is slender and long, and of a triangular figure like the *tibia*, but a little more irregular.—And the lower part (N) has a *condylus*, which makes a process called the outward ankle. It is a little hollow within, for a free motion of the *astragalus*.—The lower end of this bone descends a little lower than that of the *tibia*.

The FOOT. (O, see the fig. of the whole leg,) which is all that's comprehended from the inferior articulation of the leg unto the end of the toes, is of an oblong figure; its superior and external part is convex, the better to form the cavity of its lower and internal one, called the *sole of the foot.* (P, see the fig. of the foot mark'd P.

The uses of this cavity are, besides that of contributing to the convenience of walking, and of standing firm, to leave a free passage to the tendons that go to the toes, and to lodge one of their *flexores*.

The first and largest part of the foot is the TARSUS, (Q, see the fig. of the whole *leg*,) composed of *seven bones*: (see the bones in seperate pieces mark'd R. S. T. V. X. X. X. the first and superior is smooth, and made like a pully, upon which the great bone of the leg is placed; the second, which is anterior, is a large head that enters into the cavity of the *os naviculare*, with which the *astragalus* is strongly articulated; the third and posterior receives the head of the *calcaneum*, (S) with which it is strongly united; the fourth and inferior is rugged and unequal; the fifth and sixth surfaces of the *astragalus* are the two lateral, inclosed by the two *malleoli* or ankles.

The CALCANEUM, or heel-bone, is the second of the *tarsus*, the greatest and the most porous, and situated at the posterior part of the foot.—In this bone the tendon *achilles*, the biggest and strongest of all the tendons is inserted.—It is doubly joined with the *astragalus*, and also by a flat head with the *os cuboides*.

The third is the OS SCAPHOIDES, (T) or *naviculare*, from its resemblance to a little boat; it has a pretty large cavity that goes from one of its ends to the other, for the insertion of the large head of the *astragalus*, which joins them both strongly together; and to the three protuberances found on the other side of this cavity, the three last bones of the *tarsus* are articulated.

The OS CUBOIDES (V) is the fourth bone of the *tarsus*, situated before the *calcaneum*, unto which it is joined by an unequal surface, and articulated with the seventh bone of the *tarsus*, whose fifth, sixth, and seventh bone are called *cuneiformia*, because they have the figure of a wedge, that cleaves wood.

These three bones, although the same in figure, differ moreover in magnitude; for one of them is greater than the rest, another of a middle size, and the other is the least of all. — They are all three articulated with the *os schaphoides* by one of their ends; and by the other end one of them supports one of the bones of the *metatarsus*, the two others being supported by the *os cuboides*.

The METATARSUS, (Y, see the fig. of the whole *leg*, *&c.*) or *instep*. consists of five bones, situated sideways to one another, for the sustaining each of them a toe. These bones are compactly joined together at that end where they are united with the *tarsus*; but they separate from one another in their middle for the insertion of the *musculi interossei*. They are convex outwardly and hollow within, for the better reception of the tendons of the muscles.—They are long and slender, and end with a little head, which entering the cavity at the end of the first phalanx of the toes, unite them together by *arthrodia*.—They differ in magnitude, like the bones of the *tarsus*, and have at their slenderest end a head covered with a little cartilage for the freer motion of the toes.

There are fourteen bones of the *toes*, (Z, *ibid.*) two to the great toe, and three for each of the four others, distributed into three *phalanxes*, or ranks, as those of the fingers: those of the first order or rank, are greater than those of the second; those of the second are less, and so of the rest.—They are of the same figure as those of the hand, convex without, and concave within; and are articulated with the *metatarsus*, by *arthrodia*, and by *ginglymus* with one another.

There are also found in the joints of the bones, of the hands and feet, some very small bones, of the

the bigneſs of a pea, flat on their inſide, and round without, called *oſſa ſeſamoidea*. Their number is uncertain, although we commonly count twelve of them in each hand, and the ſame in each foot; thoſe bones, ſmall as they are, not only ſerve to ſtrengthen the joints, and hinder luxation, but their principal uſe is to ſerve for pulleys to the tendons of the muſcles, which go to the fingers, in order to keep them in their due places, and hinder them from falling upon the joint.

Of Sarcology.

Sarcology treats of the *fleſh* and other ſoft and tender parts of the human body.

This is the *ſecond* moſt eſſential and moſt curious part in *anatomy*, and is divided into (1) *Splanchnology*, (2) *Myology*, and (3) *Angiology*. The firſt treats of the internal parts eſpecially the *viſcera*. The ſecond of the *muſcles*. The third of the *veſſels*, viz. *nerves*, *arteries*, and the *lymphatic veſſels*.

For the more clear demonſtration of theſe parts it is neceſſary to divide the human body into the *trunk* and *limbs*; and to ſubdivide the *trunk* into three principal regions, *viz.* the *head*, the *breaſt*, and the *venter* or *abdomen*, with which laſt we ſhall begin this treatiſe.

The Abdomen is all that cavity extending from the *diaphragma* to the *os pubis*; terminated on the ſides by the *hip bones*, and behind by the *vertebræ* of the loins and the *os ſacrum*; and it is of a ſoft and fleſhy ſubſtance before, capable of great extenſion.

This region is ſubdivided into three parts (1) the *epigaſtric*, which begins at the *diaphragm* and and *cartilago xiphoides*, and terminates about the breadth of two fingers above the *navel*. (2) The *umbilical*, which begins where the epigaſtric ends, and deſcends two fingers breadth below the *navel*. (3) The *hypogaſtric*; which reaches as low as the *os pubis*.

Each of theſe regions are again divided into a middle part called *epigaſtrium*, and two ſides named *hypochondria*; diſtinguiſhed by the name of the right, and left *hypochondrium*. See A A in the fig. at the bottom of the left ſide in the ſecond *anatomical* plate, under the title *Sarcology*.

The Epigastrium incloſes the ſmall lobe of the liver and a part of the ſtomach, with its lower orifice, and alſo the middle of the *colon*.

The Hypochondrium, on the right ſide contains the great lobe of the liver and the gall bladder; that on the left contains the greateſt part of the ſtomach and ſpleen.

The Umbilical region (B B *ib.*) contains the navel in the middle of it; and its ſides are the two loins. The *navel* contains the greateſt part of the *inteſtinum jejunum* and the *meſentery*. The right loin contains the right kidney, the *inteſtinum ſæcum*, and part of the *jejunum* and *colon*; and the left loin incloſes the left kidney and ſome part of the *colon* and *jejunium*.

The middle of the *hypogaſtric* region, (ſee C C. *ib.*) is called the *hypogaſtrium*. Its ſides are the *ilia* or flanks; and under it we find the *rectum*, the *bladder* and the *matrix* in women.

We divide the lower part of the *hypogaſtric* (D D. *ib.*) into the middle or the region of the *pubis*; and into two lateral, or regions of the groins, which gives paſſage to the *ſpermatic veſſels*.

The hind part of the Venter extends from the laſt rib to the end of the *os ſacrum*; and is divided into an upper part called the *loins*, and a lower region called the *nates* or buttocks; between which is the *anus* or hole for diſcharge of the groſſer excrements from the guts.

The *venter* or belly is a cavity, which contains the parts for nouriſhment, and for generation, and is divided into the outward and inward *venter*. The outward is again divided into common and proper, the common parts containing are the teguments, as the *epidermis* or *cuticula*, the *cutis* or ſkin, and the *fat*, and the proper are the muſcles of the *abdomen* and the *peritonæum*.

The *epidermis* (E E *ib.*) is a membrane as thin as the peel of an onion, and ſtrongly faſtened to the ſkin, which it covers; and is inſenſible, becauſe it contains neither veins, arteries nor nerves; but is produced in the ſame manner as the other parts of the body. It is of the ſame figure with the ſkin; from which it ſeparates in burns.

This is the part, which riſes in large puſtules when veſicatories are applied. It cannot be diſſected. It regenerates without leaving a ſcar; and when it ſeparates from the *cutis* without any outward cauſe, it ſhews the part to be diſpoſed to mortify.

Its *uſes* are to cover the ſkin and render it ſmooth and equal; to prevent the evacuation of humours from the extremity of veſſels terminating to it; and to blunt that pain, which otherwiſe would always follow any impreſſion on the fibres and nerves in the ſkin, if it was not for this natural cover.

The Skin (F F *ib.*) is the ſecond tegument and the greateſt membrane of the body, and formed of fibres, intertwiſted like nets, which cover thouſands of ſmall glands. Its thickneſs is very unequal; very groſs in the back, at the kidneys, and about the limbs; very thin in the face, but much more ſo upon the edges of the lips. A ſmall branch of an artery enters every gland; and there paſſes from

from the gland a ſmall vein and a lymphatic veſſel through the nets, which terminate at the *epidermis*, or the ſuperface of the *ſkin*.

Thus we account for the manner of *ſweating*. The blood is conducted hither by as many arteries as there are glands, and is carried back by as many veins. But as it paſſes through the pores of the glands, a *ſerum* is filtrate from it, which paſſing through the excretory veſſel furniſheth matter for *ſweat*.

Beſides this there is another evacuation through the ſkin, called inſenſible *tranſpiration*; which being made without intermiſſion purifies and cools the blood, by an abſolutely neceſſary diſſipation thereof, and preſerves both the *ſkin* and *epidermis* from growing ſcurffy and too dry.

The *ſkin* is of ſuch a nature that it extends and contracts itſelf eaſily, as may be obſerved in pregnant, hydropical and fat ſubjects; and always adheres to the part it touches; and when it happens to be drawn from the fleſh it never reunites without making a ſcar. Nature has in moſt ſubjects covered it with hair; but not alike in all parts, nor in every ſubject. Some men have their whole body; but moſt men have only certain parts covered with long hairs. The like is obſerved in female ſubjects.

There is alſo a great variety in the *colour* of the ſkin upon different ſubjects. For, though *white* is allowed to be the *natural colour*; yet it is evident that ſome are brown, others ruddy, others tawny, and again others quite black; owing chiefly to the temper of the body, ſome predominant humour, and to the ſoil, climate, and ſtate of the creation.

The *uſes* of the ſkin may be ſummed up in theſe particulars, *viz.* To cover all the parts of the body, to be the organ of touching; and to ſerve for an emunctory of theſe *humours*, which nature throws off by ſweat and tranſpiration.

The FAT (G G *ib.*) or third common tegument is a white body of a middle conſiſtence, formed of the unctuous and oily parts of the blood, condenſed by a certain degree of heat, and incloſed in little bags called *cellulæ adipoſæ*, adhering to the outward ſurface of the membrane *adipoſa*, all over the body except on the forehead, eye-lids, *penis* and *ſcrotum*.

This tegument is vaſtly unlike in different ſubjects both as to ſubſtance and kind. Some bodies are covered with fat an inch thick; in others the *celulæ* are almoſt flat; and in emaciated ſubjects we find nothing but the mere membrane of a tranſparent ſubſtance.

This ſort of *fat* is termed *pinguedo*; but there is another ſort of fat in the human compoſition of a harder, whiter, more brittle nature, and not ſo eaſily liquified as the former.

The *uſes* of *fat* are to preſerve the body like a balſam; and by inveloping the ſalts, with which the blood and *ſerum* are highly ſaturated, to keep them from fretting and coroding the parts through which they paſs. It alſo ſerves for a warm covering to the whole body, to keep the heart moiſt, and pliant in its motion; and the *pelvis* of the kidneys from being hurt by the ſalts of the urine; and that at the joints to facilitate their motion, by its lubricity. Therefore nature has provided the heart, the eyes, &c. where motion is quickeſt and moſt violent, with greater abundance of fat.

Where fat encreaſes beyond its natural proportion, it not only becomes troubleſome to the body, but it affects the animal ſpirits, induces heavineſs drowſineſs, and an unwillingneſs to move. Too much about the thorax in the cavities obſtructs the expanſion of the *diaphragm* and lungs, and produces a *diſpnœa*, or an *orthropnœa*; and may hinder the neceſſary ſecretions in the brain ſhould the abundance of fatty particles return into the blood, and implicate the moſt ſubtle and active parts.

The ABDOMEN's anterior parts are alſo covered by ten *muſcles*, *viz.* Four oblique, two tranſverſe two *recti*, two pyramidal; taking their names from their ſituation and from the order and diſpoſition of their fibres. Theſe muſcles help the *abdomen* to expand and contract itſelf.

The *oblique* muſcles are two deſcending and external; and two aſcending and internal.

The oblique deſcending are (L *ib.*) what firſt appear after the raiſing of the teguments, and are ſo called from their fibres, which deſcend obliquely. They are called external to diſtinguiſh them from others placed below; and great, becauſe they exceed the other obliques in ſize.

Their figure is triangular, proceeding by digitation from the *ſerratus major*, on the 6th and 7th of the true ribs, all the baſtard ribs, and from the tranſverſe proceſs of the *vertebræ* of the loins; are inſerted into the external part of the *os ilium*, and *os pubis*, and end with a large and ſtrong *aponeuroſis* in the *linea alba*. Theſe muſcles are indented with the *ſerrati majores*, which are muſcles of the *thorax*, by five or ſix digitations: each whereof receives a nerve from the interſtices of the ribs.

The *oblique* aſcending muſcles (M *ib.*) ſo called, becauſe their fibres ariſe from below and aſcend, are ſituate juſt under the former, and are a great deal leſs. They proceed from the upper part of the *os pubis*, and end with a large double *tendon* in the *linea alba*; the upper part whereof creeping over the *rectus*, and the other creeping under it, and

and joining together at the *linea alba*, do, as it were ſheath the *rectus*.

The *tranſverſe* muſcles (N *ib.*) are placed under the *oblique* and upon the *peritonæum*, proceed from the proceſſes of the *vertebræ* of the loins, are inſerted in the internal part of the *os ilium*, and of the cartilage of the lower ribs, and, paſſing under the *rectus*, terminate in the *linea alba* by a ſtrong *aponeuroſis*. They are perforated in the middle to give a paſſage to the umbilical veſſels; and at their lower part for the communication of the ſpermatick veſſels with the teſticles in men; and ſo in women the round ligaments of the *matrix*, which proceed to make their inſertion in the thighs.

The four pair of muſcles in the *abdomen* named *recti* (O) ariſe from the *ſternum* and the extremity of the two laſt ribs, and proceed ſtrait down to the fore part of the *abdomen*, and are inſerted in the *os pubis*. Theſe have three or more tendinous coarctations of their fleſhy fibres, which make them appear as many diſtinct muſcles.

In a female ſubject, whoſe *epigaſtric* is ſtopt by the compreſſion of the pregnant *uterus*, the mamillary veins are ſupplied in the return of the blood by the veins and arteries of the *recti* or *rectus*, which creep along the inſide from the mamillary and *epigaſtric* veſſels, and communicate together.

The *pyramidal* veſſels (P) of the *abdomen* lie upon the lower tendons of the *recti*, proceed from the upper and internal part of the *os pubis*, and terminate in a point on the *linea alba*; though ſometimes they reach the navel.

Their uſes are to raiſe the *peritonæum*, and to hinder a too great compreſſion of the region of the bladder from the other muſcles.

The *linea alba* (Q) is the meeting of all the *aponeuroſes* of the muſcles already mentioned, and takes its name from being like a *line* in its conſtruction, and *white*, becauſe it has no fleſh in it.

This line extends from the *cartilago hiphoides* to the *os pubis*, being ſtraiter below than above the navel; and dividing the muſcles of the right ſide from thoſe on the left.

The Peritonæum (aaa) is a thin ſoft membrane, covering and containing all the *viſcera* of the *abdomen*. Its figure and ſize anſwer to thoſe of the *abdomen*, which it lines. Its internal ſurface is ſmooth, and lined with an unctuous humour. Its external ſurface is fibrous and unequal, and faſtened to the muſcles of the *abdomen*, *linea alba*, *oſſa pubis*, *iſchium*, *ilium*, *ſacrum*, and the *vertebræ lumbares*, and from the laſt whereof many ſuppoſe it to have its origin. It is alſo connected to the lower or convex ſurface of the liver, which it ſuſpends by a ſtrong ligament, called *ſuſpenſorium hepatis*.

The Peritonæum is double every where, but moſt apparently ſo from the navel to the *os pubis*, and near the *lumbar vertebræ*, as appears not only from its extraordinary thickneſs in both, but from its ſpontaneous parting in the latter, to receive the kidneys. It is perforated in the upper part to give paſſage to the *œſophagus*, *aorta*, and *cava*; in the lower part, for the fundament, the neck of the *matrix*, and the veſſels that go to the thighs; and in the fore-part to give paſſage to the *umbilical* veſſels.

Its exterior coat has two proceſſes, which in men fall down into the *ſcrotum*, wrap up the *ſpermatick* veſſels, and dilating make the *tunica vaginalis* of the teſticles; in women they form a cover for the round ligament of the *womb*.

The *peritonæum* receives veins and arteries from the *mammaria*, *diaphragmatica*, *epigaſtricæ*, *ſacræ*, and *lumbares*.

The *uſe* of the Peritonæum is to contain and keep in their place the *viſcera* of the *abdomen*; when it is injured the parts are apt to fall down, and to form thoſe tumors called *hernias* or *ruptures*.

The Navel, (B) called *umbilius* from *umbo* the middle, *i. e.* of the *venter*, is a *nodus* formed by the reunion of the *umbilical* veſſels, and cut as ſoon as the infant is born.

In a *fœtus* the *navel* is a *ſtring* about ¾ of a yard long, that goes from the *after-birth* to the *belly* of the *fœtus*, and then incloſes four veſſels, which are a vein, two arteries, and the *urachus*; and ſerves to conduct theſe veſſels, which would have been too weak of themſelves for ſo long a paſſage, and not been able to reſiſt the motion of the infant. Its length is of uſe to the infant, that he may remove conveniently to and fro in the womb, and that both the infant and the after-birth may come away one after another in the delivery, But as ſoon as the infant is born, this ſtring is to be tied within two fingers breadth of the belly, and cut above the ligature. Nature afterwards rids itſelf of what remains of it, ſo that there remains only the *nodus* or knot, above mentioned.

The four umbilical veſſels are annexed to it; the vein aſcends upwards, and the arteries and *urachus* deſcend; and are all four inſerted between the muſcles and the *peritonæum*.

The uſe of the *umbilical veſſels* (CDD) is, that the arteries of the mother carry a certain quantity of blood into the *placenta*; which, being therein diſperſed, is received by the branches of the *umbilical* vein, which carries it into the *vena porta*, to be filtrated through the ſubſtance of the liver in the *fœtus*, before it is to enter into the *vena cava*: that carries it into the right ventricle of the heart; from whence it paſſes into the left through the *foramen botalli*, in order to be diſtributed, afterwards, into

into all the parts of the body by means of the *arteries.* The superfluity of this blood is brought by the two *umbilical* arteries to the *after-birth*; where being dispersed, it is received by the veins of the mother spread therein, and which carries it into the great veins to circulate with the whole mass of blood: Thus there is made a continual circulation of the blood of the mother to the infant, and of that of the infant to the mother.

The Epiploon (FF) is a membrane situated under the *peritonæum*, which floats upon the intestines, and follows their sinuous windings. It extends from the bottom of the stomach unto the *navel*, where it commonly ends. But when it happens to descend unto the lower region of the *hypogastrium*, and even to lapse into the *scrotum*, then it causes the *hernia epiploceles*; and when in women it happens to slip between the *matrix* and the bladder, it makes a compression on the orifice of the *uterus*, and thereby, says *Hippocrates*, hinders generation.

Its figure is like a fisher's net. It has a great cavity in its middle part, formed by two membranes, one external before, annexed to the bottom of the stomach, and to the spleen; and the other internal behind, annexed to the *colon*, and to the back, under the *diaphragm*. —— The *epiploon* has small vessels of *fat*, which terminate in globules, and often melts in those, that have a hectick fever.

As the *epiploon*, when it comes to the air, corrupts soon; so in wounds of the *abdomen* we are obliged to cut off any such part of it, as has had any irruption outwards. There are likewise some distempers, which spoil and corrupt it, as it is easy to observe in scorbutick, phthisical. and hypochondriacal persons. —— It has more vessels than any other membrane, in proportion to its magnitude; for it receives small nerves from the *intercostal* branches of the eighth pair, many arteries from the *cœliac*, and many veins which discharge themselves into the *porta*.

The uses attributed to the *epiploon* are, to warm the stomach, and thereby help the digestion; to cover the intestines, and to conduct the splenick branch, and the other vessels, which go to the stomach, the *duodenum*, or the *colon*.

From the mouth unto the *anus*; there is a continued and a very long body, whose beginning gives an entrance to the nourishment; the middle receives, and preserves it; and whose end gives a discharge to its excrements.

The part from the mouth unto the *diaphragm* is called *œsophagus*, or *gullet*; the next to it, *stomach*; and the next, *intestines*, or the *guts*; and the membrane, which retains them all, is the *mesentery*.

I'll begin with the Stomach, (GG) which is an organical part, destined to receive the meats after deglutition, and the principal instrument of chylification, situated in the *epigastrium* immediately under the diaphragm, between the liver and the spleen, and of a round and oblong figure, resembling a bag-pipe, particularly when the *œsophagus* is left with it and a part of the *duodenum*. —— Its external surface is smooth and whitish, and the internal wrinkled and reddish; it is annexed above to the *diaphragm*, below to the *epiploon*, on the right side to the *duodenum*, and on the left to the spleen.

The *stomach* consists of four membranes or coats; the first and inmost is formed of short fibres, which stand perpendicular upon the fibres of the next coat, and are plainly to be seen towards the *pylorus*. When the stomach is distended with meat, these fibres become thick and short, whilst they endeavour to restore themselves by their natural elasticity; they contract the cavity of the stomach for the attrition and expulsion of the aliments. —— This coat is much larger than the rest, being full of plaits and wrinkles, and chiefly about the *pylorus*. These plaits retard the chyle, that it runs not out of the stomach before it be sufficiently digested. —— In this coat there are also a great number of small glands, which separate a liquor, that besmears all the cavity of the *stomach*, and helps the concoction of the aliments; for which reason this coat is called the *tunica glandulosa*.

The second is much finer and thinner; it is altogether nervous; is of an exquisite sense, and is called *nervosa*.

The third is *muscular*, being made of streight and circular fibres: The streight run upon the upper part of the stomach, between its superior and inferior orifices; and the circular run obliquely from the upper part of the stomach to the bottom. —— Of these the innermost descend towards the right side, and the outermost towards the left; so that by their action both ends of the stomach are drawn towards its middle, and the whole is equally contracted. By their contraction and continued motion, the attrition and digestion of the aliments is in great measure performed.

The fourth *tunic* is common, and comes from the *peritonæum*.

The Stomach has two orifices, the one superior, and the other inferior; the superior (HH) one, called the mouth of the stomach, is on the left side, and begins where the *œsophagus* ends; it is situated over against the eleventh *vertebra* of the back, and closely shut up by abundance of fleshy and circular fibres, at the time when it receives no nourishment, a thing very necessary, not only for the better concoction, but to hinder the aliments from being cast up again into the mouth, and also hinder the fumes, caused by digestion, from being offensive.

The inferior (N) orifice, called *Pylorus*, is on the right side; which although called the inferior orifice, 'tis only with respect to the other placed a little higher, and not with respect to the fund or bottom of the stomach, since both orifices are almost equally removed from this. ——The *pylorus* is a little bent, very narrow, because full of tranverse fibres, and is begirt with a thick circle or a *sphincter*, that shuts it.

The stomach sends veins to the *porta*, and branches the *gastrepiploica*, accompanied with others of the *cœliac*, all lying immediately under the fourth coat.

The eighth pair of nerves give two considerable branches to the *stomach* (PP) which are spread much about the upper orifice; by which it is rendered very sensible: whence also proceeds the great sympathy betwixt the stomach, head, and heart; on account whereof *Van Helmont* thought that the soul had its seat in the upper orifice of the stomach.

The *use* of the Stomach is for the concoction of the aliments, and converts them into chyle. This concoction or digestion is performed in the following manner.

The internal coat of the *stomach*, being all over bedeck'd (as we have already observed) with glandules, which continually transmit into it an acid juice, the aliments, after having been pounded in the mouth, and penetrated with the *saliva*, which springs from the *parotide*, and *maxillary* glandules, are conducted through the *œsophagus* into the *stomach*, and either by the help of the acid juice, both of that they find in it, and of that which distils into it without intermission, they become more liquid: then this liquor, not being able to rise upwards through the *œsophagus*, by reason of its situation, and the *diaphragm* making compression upon the stomach, does gently run through the *pylorus* into the intestines, where it comes to greater perfection by the mixture of the *bilis*, and *pancreatic* juice.

The Intestines, (QQ) or *guts*, are long, round, hollow, and continued bodies from the *pylorus* unto the *anus*; situated under the *epiploon* in the *abdomen*, whose whole capacity they almost fill.——They are knit or annexed to the back by the *mesentery*, which ties them together; so that the *tenuia intestina* are in the middle of the *abdomen*, towards the *umbilical* region, and the *crassa* in the circumference.

The *intestines* seem to be nothing but a continuation of the *stomach*, as consisting of the same number of coats, and fabricated in the same manner. They are, when separated from the *mesentery*, of a very great length; ordinarily about six times as long as the person's height, whose they were; and though they seem to be but one continued channel, or *fistula*, yet because in several parts, their magnitude, figure, and thickness are different, they are generally divided into the *thick* and *small*, and these again are each of them subdivided into three. The three small are called *duodenum*, *jejunum*, and *ilium*; and the thick, *cæcum*, *colon*, and *rectum*.

They have all of them in common, a kind of vermicular motion, which, beginning at the *stomach*, is propagated downwards, and is called the *paristaltick* motion; to facilitate which, they are generally lubricated with a great deal of fat, especially the thick ones, whose surface being somewhat uneven, and the contents less fluid than those of the small, they need somewhat more to make them slide easy.

The first of the *intestina tenuia*, or *small guts*, is called *duodenum*, and reaches from the right orifice of the stomach, as far as the *vertebræ* of the back, on the left side, where it ends, at the first angle made by the intestines, which is about twelve inches: from which measure, it seems to have taken its name.——Into this gut, the *meatus cholodocus*, and *ductus pancreaticus* are inserted; whereunto each of them discharges its juice, for the second preparation of the chyle.

The next *intestine* is the *jejunum*, so called, because it is generally found more empty than the rest; which may be occasioned, partly by the fluidity of the chyle, which is greater in this intestine, than in any of those that follow it; and partly by its capacity, being somewhat larger than that of the *duodenum*, and therefore gives a freer passage, and, perhaps also the irritation of this gut, through the acrimony of the bile discharged into the intestines, a little before the beginning of this gut, may contribute something towards accelerating the passage of the contents.——This intestine possesses, almost the whole umbilical region; its length being an ell and an half, *Paris* measure. *Dionis*.

The third of the small intestines, is the *ilium*; it possesses almost all below the navel, and extends by its circumvolutions, towards the *ilia* on both sides; from whence it takes its name. It begins immediately where the *jejunum* ends, and terminates at the *cæcum*.—It has fewer *venæ lacteæ* than the *jejunum*, and therefore is always fuller.—This *gut* not being so fast tied to the neighbouring parts, as the *colon*, and *cæcum*, often fall into the *scrotum*,

and

and makes the *hernia enterocelis*. It is alſo in this gut, that the *miſerere* happens, called *iliaca paſſio*, occaſioned by its *antiperiſtaltic* motion.

The firſt of the *inteſtina craſſa*, is called *cœcum*, which has a lateral inſertion into the upper end of the *colon*, and is not perforated at its other extremity; but hangs to it, like the finger of a glove, and is about three or four inches long.—*Bartholin* pretends that the name of *cœcum* is given to it, becauſe its uſe is but *blindly* known, and ſome late anatomiſts, not allowing this to be the *cœcum* of the ancients, which they imagined to be that thick globous part of the *colon*, immediately appended to the *ilium*, have given this part the name of *appendicula vermiformis*.

The next of the thick inteſtines, is the *colon*, the largeſt of them all; it begins at the end of the *cœcum* towards the right kidney, unto which it is annexed, and aſcending up to the concave part of the liver, it touches the bladder of *bile*, which tinges it with its yellow colour in this place; from thence it paſſes along the inferior part of the ſtomach, and faſtens to the ſpleen and to the left kidney; from whence it deſcends like an S, unto a little above the *os ſacrum*, and terminates at the *rectum*, inſomuch that it encompaſſes all the *abdomen*.—At the entrance of the *ilium* into this *gut*, is placed a valve formed out of the production of the inward coat of the *ilium*, which, like the finger of a glove, when its extremity is cut off, hangs looſe in the cavity of the *colon*; by which means it ſtops the return of the excrements, though ſometimes, as in inverſions of the *periſtaltic* motion, it proves not ſufficient for that uſe.—It has a great many *cellulæ*, or, as it were, diſtinct cavities, framed by a coarctation of the gut by two ligaments or bundles of membranous fleſhy fibres, about half a finger broad, each running on either ſide the gut oppoſite to each other, the whole length of it; and, as it were, girding it in at certain diſtances, thereby making it reſemble a glaſs incorporator uſed in mixing oil and vinegar.

The laſt of the inteſtines is the *rectum*, which reaches from the *os ſacrum* to the *anus*, and is plain, without cells. It is faſt tied to the *oſſa ſacrum*, and *coccygis*, by means of the *peritonæum*: in men to the neck of the bladder of urine, and in women to the *vagina uteri*, to which it is ſtrongly connected by a membranous ſubſtance. That ſubſtance of the *vagina* and inteſtine is hardly diſtinguiſhable from one another. The length of this gut is ordinarily about a hand's breadth and a half, and its capacity about the thickneſs of three fingers: its lower end, the *anus*, is furniſhed with three muſcles, *viz.* the *ſphincter ani*, and the two *levatores ani*.

The *ſphincter ani*, is like a ring; its bigneſs is two fingers breadth, annexed, before, to the *penis* in men, and to the neck of the *matrix* in women; behind, it is faſtened to the *coccyx*, and laterally, to the ligaments of the *os ſacrum*, and to the *hips*: it ferves to open and ſhut the *anus* according to our will.—The *levatores ani* proceed from the inferior and lateral part of the *os iſchium*, and inſert in the *ſphincter* of the *anus* to lift it up again, after the evacuation of excrements is over.

The *inteſtines* in general are furniſhed with blood from the *meſenteric* arteries, which is returned by the *meſaraic* veins; but the *duodenum* receives a branch from the *cœliac*, which is called *duodena*; to which anſwers a vein of the ſame name, that likewiſe returns the blood to the *porta*—the *rectum* receives others called *hæmorrhoids*; the internal from the lower *meſenteric*, and the extern al from the *hypogaſtric*, with veins correſponding of the ſame name, that alſo go to the *porta*.—Theſe veſſels ſpread the inteſtines with abundance of ramifications, and are frequently diverſified in ſeveral ſubjects of the ſame ſpecies; much leſs are they to be depended upon, for an uniform appearance in animals of different kinds.—The nerves of the *inteſtines* come, ſome of them, from thoſe of the ſtomach, and ſome from the great *meſenteric plexus*, which diſtributes branches to all the inteſtines.

The Mesentery (V) is a double membrane ſituated in the middle of the *abdomen*, and of an almoſt circular figure.—If the elongation of the *colon*, and the *rectum* be excepted in it, it has about four fingers breadth diameter, and three *Paris* ells, in its circumference, round about which the inteſtines are folded.—The *meſentery* contains a vaſt number of lateral veins, which carry the chyle from the inteſtines to the glands, which are abundantly more in number in its center, than in its circumference.—From theſe glandules the chyle goes by other *lacteal* veins, into the common receptacle, and from thence into the *ductus thoracicus*, in order to fall into the left *axillary* vein.—The other veſſels of the *meſentery* are the *lymphaticks*, which diſtil their *limpha* into the receptacle, in order to make the chyle more fluid.

Fat is collected into the *meſentery* as in the *epiploon*, from an oily and ſulphureous blood, which evaporates from the veſſels, and retained there by the thickneſs of the membranes. This fat is to preſerve the natural heat of theſe parts, and to moiſten the *venæ lacteæ*, which having only a very thin membrane, and being filled only in the time of the diſtribution of the chyle, would otherwiſe grow dry.—The *glandules* (X) of the *meſentery*, have each of them a little artery, which bring blood to them, a little vein which carries back the blood, and an excretory *ductus*, which discharges into the guts what has been filtrated through these glandules.

The use of the *mesentery* is to tie the intestines together unto the *vertebræ lumbares*, and to hinder any disorder, which could happen in their circumvolutions; and its double membrane is to shelter from all dangers the vessels, which pass between them to the intestines.—The *mesentery* receives its nerves from the *vertebræ lumbares*, and from the intercostal branch. They are so interlaced together in the middle of the *mesentery*, that they form there a *plexus*, out of which come abundance of nervous ligaments, as fine as hairs, which overspread the membranes of the intestines.

The arteries inclosed in the duplicature of the membranes of the *mesentery*, come from the superior and inferior mesenterick arteries, which are two great branches that come from the trunk of the *aorta*, and terminate in all the intestines.—All the veins, which run through the *mesentery*, unite together as they approach its basis, and form larger veins, which larger veins form a trunk called the mesenterick vein, which joining with another, called the splenick, make together the *vena porta*, which has no other use than that which is common to all the veins of the body, and which is to carry back the blood to the heart.

We must observe in this place that the VENÆ LACTEÆ, (Y) mentioned already, were never discovered till the year 1622, by *Asellius*, which is the cause that the ancients have attributed part of their most essential functions to the *vena porta*.

There are two sorts of *venæ lacteæ*: the one called first lacteal, and the others secondary; the first bring the chyle from the intestines unto the glandules spread through the *mesentery*; and the secondary carry the chyle from these same glandules into the receptacle of *Pequet*, a famous physician, who in 1651 discovered that receptacle placed between the two origins of the diaphragm, in the place where the *lumbares* glandules are found. The two branches, which proceed from these glandules joining together, form the *ductus thoracicus*. This *ductus* ascends along with the *aorta*, between the ribs and the *pleura*, and terminates by one, two, or three branches in the left subclavian vein, near unto the axillary vein, from whence the chyle is carried into the right ventricle of the heart by the descending *vena cava*.—This canal, or *ductus*, and all the *venæ lacteæ* have *valvules* from place to place, which give admittance to the chyle, and hinder its ever returning.

Bartholin discovered in 1652 the *lymphatic vessels*, which some of the ancients had mistaken for the *venæ lacteæ*.

All these vessels are employed in the chylification, which is perfected in the following manner.——After the victuals are by the diglutition conveyed into the stomach, (as already observed) and have been penetrated with the *dissolvent*, so as to appear as an uniform liquor; that liquor being squeezed by the stomach equally on all sides, is forced through the *pylorus*, and so enters the intestines: there it meets with two others dissolvent, *viz.* the *bile*, and the *pancreatic* juice, which finish the liquefaction of the aliments. This done, it pursues its course through the intestines; and mean while the subtilest part of it enters the orifices of the first *venæ lacteæ*, and is carried unto the glands at the *basis* of the *mesentery*; then that same subtilest part taken up by the secondary *venæ lacteæ*, and conveyed to *Pequet*'s receptacle, where we'll leave it till we conduct it to the heart through the *ductus thoracicus*.

The LIVER, (aa) which is the next part of the *abdomen*, which falls under our consideration, is a large glandulous viscus, of a red sanguine colour, situated immediately under the diaphragm in the right *hypochondrium*, which it almost fills; and then stretching itself over the right side of the stomach towards the left *hypochondrium*, reaches behind the *cartilago xiphoides*, growing gradually thinner and narrower.

The upper part of the liver is convex and perfectly smooth; the under concave, and somewhat more uneven, having four large fissures; one, through which the umbilical ligament passes; a second on the left side receiving the *pylorus*, and the beginning of the *duodenum*; a third on the right side, near the margin, in which the gall bladder is lodged; and the last in the upper part affording a passage to the *vena cava*.

Its figure is somewhat approaching round with thin edges, not altogether even, but notched in some places.—Its magnitude is various in different subjects, according to the proportion of the body; though in a *fœtus* it is always larger, in proportion, than in adults.—The liver is fastened by two ligaments, the first, which is the strongest and chief ligament, penetrates into the substance of the liver, and ties it up to the *diaphragm*.—This suspensory *ligament* proceeds from the common *capsula* of the *porta*, and gall duct.——The other ligament has its origin from the external coat of the liver, or, which amounts to the same, from the *peritonæum*, and terminates in the *cartilago xiphoides*.———These ligaments serve to keep it in its due situation.—Some authors give in the dry'd umbilical vein for a third ligament; which cannot be, since, thereby the liver and the midriff, to which it it is tied, would be drawn downward, and ſo would hinder its motion, eſpecially in expiration.

The *liver* has a motion, not of itſelf, but depending on that of the *diaphragm*; to which being very firmly connected, it muſt needs obey its motion.—The ſubſtance of the liver is vaſcular and glandulous, which latter part is very ſoft and friable, and eaſily ſcraped off from the veſſels, to which the glands every-way adhere, as it were, in bunches; which has made the Anatomiſts call the conſiderable ones, the internal lobes of the liver.

The glands adhering thus to the veſſels, and conſtituting thoſe lobes, are wrapped up together in proper membranes, whence this appearance of diſtinct lobes.—Every one of theſe glands, according to *Malpighi*, is compoſed of ſix unequal ſides, or faces.—They are all cloathed with their proper membranes, and have each an excretory duct; ſeveral of which joining together form little trunks, which run all along with the branches of the *porta*; and theſe again uniting form larger trunks always full of *bile*, and which conſtitute the *porus bilarius*, which being diſtributed all over the *liver*, receives, in the foregoing manner, the *bile*, which is ſeparated by theſe glands; and terminating in the *meatus hepaticus*, and in the *ductus communis*, at length diſcharges that *bile* into the *duodenum*.—Beſides this diſcharge by the *porus bilarius* (ſuppoſed to be the great one) the *liver* delivers alſo part of its *bile* into the gall-bladder, by a duct, called the *cyſt-hepatic duct*, firſt diſcovered by Dr. *Gliſſon*, and therefore called, alſo, *Gliſſon*'s *capſula*, by means whereof there is an immediate communication, between the *porus bilarius*, and the gall bladder.

Beſides theſe gall-veſſels, peculiar to the liver, it has alſo *nerves*, *arteries*, *veins*, and *lymphatick* ones.

It receives two *nerves* from the eighth pair, one from the ſtomachic branch, and the other from the intercoſtal, which not piercing through its ſubſtance, but only being loſt in its tunicles, is the reaſon why its ſenſe is not ſo quick, as the other parts, which are better ſtock'd with nerves.

The *arteria cœliaca*, ſpringing from the *aorta*, divides itſelf into two branches, one of which repairs to the *liver*, and the other to the *ſpleen*. The firſt, which is the leaſt, detaches from it the gaſtrick, the two *cyſticæ*, the epiploick, the inteſtinal, and the gaſtro-epiploick, before it enters the liver; where, at laſt, 'tis divided into almoſt as many ſmall branches, as the *vena porta*, which is diſſeminated, with the *cava*, through its whole ſubſtance.—And here it is particularly remarkable of the *porta*, and the *cava*, that, contrary to the ſentiment of ſome *Anatomiſts*, they are both equally diſperſed through the whole ſubſtance of the *liver*, with this ſingle difference, that the branches of the *porta* arrive there, and thoſe of the *cava* ſet out from thence.

The lymphatick veſſels of the liver, proceed from the ſmall conglobated glands found under the tunicle of its concave part, towards the entry of the *vena porta*, in the *capſula*.—Theſe veſſels ſerve to carry the lympha of theſe glands to *Pequet*'s *ciſtern*.

Although the *liver* is not the organ of ſanguification, as imagined by the ancients, it nevertheleſs contributes towards the refining of the blood, which is effected in this manner.—It is almoſt unqueſtionable, at preſent, that it performs the office of an artery, and ſupplies the *liver* with blood, by promoting the filtration performed in the glands, which opens into the extremities of the biliary veſſels, the capillaries of the *vena cava*, and thoſe of the arteries, which convey blood to them, as well as the *vena porta*. Now all this blood is filtrated in ſuch a manner, that its particles, which are proportioned to the ſhoots of the extremities of the biliary veſſels, flow perpetually into them; after which ſome of them are conveyed to the gall-bladder, and others to the *hepatick* duct, and from thence to the *duodenum*: whereas the other particles of blood, the figure and ſize of which is diſproportioned to the above-mentioned orifices, are reconducted by the capillaries of the *vena cava*, into its large trunk, and at laſt to the right ventricle of the heart; which, the better to perform, nature has taken care to join the *hepatic* artery to the *vena porta*, that its continual pulſation may facilitate and augment the motion of the venous blood; and has alſo placed the *liver* under the diaphragm; and the muſcles of the *abdomen*, that the concourſe of the blood may be quickened by their continual beating.

In the concave part of the liver, towards the lower margin, is the GALL-BLADDER (B), which is a membranous receptacle, in figure, ſomewhat like a pear, being about the bigneſs of a pullet's egg; though it is ſometimes larger, eſpecially in thoſe of a bilious temperament.

The *gall-bladder* adheres to the liver, both by its veſſels, which it receives from it; and by its membranes; whereas the external is common with that of the *liver*.—The lower part, which hangs out of the *liver*, reſts on the *pylorus* of the ſtomach, which it dies yellow, with the gall tranſuding through its membranes.

Its membranes are five; an outer or common one, from the *peritonæum*: an inner one, from the *capſula* of the *porta*, and *porus biliarius*; and three proper ones.—The firſt, *vaſculous*, conſiſting of white fibres, interwove with veſſels. The ſecond,

muſcular,

muscular, consisting of a double row of fleshy fibres, the one longitudinal, the other angular; the third or inner coat, glandulous, consisting of a great number of glands, like the *crusta villosa* of the stomach, which separates a mucus that lines the inside of the *gall-bladder*, and defends it from the acrimony of the bile.

The *bladder* is usually divided into two parts, the *fundus*, or bottom (C,) and the *collum*, or neck (D,) at the orifice of which latter, is placed a ring or circle of muscular fibres, which serve as a sphincter, to constringe it, and hinder the too liberal discharge of the bile.

The Duct, called *cholidochus* (E), is a long vessel, twice as broad as the neck of the *bladder*, which runs straight from the liver, through the common passage to the *duodenum*, and throws the gall directly into that intestine.

The *common duct* (F,) or passage of the bile, is formed by the union of the *cholidochus*, and *porus bilarius*. It terminates obliquely, in the end of the *duodenum*; and sometimes in the beginning of the *jejunum*, but very rarely in the ventricle. It runs between the coats of the intestine, and cuts through the outer coat two fingers breadth higher than the inner.—When any obstruction happens in this duct, the *bile* not having a free egress, flies back into the blood, and so occasions a jaundice, which oftentimes proves mortal.

There are two sorts of Bile, one is subtle and fine, being conveyed by the biliary vessel to the *bladder*, and from thence to the intestine; the other is of a grosser substance, and being strained out of the glands of the liver, in which the shoots of the *vena porta* terminate, is carried by small ducts to the *cholidochus*, and from thence to the common passage, where the two sorts meet; and so repair with joint forces to the intestines.

The *bile* being a potent dissolver, compleats in the first intestines, the breaking and mincing of such parts of the aliments, as were not entirely dissolved in the stomach: so that the *bile* is a necessary liquor, without which, the chyle would never attain to that degree of perfection, that is requisite for its sanguification.

Dr. *Quincy* thinks the principal use of both sorts of *bile*, called by the moderns, *cystic*, and *hepatic*, is to sheath and blunt the acids of the chyle, entangling them with its sulphur, so as to prevent their being sufficiently diluted by the *pancreatic* juice to enter the *lacteals*.

Borelli asserts, that part of the *bile* discharged into the intestines, re-enters the meseraic veins, and mixing with the blood of the *vena porta*, is again percolated through the liver; and *Boerhaave* seems of the same opinion: which, if true, the *bile* has its *circulation*, as well as the *blood*

The *bile* is a juice of great importance, with regard to the good or ill habitude of the animal.—Dr. *Woodward* has traced its effects throughout the body, very minutely, and makes no scruple to ascribe most of the diseases thereof, to some disorder of the *bile*. This he takes to be the chief spring in the animal machine, and from this accounts for most of the *phænomena* of a body, whether healthy or diseased.

Many, even among the modern Anatomists, from the small quantity of *bile* secerned, have been led into a mistake, that this secretion is not the sole end of so considerable a *viscus*, as the liver. Dr. *Keil* observes, that in a dog, whose common duct was near as big as that of a man, he gathered about two drams an hour; though in a human body, there is reason to think the quantity secreted to be greater. Mr. *Tauvry* observes, that the *bile* becomes one of the principal causes of thirst, by mixing with the salival juice.

Sometimes the *bile*, from yellow, becomes greenish, like verdigrease, and frequently pale, like the yolks of eggs, and that without any other apparent cause, than a little motion, a convulsion, or a violent passion of the mind.—This occasions many and terrible diseases, as nausea's, an abhorrence of food, anxiety, sighing, cardialgia's, wind, diarrhœa's, dysenteries, acute diseases, fevers, and convulsions.

Sometimes it becomes black, and takes the name of *choler*. In this case, it sometimes tastes like a very sharp vinegar; sometimes like putrified blood, gnawing, burning, dissolving, consuming, occasioning inflammations, gangrenes, mortifications, violent pains, and terrible fermentations.

Of *atra bilis*, or black *bile*, *Boerhaave* distinguishes three kinds. 1. The mildest, arising from the matter of the blood, put in too great a motion, which, hence, takes the name of *adust*. The 2d, is an aggravation of the first, arising from the same causes, only heightened. The 3d, is a corrupt, parched *bile*, which if it arose from a greenish, or palish sort, is still worse.

Too great an evacuation of the *bile*, either upwards or downwards, robs the chylefaction of its main instruments. Hence it prevents digestion, secretion, excretion of the *fæces*, produces an acid temperature, coldness, weakness, paleness, *&c.*

The Spleen (GG,) (the next part to be considered in the *abdomen*) is a *viscus*, of a darkish red, or rather a livid colour, ordinarily resembling the figure of a tongue, though sometimes triangular and sometimes roundish.—It is situated in the left hypochondrium, between the ſpurious ribs, and the ſtomach; is ſomewhat convex on the ſide towards the former, and concave towards the latter, Its ordinary length is ſix inches; breadth, three; and thickneſs, one.——It is connected to the *omentum*, and by means of that and the blood veſſels, to the ſtomach, and left kidney, and ſometimes to the diaphragm.

The *ſpleen* has but one membrane, which is very thick, its inward ſurface ſends out hard fibres which run a-croſs it: all theſe fibres make a net, the interſtices of which are of different figures. Theſe fibres are fleſhy, like thoſe of the lungs.——The bulk of the *ſpleen* is compoſed of innumerable cells, or little bladders, which communicate with each other, and diſcharge themſelves into the trunk of the ſplenick vein.——Their inſide, according to *Malpighi*, is furniſhed with various minute glands adhering together; ſix, ſeven, or eight whereof form a kind of ſmall conglomerate glands, wherein the arteries and veins ſeem to terminate.

Its blood veſſels are the *ſplenic artery*, which furniſhes it with blood from the *cœliaca*, and the ſplenic vein, which carries it thence, by the *porta* to the liver.——Its nerves come from the *plexus linearis*, near the bottom of the ſtomach.—The veſſels are all, as ſoon as they enter the *ſpleen*, wrapt up in one common *capſula*, or membrane, and plentifully diſtributed together, throughout the ſuſtance of the *ſpleen*. Beſides theſe, are lymphatics in abundance.—The *anaſtomoſes* between the arteries, and veins of the *ſpleen*, are more apparent than any other part of the body; and this *viſcus*, is obſerved to be furniſhed with a greater quantity of blood than any other part.

Some have imagined the *ſpleen* only ſerved to make a ballance in the weight of the body; others, that it was only intended for the ſake of ſymmetry; others hold it an uſeleſs load, (ſince it appears from diſſection, that animals from whom it has been cut, live very well without it) others a pit or common ſhore to diſcharge the *fæces* of the blood into; others a fire, by the heat whereof the action of the ſtomach is animated. But Mr. *Cowper*, from the great quantity of blood, and the apparent inoſculations of the *ſpleen*, takes the *ſpleen* to be a ſubordinate organ, miniſtering to the circulation; and thinks, that by this congreſs of the arterial and venal blood, an *impetus* is communicated to the latter; by which its progreſs through the ramifications of the *porta* to the *cava*, is promoted, which would otherwiſe be ſo broke by the double ramifications of the *porta*, as to want ſtrength ſufficient to carry to the heart.

This action or effect of the *ſpleen*, according to Dr. *Boerhaave*, is to receive the freſh arterial blood, to prepare it in its glands, and pour it into its cells; to turn what blood is left from this action, to the little veins, and thence to the ſplenic vein; to mix the humour thus prepared with the nervous juice, and to prepare, attenuate, and more intimately unite them together into one humour.

Malpighi and Dr. *Keil* take the ſpleen to be a viſcous aſſiſtant to the *liver*, in the ſecretion, *&c.* of the bile. Becauſe the *moleculæ*, or little particles, ſhould be already ſeparated before they come to the ſtrainer, and therefore thoſe of the bile ſhould be parted from thoſe of the blood before they arrive at the glands of the liver.

The PANCREAS is a conglomerate gland, or a body compoſed of a great quantity of glands ſeated under the lower and back part of the ſtomach near the firſt *vertebra* of the loins; it reaches from the *duodenum* to the ſpleen, the principal part of it being in the left *hypochondrium*, 'tis tied very faſt to the *peritonæum*, and weighs about five ounces; commonly it has ten fingers breadth in length, one in thickneſs, and two in breadth; furniſhed with a nerve from the intercoſtal, with arteries from the *cœliaca*, with veins leading to the ſplenick, and with lymphatick veſſels, which run to the *receptaculum*.

Beſides all theſe veſſels it has a peculiar *duct*, called the *pancreatic*, diſcovered in 1642, by *Virtſungus*, a celebrated anatomiſt at *Padua*.——This *duct* running along the middle of the *pancreas*, opens into the cavity of the *duodenum*, where its orifice is guarded by a valve, allowing an *exit* to the contained liquor, and oppoſing the entrance of the chyle and other liquors contained in the inteſtine. There is but one paſſage of this nature, though *De Graaf* obſerves that it is frequently double; and in its natural ſtate it is no bigger than a ſmall quill.

The *Pancreas* ſerves, by virtue of its glands, to ſeparate and ſtrain out a certain juice from the blood called the *pancreatic juice*.

This juice is not acid, as ſome authors have ſuppoſed; nor *alkaline*, as ſome others; but a little *ſaline*, and much reſembling the *ſaliva* in its origin, veſſels, and properties.—It is carried by the *pancreatic* duct, into the *duodenum*, where it ſerves to dilute the bile, to change its viſcidity, bitterneſs, colour, *&c.* and make it mix with the chyle, in order to reduce the ſeveral taſtes, odours, and properties of the ſeveral foods in an homogeneous one.

De Graaf, a *Dutch* phyſician, had found means to collect a quantity of it for experiments, and has publiſhed an expreſs treatiſe *de ſucco pancreatico*.

Brunner relates, that the *pancreatic duct* having been

been tried in ſeveral dogs, and cut, they ſtill continued to eat as uſual, and performed all the other functions of life; one of them ſeemed to have the better ſtomach for it.

Before we proceed to the *kidneys*, we muſt take notice of two parts, called *capſulæ atrabilariæ*; becauſe there is found in their cavity, an humour reſembling the *atrabilis*.

Thoſe two *capſulæ* are placed ſometimes above the *kidneys*, and ſometimes between it and the great artery.——They are incloſed in a thin membrane, and entangled with fat, which occaſions the difficulty of tracing them.——That on the right ſide is commonly leſs than the other. Each of them is as big as a walnut laid flat, and has a cavity large enough in proportion to its bigneſs.—In a *fœtus* they are generally as big as kidneys, from which they differ, in this, that their ſubſtance is ſofter and more flaggy.

Their figure is as inconſtant as their ſituation; for, in fact, they have no determined figure.——Their colour is ſometimes red, ſometimes the ſame with that of the fat they are wrapped in.—In their cavity they have ſmall holes, which penetrate through their ſubſtance.—They have a nerve derived from the intercoſtal, which makes a *plexus* in this place; one or two branches detached from the emulgent artery, and ſometimes from the *aorta*, and a ſmall *duct* inſerted into the upper part of the emulgent vein.—Their cavity has a valve, which opens towards the emulgent vein.

The *capſulæ atrabilariæ*, are probably glands for the ſecretion of ſome humour from the blood, imported by the arteries, which humour is afterwards conducted by their ſmall veins to the emulgent vein, and there mixed with the blood.

The parts, which purge the blood of the ſuperfluous ſerum, called *Urine*, are of three ſorts, *viz.* the *kidneys*, the *ureter*, and the *bladder*. The firſt make a ſecretion of the *ſerum*; the ſecond convey it to the *bladder*, as ſoon as it is ſeparated; and the *bladder* ſerves for a *ciſtern*, where it is kept for ſome time, and evacuated when it ſwells to a ſufficient quantity.

The Kidneys are called *Renes*, from Ῥεῖν, to flow, becauſe the *urine* flows inceſſantly into the *pelvis*.——They are ſeated in the region of the loins under the *pſoas* muſcle, upon the ſides of the *aorta*, and *vena cava*, without the *peritonæum*, one on the right ſide under the liver, and the other on the left under the ſpleen, at the diſtance of about four fingers breadth one from the other.

They are faſtened to the *vena cava*, and the great artery, by the emulgent arteries and veins, and to the bladder by the *ureter*; the right *kidney* is knit to the inteſtine *cæcum*, and ſometimes to the liver; the left one is tied to the *colon*, and ſometimes to the ſpleen.——Their figure reſembles that of a half-moon or a bean; that ſide which faces the veſſels is concave, the oppoſite ſide is *convex.* Commonly they are four or five fingers breadth long, three broad and two thick.——Their ſurface is ſmooth and ſoft, like that of the liver, and their natural colour a dark red.

The *kidneys* have a proper and very thin membrane, which keeps all their glands in their natural order; which membrane ſome imagine to be nothing elſe but a continuation of the tunicle of the veſſels inſerted in the kidneys, which by dilating themſelves, line their inſide; and then turning back upon the outſide, cover that too.—They are covered, beſides, with the *peritonæum*, and always with a great deal of fat.

Each of them receives *two nerves*, one from the *ſtomachic branch*, which ſpreads itſelf along the membrane; and the other from the neighbourhood of the *meſentery*, which enters the concave part of the kidneys, and is loſt in its ſubſtance; theſe nerves occaſion the vomiting in the nephretick pains.—The trunk of the *aorta* ſends out two large veſſels to the kidneys, which, before they enter, divide themſelves into three or four branches, and which paſſing through the ſubſtance of the kidney, by its concave part, are loſt in an infinity of little glands, to which they convey the blood and its *ſerum* promiſcuouſly mixed.

The blood imported by the arteries to the glands, which cannot paſs through the orifices of theſe ſmall pipes, is taken up by the branches of the emulgent vein, which conducts it to the *vena cava.*

The *pelvis*, or baſon, is a cavity made of the upper end of the *ureters*, in the form of a funnel, the narrow part thereof marches out of the kidney, and makes the beginning of the *ureter*.—Its office is to receive the urine that diſtils from the nipples, which are ſmall mamillary bodies, ſhooting out a little to a point where they are perforated, in order to let the urine fall into the baſon, and to which repair the arteries diſtributed through the whole circumference of the *kidneys*.

The Ureters, (SS) are two canals of a peculiar form, which ſpring upon each ſide from the *pelvis* of the kidneys, are covered with the *peritonæum*, and terminate in the bladder not far from its neck.—They are furniſhed with annular fibres, to enable them to contract themſelves, and thereby facilitate the courſe of the urine into the bladder. Their length is equal to the interval between the *kidney* and the *bladder*; they are no bigger than a writing-pen, except in the *nephretick*, when their cavities are ſometimes ſo dilated as to receive one's

little

little finger, and resemble an S.——They receive nerves from the *intercostal* branch, which occasion their exquisite sense in the gravel, and arteries from the neighbouring parts, and return the small veins.

The *ureters* proceed from the *kidneys*, beginning at the end of the *pelvis*, and terminating in the bladder, which they perforate very artificially; for, having pierced through the outward membrane, they run for two fingers breadth between the two membranes, and then perforate the inner one, near the neck of the *bladder*. By this contrivance the urine having once entered the bladder, cannot return back, the orifice of one membrane being stopped by the other.——The *ureters* receive the urine from the *pelvis*, and convey it to the *bladder*.

The BLADDER (T) is a membranous part, which forms a considerable cavity fit to contain the urine and the solid bodies that are preternaturally bred in it; such as stones, &c.

The *bladder* is situated in the *pelvis* of the *abdomen*; in men, immediately on the *rectum*; in women on the *vagina uteri*. Its figure in human bodies, the lower part is almost on a level with the upper; and its orifice, or neck, placed side-ways, while the *fundus*, (V.) or bottom, which in a human *bladder* is very broad, rests either on the *rectum*, or the *vagina uteri*.——It is fastened to the navel by the *urachus*, degenerated into a ligament, its sides to the umbilical arteries, and its neck to the *intestinum rectum* in women.

The *bladder* is composed of three coats; the first a covering of the *peritonæum*: the second consists of muscular fibres, which run irregular several ways; and the third, which is full of wrinkles for facilitating its dilatation, is both glandulous and nervous. Its glands separate a viscous and slimy matter, which defends the *bladder* from the acrimony of the salts in the urine.—Around its neck there goes a small muscle, called *sphincter vesicæ*, which contracts the orifice of the *bladder*, to prevent the urine from dripping involuntarily, or till it thrusts open the passage by the contraction of the second coat of the *bladder*, called, therefore, *detrusor urinæ*.

Having already considered all the parts of the *abdomen* which contribute to the perfection of the blood, it will not be improper to consider in this place the *aorta*, or great *artery*, and the *vena cava*, which are two large vessels of the *abdomen*.

The AORTA, or *great artery*, (Y) rises directly out of the left ventricle of the heart, where it receives the blood, in order to disperse it all over the body.—We'll only examine in this place the arteries it sends to the *abdomen* after its perforation of the *diaphragm*, which are seven.—The first is the *cœliaca*, which splits into two branches, one on the right side for the liver, and the other on the left for the spleen.—The second is the upper mesenterick, which visits the upper part of the mesentery.—The third are the emulgents, which run to the kidneys.—The fourth, the spermaticks, which repair to the parts calculated for generation.—The fifth, the lower mesenterick, which goes to the intestines, and the lower part of the mesentery.—The sixth, the *lumbares*, which serve the muscles of the loins.—And the seventh, the upper *musculares*, which are lost in the flesh.

When the *aorta* reaches the *os sacrum*, it gets over the *vena cava*, and divides itself into two large arteries, called the *iliacæ*. Each side has one of them, which subdivides itself into the internal and external.—The internal iliack artery detaches four other arteries, *viz.* the *sacra*, *muscularis inferior*, the *umbilicalis*, and the *hypograstric*. The external *iliack*, which is the larger of the two, sends out the *epigrastrick* and the *pudenda*, and then marches to the thighs, where it changes its name, and assumes that of the *arteria cruralis*.

Where the *iliac* artery terminates, there's a vein of the same size, called the *iliaca externa*, which receives not only three other small veins, called *muscularis inferior*, *pedenda*, and *epigastrica*; but also the internal *iliac* branch, consisting of two veins, *viz.* the *hypogastrica*, and the *muscularis media*.——These two *iliac* veins upon one side, and the other two on the opposite, begin about the *os sacrum* to form a very large vein, called the ascending *vena cava*, further enlarged by the accession of the *sacra*, and *muscularis superior*.

I call it *ascendens*, since its office is to convey the blood from the inferior parts to the heart.—It begins to assume the name of *vena cava* upon the *os sacrum*, where the four *iliacæ* join. As it rises higher, it is joined by four sorts of veins, *viz.* the *lumbares*, which come from the muscles of the loins; the *spermatica*, springing from the instruments of generation; the emulgents from the kidneys; and the *adiposa* from the *membrana adiposa* of the reins. This done, the *vena cava ascendens* strikes through the diaphragm into the breast, and terminates in the right ventricle of the heart..

The last parts to be considered in the *abdomen*, are those calculated for GENERATION, which nature has formed to perpetuate itself, by producing new creatures to supply the place of those who are gone.

The *organs* for *generation* are either common or proper; the common are met with in both sexes, such

ſuch as are the *ſpermatic* veſſels, the teſticles, and the *vaſa deferentia.* The proper parts are peculiar either to a man, as the *paraſtatæ*, the ſeminal veſicles, the proſtates, and the yard or *penis*; or the womb to a woman.

We muſt conſider firſt the parts of a man, not only thoſe peculiar to his ſex, but likewiſe thoſe which are common to both ſexes, that we may obſerve wherein they differ.

The parts of a man, which fall firſt under our conſideration, are the *ſpermatick* veſſels, which are four in number, *viz.* two arteries, and two veins.—The *two ſpermatick* (AA) *arteries* ariſing from the trunk of the *aorta*, run obliquely upon the *ureters*, and along the muſcle *pſoas*, till they arrive at the groin, where they are received by a production of the *peritonæum*, and ſo conducted to the teſticles, by paſſing through the rings of the *aponeuroſes* of the muſcles of the *abdomen.*—The two *ſpermatick veins* (BB) march out from the teſticles towards the *vena cava*; the right runs ſtrait to the trunk of the *cava*; but the left one terminates in the emulgent vein.—In their progreſs they are joined by ſmall veins from the *peritonæum*, and the neighbouring muſcles loaded with the ſuperflous blood of their parts, in order to lodge it in the *cava.*

The *artery* in its aſcent, and the vein in its deſcent, on each ſide approach to one another, and are covered with the *peritonæum.*—The various branches of the vein form in their progreſs (without the aſſiſtance of the artery) what we call *corpus varicoſum*, or *pyramidal*; but the *artery* deſcends almoſt in a ſtraight line, without dividing itſelf, unleſs it be at the place of its inſertion, where it ſplits into two branches, the leaſt whereof terminates under the *epydimis*; and the other in the teſticle.

The *ſpermatick veſſels* are larger in men than in women, and in both the arteries are always larger than the veins.—They don't perforate the *peritonæum*, as in dogs, but a production of that membrane conducts them along, together with ſome branches of the *intercoſtal* nerves, and ſome from the one and twentieth pair of the *ſpine*, which ſupply the teſticles with animal ſpirits, and not with the matter of the ſeed, as ſome have imagined, ſince they have not a ſufficient cavity to contain ſuch liquor.

The reaſon why the leſs *ſpermatick* vein terminates in the emulgent, and not in the *cava*, is, that its bulk in paſſing over the emulgent artery, would have hindered the reflux of the blood to the *cava.*

The preparation of the ſeed is not commenced in the ſpermatic veſſels, as falſly ſuppoſed by the ancients; for if the two arteries penetrate the ſubſtance of the *teſticles*, 'tis only to procure a more exact ſeparation of the ſeminal particles that accompany the arterious blood since the remains of that blood are carried back by the ſpermatic veins to the *vena cava*, and the arteries have no *anaſtamoſes* with the veins, either in this place, or any other part of the body.

Therefore the uſe of the *ſpermatick veſſels*, is to have the blood conveyed by the arteries, to the upper part of each teſticle, where the ſeminal particles are ſeparated, and the remains of the blood carried back, by the branches of the veins to the *cava.*

The Testicles, are ſo called from the *Latin* word *teſtes*, witneſſes; as giving teſtimony of virility; they are what we properly call *genitalia.*—The *Greeks* call them *dydimi*, or *twins*, becauſe men have but *two.*

The *teſticle* (DD) are ſoft, white bodies of an oval figure, and about the ſize of a pigeon's egg; they have been thought to be of a glandulous ſubſtance; and according to the preſent doctrine of the glands they may be allowed to be ſo ſtill.

They are formed of a convolution of divers kinds of veſſels, particularly of the *ſpermatick* veins and arteries, the latter of which bring the blood; whence the particles of the *ſeed* are to be ſecreted in the meanders of the *teſticles*, and the former return it back again, after the ſecretion made.

The reſt of the *teſticles* is made up of ſeed-veſſels, which, indeed, are but one continued ſeries, intricately convoluted, and wound up, as it were, into a bottom; but adhering ſo laxly, that it is eaſily drawn out into length, and in rags ſhaken from its cloſe contexture.—Theſe ſeminal veſicles terminate in the *paraſtatæ.*

They are ſeated, in men, without the *abdomen*, at the root of the yard, wrapped up in five coats, two of which are common, *viz.* the *ſcrotum*, and the *dartos*; and three proper, *viz.* the *eritroides*, the *elitroides*, and the *albuginea.*

The firſt of the common ſort is the Scrotum, or purſe, compoſed of a ſcarf ſkin, and a true ſkin, which is here thinner and tenderer than in any other part of the body: it is ſoft, wrinkled, and void of fat, divided into the right and left halves by a line, or ſuture, which commences at the *anus*; paſſes through the *perinæum*, and terminates in the *glans*, or nut.

Dartos, is a cutanous muſcle, conſiſting of a texture of many fleſhy fibres, by virtue whereof, the *ſcrotum* contracts and furls itſelf. It receives ſeveral veſſels from the *arteriæ pudendæ*, and not

not only covers the two testicles, like the *scrotum*, but runs in between them, and keeps them from grating one upon another.

The ERITROIDES (E), is the first of the proper class; it is interlaced with fleshy fibres, which makes it appear red; and is produced by the *cremaster*, a muscle, which holds up the *testicles*.

The ELITROIDES (F), called also *vaginalis*, is a dilatation of a production of the *peritonæum*. —Its internal surface is even and smooth, and the external rough and unequal, whereby it sticks very close to the *eritroides*.

The ALBUGINEA (G), so called from its *whiteness*, is the immediate cover of the *testicles*, and impresses them with a figure answerable to its own. —It proceeds from the coat, in which the *spermatick* vessels are wrapped.

The *testicles* are suspended by two muscles, called *cremastores* (H), or *suspensores*, which are inserted in the *ossa pubis*, at the end of the transverse muscle of the *abdomen*, and surround the *testicles* like a membrane, which if they happen to be stronger than ordinary, move the *testicles* of themselves, pulling them up, and letting them fall at pleasure.

The PARASTATÆ (LL), or *epididymidæ*, are two tuberous, varicose bodies, lying upon, and adhering to the upper part of the *testicles*, whereof they properly appear to be a part; though different from the rest in form and consistence.

The *parastatæ* consist, like the *testicles*, of a convolution of seminal *tubuli*, mixed with bloody vessels; the difference between them lying only in this, that the *parastatæ*, and the *tubuli*, are united into one; the various convolutions of which being more firmly bound together, by a strong membrane, arising from the *tunica albuginea*, it feels more compact than the *testicles*.

The use of the *parastatæ*, is to receive the seed separated in the *testicles*, and pour it into the trunk of the *vas deferens*, to which it is contiguous.

The VASA DEFFERENTIA (M), are white and nervous vessels, of a round figure, and of the bigness of a quill, seated partly in the *scrotum*, and partly in the *abdomen*. —— They are rooted in the testicle; from one end of which they proceed, and march upwards, in the same process of the *peritonæum*, that covers the *spermatick* vessels. —— They turn about, upon their arrival at the upper part of the *pubis*, and climb over the *uterus*; and then, approaching to one another, run under the upper part of the bladder, where they have a communication with the seminal vessels. —— The two extremities of the *vasa deferentia*, being arrived between the bladder and the *rectum*, dilate themselves, and form the *vesiculæ seminales*. —— They resemble a bunch of grapes; and their cells, the cavities of pomegranate kernels; though not separated by a membrane, like grapes, for their cells communicate with one another. —— Their broadest part is about an inch over, they have one side thicker and larger than the other, and their cavities are unequal, some being greater than others. — They are seated between the bladder and *rectum*, near the *prostatæ*, and serve for a cistern to the seed.

From these vesicles, proceed two small *ducts*, called EJACULATORY VESSELS, because in the heat of action, they really throw the *seed* of the vesicles into the *urethra*. — These *ducts* are broad near the vesicles from whence they proceed; but dwindle as they approach the *urethra*, which they perforate; and on its inside, at the place of their entry, form a small caruncle or tuft, called *verumontanum*, which is a sort of small valve, keeping the urine out of the two ducts, in its passage to the *urethra*; and obliging the seed to turn towards the *penis*, and not towards the bladder.

The PROSTATÆ (OO), are two white, spungy, glandulous bodies, situated at the root of the *penis*, or just below the neck of the bladder, and about the size of walnuts.

Authors ascribe two kinds of substance to the *prostatæ*, the one glandulous, the other spongeous, or porous; which last seems nothing but a congeries of minute vessels, and cells, through the middle of which pass the *vesiculæ seminales*, without any communication therewith.

The *prostatæ* have many excretory ducts of their own: *De Graaf* does not remember to have known them fewer than ten in the *prostatæ* of men. — Out of these issues a whitish slimy humour, secreted in the glandular parts of the *prostatæ*, and conveyed into the cavity of the *urethra*.

The use of this humour is to line and lubricate the cavity of the *urethra*, and prevent it from being annoyed by the acrimony of the urine, in its passage through it, and to serve as a vehicle to the *seed*, in the time of ejaculation.

Boerhaave thinks, that this humour may serve to nourish the animalculæ, during the first moments after coition. — This humour, he adds, remains after castration, but is not prolifick.

The same author, from the memoirs of the *French* academy, makes the *prostatæ*, to consist of an aggregate of twelve glands, each of which terminates by its excretory duct, in a little bag, into which it discharges its humour. —— These twelve bags open by as many excretory ducts, into the cavity of the *urethra*, so as to encompass the exit of the *vesiculæ*; whence the *seed* and the humour of the *prostatæ* are the more accurately mixed.

'Tis alledged, that this place is the ordinary ſeat of a *clap*, upon the plea, that ſome volatile ſalts faſtening there, occaſion ulcers that corrode the caruncles; and upon that, the orifices of the heretofore mentioned ducts, throw out their ſlimy liquor, the flux of which is ſometimes never cured.

The Penis (PP), which is the inſtrument appointed by nature to convey the *ſeed* to the womb, for the formation of man, is placed at the lower and external part of the *abdomen*, and faſtened to the *os pubis*.

Its body conſiſts of the two *corpora cavernoſa*, *viz.* the *corpus cavernoſum urethræ*, and the *urethra* itſelf.

The *corpora cavernoſa* of the *penis* have two diſtinct origins in the *os pubis*, whence they proceed, growing both in bulk and thickneſs, till they meet the *corpus cavernoſum* of the *urethra*, where they join; leaving an interſtice or channel, for its paſſage along them; and thus continue their progreſs connected together by a membranous body called the *ſeptum*, and terminating at length in the *glans*.

The cavernous body of the *urethra*, includes the *urethra*, or urinary paſſage. —— Its form, contrary to that of the other cavernous bodies, is largeſt at the two extremes, and ſmalleſt in the middle. —— That part included between the two origins of the cavernous bodies of the *penis*, Mr. *Cowper* calls the *bulb of the urethra*: Its other extremity being dilated, forms the *glans*.

The *penis* receives arteries (QQ) from the internal iliac branches, and umbilical arteries, from the capillary extremities whereof ariſe ſo many veins, in whoſe channels are apertures, correſponding to ſo many cells, which communicating with each other empty themſelves into larger venous ducts, running on the ſuperior ſurface of the *penis*; ſome whereof join the vein of the prepuce; others make one large trunk, called *vena penis*, which marching on the *dorſum penis* to the *proſtatæ*; there divides and enters the internal iliac on either ſide.

The *penis* has nerves from a trunk, compoſed of a coaleſcence of the third of the *os ſacrum*, and a branch of the great crural: Theſe aſcending the cavernous bodies, expand themſelves over the upper ſurface thereof, and are thence diſtributed to all parts of the *penis*.

It has a great number of *lymphatick* ducts, on its ſurface under the ſkin, which diſcharge themſelves into the *glandulæ inguinales*.

The *penis* has two pair of muſcles, and an odd one; the odd muſcle is called *accelerator urinæ*: Its upper part, which covers the bulb, ſerves to ſtreighten the veins paſſing through it, from the *corpus cavernoſum* of the *urethra*, and thus hinders the reflux of the blood in erection, and, by repeated contractions, drives the blood into the bulb towards the *glans*. — Its elongation ſerves to compreſs the channel of the *urethra*, and to force out the contained *ſeed*, or urine.

The firſt pair of muſcles is called the *erectores penis* (RR). By their action the *penis* is ſuſtained and drawn towards the *pubes*; and by the aſſiſtance of the ſuſpenſory ligament of the *penis*, the *vena penis*, is applied to the tranſverſe ligament of the *oſſa pubis*, and the refluent blood hindered from paſſing that way, whereby the *corpora cavernoſa* become diſtended.

The laſt pair of muſcles are the *tranſverſalis penis* (SS), which vary in various ſubjects, and are ſometimes wanting; their uſe is to dilate that part of the cavernous body of the *urethra*, to which they are faſtened.

The *penis* has alſo three glands (TT), firſt diſcovered by Mr. *Cowper*; theſe all empty themſelves into the *urethra*, and from the tenacity of the liquor they ſeparate, are called the *mucous glands*.

The whole compages of the *penis*, is inveſted with a cellulous membrane, of admirable texture; which, again, is covered with a firm nervous coat; and that with a *cuticula*, and *cutis*; the duplicature of the *cutis* on the *glans* makes the *prepuce*.

The Prepuce (V), is tied to the lower part of the *glans*, by a ligament, called *frænum*. ——— By another ligament, called *ſuſpenſorum*, the *penis* is tied to the *oſſa pubis*.

The Uretrha (Y) is a nervous paſſage reaching from the neck of the bladder to the end of the *penis*, ſeated underneath, and between the nervous bodies. — 'Tis compoſed of two membranes; the outermoſt fleſhy and uneven, with tranſverſe fibres; the inner one thin and nervous.

The *urethra* deſcends from the bladder, and paſſes under the ſhare-bone, after which it aſcends and accompanies the *penis* to its end, where it terminates; therefore its figure reſembles an S (which ſhould be minded by ſurgeons when they probe the bladder).

The uſe of the *urethra* is to be a common paſſage to the ſeed and urine.

Having thus examined with all poſſible care and attention the parts calculated for *generation* in a *man*, we muſt proceed to another hiſtorical account of the ſame organs in a *woman*.

To obſerve the ſame order I have followed in the deſcription of the parts of a man, I'll begin with the *ſpermatick* veſſels. — A *woman* has four *ſpermatick veſſels*, *viz.* an *artery* (AA) and a *vein* (BB) on each ſide, as 'tis in a man. — In both the arteries proceed, in the ſame manner from the fore

fore part of the *aorta*, but have in both a different insertion; for, in a woman, they divide themselves half-way into two branches, the greatest of which after several circumvolutions marches to the testicles; and the least to the *matrix*, where it splits into several twigs, some of which repair to the sides of the *tubæ*, and neck of the womb, and others to the upper part of its bottom.

This ramification of the *arteries* is accompanied with an equal number of branches of veins, which wind up again from the womb and the testicles, and joining together make two considerable veins: of which that on the right side terminates in the *cava*, and that on the left in the emulgent vein.

These *spermatick* vessels differ from those of men in two points; 1. They are not so long as in men. since the women's testicles, or *ovaria*, being lodged within the *abdomen*, whereas those of men, hang out in the *scrotum*, consequently the passage from the *aorta* to the testicles, and from the testicles to the *vena cava* must be much shorter in a woman than in a man.

Women have two testicles (CC) as well as men, but differ in their situation, magnitude, figure, connexion, covers and substance. — They are seated in the *abdomen* upon the sides of the bottom of the womb, at the distance of two fingers breadth from it, by reason that their commerce and alliance with the *matrix* requires that they should not lie at a great distance. ——— They are connected to the *uterus* by a strong ligament, which the antients improperly called *vas deferens*, (for it is not at all hollow) and in some measure by the *fallopian tubes*, and the broad ligament about the region of the *ilium*. — They are fastened to the *peritonæum* by the spermatick vessels, by which means they are kept suspended about the same height with the *fundus uteri*.

Their *figure* is semi-oval; their surface somewhat uneven, and their size different in the different stages of life. At the time of puberty, when largest, they usually weigh a drachm and half.

They are covered with a common membrane from the *peritonæum*; their substance is whitish, composed of a number of little thin membranous and slender fibres, interwoven with arteries, veins and nerves.

Among these fibres and vessels are interspersed a number of little round bodies, like bladders; full of a limpid substance, and called *ova* or eggs, which include the sperm that contains the *fœtus*.

On each side of the *fundus uteri* are discovered two ducts arising from it, called *tubæ fallopianæ* (D) or trumpets, in respect of their form: for that in their rise or opening into the womb, they are exceeding small, but in their progress towards the *ovary* they grow much bigger, and at length are capable to receive the finger; from whence they contract again, and at the extremity next the ovaries are expanded into a sort of flanch or foliage, fringed round with innumerate little fibres, bearing some resemblance to the flanch of a trumpet.

The FALLOPIAN TUBES are four or five inches long; they consist of a double membrane, derived from the outer and inner membrane of the *uterus*. — The extremity next the *ovary*. at the time of impregnation, at which time the whole tube is expanded, reaches to, and embraces the *ovary*; tho', at other times, it seems to fall a little short of it, and is only slightly tied by the fringe to the under side of the ovary.

The use of the *tubes* is to convey the *seed*, or rather *ova* of women, from the testicles, or ovaries into the *uterus* or *womb*.

Their inner substance is composed, in good measure, of ramifications of veins and arteries, which form a kind of reticular or cavernous body, not unlike that of the *clitoris*. This structure makes them capable of dilatation and contraction, according to the quantity and stop of the blood; and consequently of being, as it were, erected *in coitu*, and of embracing the *ovary* at that time, which in their state of flaccidity they did not.

They take their denomination *fallopian* from *Gabriel Fallopius*, a *Modenese*, who died in 1562, commonly reputed their first discoverer, though we find them described long before in *Rufus* of *Ephesus*.

The *ova*, or *embryos*, are sometimes detained in the *tubæ fallopianæ*, and cannot make their way into the womb.—*Abraham Cyprianus*, a celebrated physician of *Amsterdam*, in a letter to Sir *Thomas Millington*, describes the manner in which he drew a *fœtus* twenty-one months old out of the *tuba* of a living woman, who lived and had several children after the operation.

TWINS spring always from two *eggs* disengaged from the *ovarium* at one and the same time. The *egg* has two membranes strew'd with vessels, which at first are very small and fine, but grows larger after it has been fecundated by the more volatile part of the *seed* of man carried to the *ovarium*, through the *tubæ fallopianæ*.

The MATRIX (E) *uterus*, or *womb*, is the principal organ of *generation*. 'Tis placed in the lower part of the *hypogastrium*, between the *rectum* and the bladder; lodged in a cavity called *pelvis*, so large as to give the womb liberty to distend itself upon impregnation. It is surrounded and defended by mighty bones; before by the *os pubis*, behind by the *sacrum*; on each side by the *ilium* and *ischium*. It is in figure somewhat like a flat flask, or dried pear.

pear. In women with child, it expands and receives different forms, according to the different times and circumſtances of geſtation.—It has ſeveral coats, arteries, veins, nerves, and ligaments, and is interwoven with ſeveral kind of fibres.

Anatomiſts divide the *matrix* into the *fundus* and *cervix*; a broad part, and a neck.—It is in extent from the extremity of the one to that of the other, about three inches in length; its breadth at the *fundus* is about two and a half, and its thickneſs two inches.—It has but one cavity, unleſs we diſtinguiſh between the cavity of the *uterus*, and that of its neck. That of the *cervix* is very ſmall, ſcarce ſufficient to contain a garden bean. At the bottom or neck towards the *fundus*, it grows very narrow in virgins; the extremity of it is called the *oſculum internum*; in pregnant women it opens, more eſpecially towards the time of delivery.——The other and lower orifice of the neck towards the *vagina*, called *oſculum externum*, is a little prominent, reſembling, in ſome meaſure, the glans of the virile organ.

The ſubſtance of the *matrix* is membranous, which enables it to receive the *ſeed*; to ſtretch and ſpread itſelf for the growth of the child; to contract itſelf for the egreſs of the child, and afterbirth, and at laſt to reinſtate itſelf in its natural poſture.

The *matrix* is tied faſt at the bottom and at the neck. The neck, which is covered with the *peritonæum*, is knit before to the bladder and the *ſhare-bone*, and behind to the *rectum* and the *os ſacrum*. The bottom is more at liberty, in order to move, dilate, and contract itſelf upon occaſion, though equipped with four ligaments; two upper ones (FF,) which are nothing elſe but the productions of the *peritonæum*, which proceed from the loins, and are inſerted in the ſides of the bottom of the womb, to prevent its falling down upon the neck; and two inferiors (GG) which riſe from the ſides of the bottom of the womb, towards its horns, and paſſing through the reins in the *aponeuroſes*, or tendons of the muſcles of the *abdomen*, march to the groins, where they divide themſelves into ſeveral branches, ſome of which are inſerted into the ſhare-bone, and others in the thighs, from whence proceed the pains which pregnant women feel in thoſe parts, which increaſe as the belly riſes.

From the *nerves* diſperſed over the bottom of the womb, as well as its neck, and which proceed, ſome from the *intercoſtal* branch, and ſome from thoſe that paſs through the *os ſacrum*, the *matrix* receives its exquiſite ſenſe of pain, or pleaſure; and are the occaſion of its ſympathy with all the parts of the body.

The womb is ſprinkled all over with blood imported, part by the *ſpermatick* arteries, mentioned above; and part by other arteries, which ſpring from the *hypogaſtrick* ones.

Theſe *arteries* not only furniſh the womb with blood for its nouriſhment, but likewiſe pour in blood through an infinity of ſmall branches upon the whole body of the *placenta*, in order to be ſent through the *navel-ſtring* to the *fœtus*.—When a woman is not with child, the ſame blood ſlips away through ſeveral paſſages that open into the circumference of the bottom of the womb, and falls into its cavity, from whence it makes its *exit* through the *vagina* every month; and this is what we call *menſtrual* blood.

There are ſome of theſe arteries, that ſupply the inner orifice with blood, which is ſometimes let out in pregnant women, eſpecially when the perſon has more than is neceſſary for the nouriſhment of the child: ſo that we muſt not be ſurprized upon ſeeing ſome women viſited by their *terms* ſeveral times during their being with child, who nevertheleſs go their full time; ſince in that caſe the flux comes from the veſſels of the neck of the womb, and not from the bottom: for, if from the bottom, it would occaſion a miſcarriage; but no otherwiſe.

The *hypogaſtrick* and *ſpermatick* are the two principal veins of the *matrix*, which conſiſts of an infinity of branches, ſpringing from all the parts of the womb, and exporting the blood to the trunk of the *vena cava*.

Since we have already compared the *matrix* to a flaſk, we muſt believe that it has a bottom, a neck, and orifices: and in fact it has two orifices, the one internal, and the other external.

The *external orifice* (H) called Pudendum, is compoſed of ſeveral parts, ſome of which are obvious, as the *pubes*, the *mons veneris*, the lips, and the great ſlit. But the others are only deſcry'd after the deduction of the lips, ſuch are the *nymphæ*, the *clitoris*, *urinary paſſage*, and the *caruncles*.

The Pubes (I) is ſeated on the forepart of the ſhare-bone, and immediately above the *pudendum*. It conſiſts of fat, which ſerves as a little cuſhion to hinder the hardneſs of the bones from being hurtful in amorous embraces.

Mons Veneris (K) is ſeated a little lower than *pubes*, above the great lips.

The great Labia (LL) deſcend from this hill, one on the right and the other on the left, and meet in the *perinæum*.—They conſiſt of the ſkin doubled, and ſpongy fleſh and fat, which renders them pretty thick.—In girls they are firmer than in thoſe who have received man, and in thoſe who have bore many children they are ſoft and flaggy.

 —The

—The ſpace between the two lips is called the great cleft, or ſlit, and reaches from the *mons veneris* to the *perinæum*.

Upon ſpreading the thighs, and drawing aſide the *two lips*, are two fleſhy ſoft and ſpongy excreſcences, called

NYMPHÆ (MM) which deſcend from the tip of the *clitoris* to the ſides of the urinary paſſage; thus reaching to about the middle of the orifice of the *vagina*, where they grow leſs and leſs till they diſappear.

Their breadth is uncertain, uſually in maids half a finger; ſome times they are larger, and capable of being diſtended to a great degree; ſo as to hang a good way out of the body, and in ſuch caſes are often extirpated.

The uſe of the *nymphæ* is, by ſwelling in act of coition, to embrace the *penis*, and by their ſenſibility to affect the woman, and mutually invite to procreation.

Their ſubſtance is very ſpongy, compoſed of membranes, and veſſels looſely cohering, and therefore eaſily diſtendible.

Within the great cleft above the *nymphæ*, there is a long round and glandulous body, which encreaſes towards the extremity, called

CLITORIS (NN) which ſome call *oſtrum veneris*, from its exquiſite ſenſation, for all *Phyſicians* as well as *Anatomiſts* agree in this, that the *clitoris* is the principal ſeat of pleaſure.

Its appearance commences in virgins about the fourteenth year of their age; after which it enlarges as the years advance, or in proportion to the greater or leſſer ſalaciouſneſs of the perſon.—In the ardour of enjoyment it ſwells and becomes hard, juſt as the yard ſwells in the time of erection, and by the ſame cauſe.—In ſome women 'tis very large, and ſhoots without the lips; in others it has the ſize of a man's yard, and ſerves for an inſtrument to abuſe other women, as ſeen in the *hermaphrodites*.

The *clitoris* is compoſed of the ſame parts with thoſe of the *penis*; it has, like it, two cavernous or ſpongious bodies, and a *glans* (O,) at the extremity, covered with a *præputium* (P,) but not perforated like the *penis*.

It has two muſcles (RR) which erect it in coition, on which occaſion it ſwells and grows hard.

The ſpongious bodies of the *clitoris*, ariſe diſtinctly from the lower part of the *os pubis*, and approaching one another, unite and form the body of the *clitoris*; before their union they are called *crura clitoridis*, and are twice as long as the body of the *clitoris*.

Its muſcles ariſe from the protuberance of the *iſchium*, and are inſerted into its ſpongious bodies; it has veins and arteries from the hæmorrhoidal veſſels and *pudenda*; and nerves from the intercoſtal, which ſerve not only to raiſe and ſtiffen the *clitoris*, but likewiſe to contract and ſtraiten the orifice of the *vagina*; for when they ſwell themſelves, they oblige the *labia* to draw cloſe to one another; by which means the yard is extremely ſqueezed in the amorous approaches.

The *arteriæ pudendæ* furniſh the *clitoris* with blood; and the *venæ pudendæ* carry it back into the *cava*.

Under the *clitoris* appears the *urinary* paſſage, ſurrounded with a *ſphincter*, which ſerves to impriſon or releaſe the urine at pleaſure; and this paſſage being larger and ſhorter in women, than in men; their urine being thereby provided with more diſpatch, ſweeps off the ſmall ſtones, ſand, and gravel, which oftentimes remain in the bottom of a man's bladder: ſo that women are leſs ſubject to the ſtone.

Graaf calls *lacunæ* a glandulous body, of about a finger's breadth thick, ſituated between the fleſhy fibres of the *urethra*, and the membrane of the *vagina*, and which ſpreads itſelf along and round the bladder.—Thoſe conducts terminate in the lower part of the *vulva*, and there throw out a ſlimy matter that mixes with the male ſeed.

The CARUNCLES MYRTIFORMES (V V V V) come next, placed, as it were, in the four corners of a quadrangle, and in the midſt of a long cavity called *foſſa navicularis*.—They are made of the fleſhy wrinkles of the *vagina*, which render the paſſage ſo much the ſtraiter, eſpecially in virgins, in whom they are joined ſide-ways to one another by ſome ſmall membranes, which make them reſemble a roſe-bud half blown; but when thoſe membranes are once broken, by the ingreſs of the *penis*, or the egreſs of a child, they are ſeparated, and never rejoin.—Theſe *caruncles* ſerve for two uſes, one is to heighten the mutual pleaſure of enjoyment, by clinging round and locking up the yard; the other is to facilitate the egreſs of the child, by extending themſelves.

Qu. May not the union of theſe two *caruncles*, be the ſole mark of virginity in a woman?

Having thus carefully examined the parts calculated for generation, both in men and women; it will not be improper to give here, ſome account of the generation itſelf.

To proceed with ſome order in this diſcovery, we muſt conſider, that an animal cannot be produced without a couple, *i. e.* a male and a female, each of which acts its reſpective part in the admirable work of generation.

Let us therefore inquire firſt into the man's part. The whole of his action may be reduced to two heads,

heads, *viz.* the *producing* of feed, and the *conveying* it into the womb.

The Seed, *femen*, is a white liquid matter, the thickeft of any in the body, feparated from the blood in the tefticles, and referved in proper veffels to be the means of *generation*.

The parts concerned in the preparation of the *feed* are the fpermatick arteries, which bring the blood to be fecreted into the tefticles; the tefticles and *paraftatæ*, where the fecretion is chiefly effected; the *vafa deferentia*, which convey the fecreted matter out of the tefticles; and the *veficulæ feminales*, which receive and preferve it to be emitted in coition.

The *feminal* liquor emitted for ufe, is a mixture of feveral fluids, poured at the fame time into the common canal of the *urethra*, either from the glands, that have fecreted them, or from the refervoirs, that have kept them.

The feveral feminal particles being feparated from the blood by the natural difpofition of the tefticles, are received by an infinite number of the fmall roots of the *epididymus*, which convey them to thefe glandulous bodies; from whence they repair to the *vafa deferentia*; and are by them conducted by drops to the feminal veficles. ——— In thefe vefcicles all thefe particles being joined make a prolifick liquor, called *feed*, laid up for a referve in thefe little bags.

This liquor muft have an egrefs, and be transferred to a place that's qualified for the production of man. This place is the *womb*; and the action which transfers the *feed* is called *copulation*.

Copulation is the joining of a male to a female; in the action the male gives, and the female receives; there are three neceffary circumftances in performing the act of *copulation*; the firft is the erection of the *penis*; the fecond its being lodged in the neck of the womb; and the third is the ejection of the *feed*.

The *erection of the penis*, confifts in a diftention of its *corpora cavernofa*, by an extraordinary quantity of blood pent up therein; and which is effected in the following manner.

The Ejaculation, or Ejection which ought to follow the lodging of the yard in the neck of the womb, is thus performed. The feed taking leave of the feminal vefcicles, paffes through the ejaculatory veffels, and enters the *urethra*, from whence it is fquirted out with a jirk, by virtue of the convulfions that then feize the yard. The quantity of feed thus emitted cannot be determined; fome fquirt out more than others; and no more is neceffary than what can keep up its conveyance to the *ovarium*.

We'll now take a view of the woman's part in the act of *generation*; but before we proceed further we muft make fome remarks upon the *tefticles* of women. 1. That the tefticles of women are glands which filtrate the feed; and that each of them has an excretory veffel, which conveys the filtrated feed to the vefcicles. 2. That in women each of thefe vefcicles is feparated from its neighbouring vefcicle, as one grape is from another in the fame bunch. 3. That in each vefcicle there is a feed which is capable to form a child, juft as a hen's egg contains all the neceffary particles for producing a chick; and, 4. That each vefcicle may difengage itfelf from the tefticle, and be tranfported to the bottom of the womb. — Upon this principle we call the vefcicles, *eggs*, and change the name of tefticles into that of *ovarium*.

The Matrix, or womb, is the proper and peculiar organ of generation. 'Tis certain that the *fœtus* is formed within it out of the feed that it foments; but we are at a lofs to know in what manner it is formed.

There are two principal theories or methods of accounting for the generation of animals: The one fuppofes the *embryo* or *fœtus* to be originally in the feed of the male; the other in the *ovum* or egg of the female.

The *firft* fuppofes animalcules in the male feed to be the firft rudiments of the *fœtus*; and that the female only furnifhes a proper *nidus* and nutriment to bring them forwards.

The *fecond* fuppofes the firft rudiments of the animal to be in the *ova*; and that the male feed only ferves to warm, cherifh, and ripen the *ova*, 'till they fall off out of the *ovary* into the womb; which is chiefly fupported (fay the retainers to that fyftem) from the conformation in rabits, cows, &c. where the *vagina* of the womb is fo long and finuous, that it is fcarce poffible the male-feed fhould ever arrive within the body of the *uterus*, efpecially in cows, whofe *vagina* is filled with a thick, vifcid ichor, and the inner orifice of the womb exactly clofed —— They add to this that it is highly improbable that the animalcules (mentioned by Mr. *Leewenhoeck* and others) fhould contain the rudiments of a future body; fince their large number would produce too plentiful an offspring; in fo much that it would be neceffary for 9999 parts of them to be in vain and perifh, which is contrary to the œconomy of nature in other things.

Analogy is likewife urged in favour of this fyftem: That all plants are maintained to arife from eggs; feeds being no other than eggs under another denomination. All *oviparous* animals do unexceptionably arife from eggs; which the female cafts forth; and it is highly probable, that the females lay and hatch their eggs within themfelves.

Againſt this hypotheſis it is urged, that what are uſually called *ova*, or eggs, in women, are no other than little cells or bladders, full of a certain liquor: And how can a drop of liquor paſs for an egg? And that theſe imaginary eggs have no proper membrane belonging to them, nor any covering but that of the cell; which ſeems ſo inſepable therefrom, that when they are diſcharged, it is hard to conceive how they ſhould take it with them. And beſide, how ſhould they make themſelves a paſſage through the common membrane, wherewith the *ovary* is inveſted, which is of ſo cloſe a texture, that it muſt ſeem abſolutely impenetrable, by a round body of ſo ſoft a conſiſtence, as one of theſe veſicles. —— Laſtly, *veſiculæ*, in all reſpects perfectly like *ova*, have been found in other parts of the body, where it is apparent they could not ſerve for any purpoſes of generation. *Mem. de l'Academ. Royal des Scien.* An. 1708, 1709.

To this it is anſwered, that *ova*, or *veſiculæ*, have been actually found in diſſections, detached and ſeparated from the *ovary*, and the ruptures in the membranes in the *ovary*, through which they had paſſed, ſtill viſible.

Mr. *Littre* even obſerved ſome of theſe ſeparated *ova*, ſpread with blood veſſels, like thoſe in the yolks of birds eggs. —— Nay more, the ſame author is poſitive, that he ſaw an *embryo* in one of the *ova* not yet ſeparated; could diſcern its head, mouth, noſe, trunk, and *funiculus umbilicalis*, whereby it adhered to the membranes of the *ovary*.

Sir *John Floyer* ſtarts a difficulty, which ſeems to preſs equally againſt each ſyſtem, taken ſingly: It is fetched from monſters; in a mule, for inſtance, which is the production of a *venereal copula*, between an aſs and a mare, the bulk of the body partakes of the form of the dam; and the feet, tail, and ears of that of the ſire; hence it is argued, that the rudiments of the greater part of the *fœtus*, are laid in the *ovum*; and that the impregnation, either conveys or changes the extremities. If the male ſupplied the *animalcula*, the *fœtus* ſhould always be of the ſame ſpecies as the male: If the female ſupply it, it ſhould be of her kind; whereas monſters are of both.

But notwithſtanding this objection, all Anatomiſts agree, at preſent, that the *fœtus* is certainly lodged in an egg; and that the proceſs of generation, on the part of the female, is thus,

The *clitoris* being erected, after the like manner as the *penis* in man; and the neighbouring parts all diſtended with blood, they more adequately embrace the *penis* in *coitu*; and by their intumeſcence, preſs out a liquor from the glands about the neck of the womb, to facilitate the paſſage of the *penis*. — At the ſame time the fibres of the womb contracting, open its mouth, (which at other times is extremely cloſe) for the reception of the finer part of the ſeed.

Thus the ſeed, pregnant with animaleulæ, is conveyed with ſome impetus, into the *uterus*; where, being retained by the convulſive conſtriction of the inner membrane thereof, and further heated and agitated therein, it is prepared to impregnate the *ovum*.

During the act of coition the *fallopian tubes* growing ſtiff, embrace the ovaries with their ſtrong muſculous edges, like fingers, and compreſs them; till their mouth being dilated, and expanded by this embrace, force the egg, now ripened, into their cavities, and gradually drive it forwards by their vermicular motion till at laſt they protrude it into the cavity of the womb, to meet the ſeed; ſome of the animalcules whereof, entering the dilated pores of the glandulous membrane of the egg, are there retained, nouriſhed, grow to its navel, and ſuffocate the reſt of the leſs lively *animaculæ*.

Thus ſpeak the aſſerters of that ſyſtem.

They who ſet aſide the *animalcules*, as unconcerned in *generation*, account for it thus: The ſeed containing oily, volatile, and ſaline parts (as appears from its fetid ſmell, oleaginous ſubſtance, *&c.*) being lodged in the womb, and there further digeſted and exalted, grows yet more volatile, fetid, pungent, and ſtimulating; and thus adding to the heat occaſioned by coition, vellicates the nervous fibres of that part, and occaſions a fermentation; and by that means an extraordinary flux of humours to that and the adjacent parts.

By this means the *tubæ* become rigid, and fit to graſp the *ovaries*, which are alſo heated by the *effluvia* of the *ſemen*, and the warmth of the parts ſurrounding: till at length, ſome of them at leaſt, by ſuch greater ſupply of nouriſhment, increaſe in bulk; and as thoſe graſped by the edges of the *tubæ*, will be kept warmeſt, and the greateſt flux be made thereto, they will ſooneſt be ripened, fall off, and be received by the *tubæ*, and conveyed to the womb; where growing after the manner of the ſeed of plants, the *placenta*, at length, lays hold of, and adheres to the *uterus*; from which time the *embryo* begins to be nouriſhed after a different manner.

From the *abdomen* we proceed to the region of the *thorax*.

The THORAX or *breaſt* (ſee A on the fig. of the *ribs*, *&c.* in the centre of the plate of *Oſteology*) is the cavity that reaches from the *claviculæ*, or channel bones to the midriff, terminated by the

the *ſternum* before; the ribs on the ſides and the *vertebræ* of the back behind. Its figure is almoſt oval; flat behind, and broad and arched before. It is compoſed of bone and fleſh; but not of the ſame ſize in all ſubjects.

It is divided into parts *containing* and *contained.* And the containing parts are either common or proper. The common parts are already deſcribed in the account of the *abdomen* (ſee page 73.) To which add that the fat of the *thorax*, (except in the breaſts) is but a ſmall quantity. The proper containing parts are; ſome glandulous, as the breaſts; ſome cartilaginous, and bony, as the breaſt bone, ribs, channel bone, ſhoulder blades, and the *vertebræ* of the back; ſome fleſhy, as the pectoral, intercoſtal and other muſcles; and ſome membranous, as the *pleura* and the *mediaſtinum.*

The parts containing are the *viſcera* and the veſſels.

The *viſcera* are the *heart* and its *pericardium*; and the *lungs*, and part of the *wind pipe* and *gullet.*

The *veſſels* are ſeveral *nerves*; the *great artery*, *vena cava*, and the *thoracick* duct.

The moſt apparent of theſe parts are the breaſts, a prominent fleſhy part on the outſide of the *thorax* laterally, ſerving to ſeparate the milk. Their ſhape repreſents a large ſection of a globe. In the middle of each there is a protuberance, terminating in a blunt point, called the *papilla* or *nipple*; whoſe extremity is perforated with many holes through which the lacteal tubes diſcharge themſelves, in women, whoſe breaſts are more perfect, conſpicuous and uſeful than in men. They differ in their ſize not only according to the difference of the ſex; but likewiſe in different female ſubjects; and even in the ſame women at different times; being always biggeſt in times of pregnancy and giving ſuck.

The *papilla* or nipple is of a fungous and ſpungy ſubſtance; by which means it droops or raiſes itſelf, when ſucked or handled; and it is poſſeſſed with an exquiſite ſenſe, ſo as to give the woman pleaſure by a certain titillation, occaſioned by the ſucking of the child. This nipple varies according to the age and condition of ſubjects. In virgins it is ſmall and red; in nurſes, and thoſe paſt child-bearing it is large and livid. In virgins it is encircled with a pale coloured *areola*; which is brown in pregnant women, and nurſes; but black in old people.

The internal ſubſtance of the *breaſts* is of an oval figure compoſed of a great many different ſized glands, mixed with globules and veſſels of fat. Their excretory ducts, as they approach the nipple, join and unite together, and form ſeven or more pipes, called *tubuli lactiferi*, which communicate alſo with each other by croſs canals to prevent caſual obſtructions. Theſe *tubuli* are in ſome parts more dilated than in others, ſo as to form cells, to hinder the ſpontanous efflux and create a neceſſity to draw out the milk by ſucking; and the ſubſtance of the *papillæ* is in ſome meaſure formed by the concurrence of theſe *tubuli*; and they are preſerved from paſſing too cloſe on each other by an intermediate glandulous ſubſtance, intermixed with abundance of fibres derived from the external tegument of the *papilla.* By which the lacteal tubes are conſtringed, and the motion of the milk is modified.

Here alſo we find abundance of fatty globules called *ductus adipoſi*, which, according to *Drake* and *Malpighi*, contribute to the compoſition of the milk.

Theſe tubes, which compoſe the glands of the breaſts in virgins, contract ſo cloſely, that they admit no blood to enter them; but when the womb grows big with the *fœtus*, and compreſſes the deſcending trunk of the great artery, the blood increaſes and is accelerated ſo much through the arteries of the breaſts, that it forces a paſſage into the glands. By this ſecretion of the *blood*, or a thick *chyle* circulating with it, there at firſt appears only a thin water; but as the woman advances in her pregnancy and the womb enlarges, the glands grow wider and admit a thick *ſerum*; which after her delivery coagulates into a thick milk; becauſe that blood, which before flowed to the *fœtus* by the *uterus* begins then to ſtop and no longer dilates the mamillary glands.

The *nerves* of the *breaſts*, derived from the fifth pair of the *vertebræ*, are diſperſed through the whole ſubſtance of the breaſt, and, terminating in the *nipple*, give it every ſenſible feeling.

The *arteries* of the *breaſts* are internal and external.

The *internal* arteries, which viſit the inner part, are named *mammariæ*, ſpring from the *ſubclavia*, and lend a branch to each of the oval glands, that compoſe the breaſt.

The *external* arteries run along the outward ſurface, are named the upper *thoracicæ*, and ſpring from the *axillares.*

The oval glands give riſe to ſeveral ſprigs of veins, which form the *venæ mammariæ* and unload in the *ſubclaviæ.*

In like manner the external part of the breaſt ſends out ſeveral branches, which are the trunks of the *thoracicæ ſuperiores* and repair to the *axillares.*

The other arteries import blood for the nouriſhment of the breaſts, and the inner ones feed all the glands

glands. And that blood is exported by the veins *mammariæ* and the *thoracicæ superiores*, into the *subclaviæ* and *axillares*.

As to the MILK obtained through the nipple of the breaſt, various have been the conjectures about its formation. The ancients took it for granted that nature had endowed the glands of the breaſts with a certain concocting virtue capable of turning that blood into *milk* for the nouriſhment of the child when born; which had fed the *fœtus* in the womb; and that this concoction received its *whiteneſs* by a certain aſſimulating faculty in the glands.

This opinion is exploded by the moderns, who teach that *milk* is produced from *chyle*, through the arteries, and like urine through the reins, is filtrated through the glands without undergoing any conſiderable change. But *Lewenhoeck* ſays, that by experiments he has found *milk* to conſiſt of globules ſwimming in a clear, tranſparent liquor, called *ſerum* or *whey*.

This premiſed; I am of opinion that MILK is compoſed of butyrous, caſeous and ſerous parts.

The *butyrous* part is the cream or oil that ſwims on its ſurface.

The *caſeous* is the groſſer part, which coagulates, or curdles like cheeſe.

The *ſerous* is that part called *lympha*, or a ſort of *whey*.

MILK is the *chyle* conveyed by the *thoracick* duct to the *ſubclavian* vein, near the *axillary*; from whence running to the *cava* and to the right ventricle of the heart, it there joins with the blood and accompanies it into the great artery, which injects it into all the other arteries of the body; the moſt ſerous part thereof being dropt into the reins by the emulgent arteries; and the moſt milky carried up to the ſmall branches of the *mammariæ* to all the glands of the *breaſts*, which completes its ſecretion and filtration for uſe; to be depoſited by thoſe glands in the ciſtern of the *milk* till preſſed out by the child or ſome other means; and if kept there too long proves not only very troubleſome, but hurtful to the woman; and induceth a diſeaſe, called the *milk fever*, occaſioned by its fermentation, for want of proper vent.

It will be neceſſary here to remark, that ſome men have been found with milk in their breaſts; and that authors give us a caſe of a girl of eight years old, who voided milk in abundance through one of her thighs, and continued for ſeveral years ſo to do, which confirms the doctrine of the *milk*'s production from chyle, or that it is a thick chyle.

Nurſes ſhould never give a child the breaſt ſo as to load its ſtomach; for though ſuch a practice, which is too common in good mothers, is allowed to fatten the child, as cramming does turkies; it often enflames the conſtitution and carries the bab off with a continual fever.

Great attention alſo ſhould be given to children, who live much upon milk, who contract ſeveral diſeaſes by the corruption of the wholeſome nouriſhment of *milk*, occaſioned by a bad digeſtion. In ſuch a caſe we are directed by *Celſus* and *Dobel* the *Dane*, to give the patient only a glaſs of water with a little ſalt in it, which will throw up the corrupt matter.

The next parts of the *thorax* are muſcular and cartilaginous or bony. The muſcular will be treated of hereafter. The cartilaginous and bony parts have been deſcribed (ſee page 49.) Therefore we'll proceed to that claſs of the containing parts of the *breaſt*, called *membranous*, *viz.* the *pleura* and the *mediaſtinum*.

The PLEURA is a membrane of the ſubſtance of the *peritonæum*, the figure and extent of the *thorax*, lines the whole inſide of the cavity of the *breaſt*, and incloſes all its contents. It is double; yet very fine and thin. It riſes from, and is faſtened to the ligaments of the *vertebræ*; and is thickeſt about the back. Its other faſtenings are to the *perioſteum* of the *coſtæ*, to the intercoſtal muſcles and to the inner and fore part of the *ſternum*.

Its duplicature is in the middle of the *thorax* and forms the *mediaſtinum* (G). It contains ſeveral holes; thoſe above make way for the great artery, the *vena cava*, the gullet, the wind pipe, and to the nerves of the eighth pair. There are other holes below for the paſſage of the *vena cava* alſo, and for the gullet.

There are ſeveral nerves, arteries and veins; which render the wounds in this part both painful and dangerous. The nerves branch from the *vertebræ* of the back, and from the eighth pair. The arteries ſpring from the intercoſtal and great artery; and the veins flow to the *intercoſtalis ſuperior*, and the *ægygos*.

The uſe of the *plura* is to defend the inſide of the *thorax*, and to make it ſmooth; which otherwiſe might injure the lungs in their motion.

The MEDIASTINUM is a double membrane, as above; divides the *thorax* from the lungs, and ſuſtains the *viſcera*, to prevent their falling from one ſide of the *thorax* to the other.

It riſes in the *ſternum*, and paſſing, downwards through the middle of the *thorax* to the *vertebræ*, divides its cavity into two parts longitudinally, ſo that one lobe of the lungs may officiate, ſhould the other on the other ſide be hindered by any accident.

It contains the heart between its two *lamellæ*; and gives a paſſage to the *vena cava*, the *œſophagus*, and to the ſtomachic nerves.

The membranes of the *mediaftinum* are thinner than the *pleura*, and have a little fat. Betwixt its membranes immediately under the *fternum* there is matter fometimes lodged; which may occafion the tapping of this part.

It is fpread with nerves, arteries and veins. The *nerves* come from the *ftomachic*, and fome from the *lymphatic*, which open into the *thoracic* duct. The *arteries* and veins are branches from the *mamillary* and *diaphragmatic* arteries; but one of them is particularly named the *vena mediaftina*.

The Pericardium is a membranous pouch or bag, confifting of a double membrane; the inner rifing from the coats of the veffels of the heart; the outer from the *mediaftinum*. Its figure is *conoidal*, like the heart, including the heart, which it embraces loofely, allowing fpace for its pulfation; and it is connected either immediately, or by *veficulæ*, emitted from it to the *fternum*, back, *jugulum*, and to the tendinous parts of the diaphragm; being fituate in the middle and lower part of the *thorax* between the two lobes of the lungs.

This membrane, when expanded upon the finger difcovers a great number of *foramina*, or little holes.

Its arteries and veins are branches from thofe of the *mediaftinum* and *diaphragm*; and its nerves are alfo derived from the *diaphragmatics*. But its *lymphatics* all run to the *thoracic* duct.

The ufes of this *pericardium* are, 1. To fupport the heart in a pendulous ftate, efpecially when we lie down. 2. To defend the heart from the cold air taken in at the lungs. 3. To preferve it from being injured by water, by matter, or any other extraneous fluid in the cavity of the thorax, And, 4. To contain the liquor of the *pericardium*, as it is called, which ferves to facilitate the motions of the heart.

The *liquor* of the *pericardium* is a fluid refembling in appearance water, in which raw flefh had been wafhed. The *anatomical* writers, in general, deduce this fluid from certain glands fituated either in the *pericardium*, or in the *heart* itfelf; but as thefe glands are not to be found, Heister thinks it more rational to fuppofe that it is expreffed out of the *auricles* of the heart in its *fyftole*.

The *pericardium* is found fometimes in long *hectics*, to cohere with the fubftance of the *heart*; and there are accounts of its having been wholly wanting.

Dr. Keil in his treatife of animal fecretion attempts to fhew, that the liquor in the *pericardium* muft be the moft fluid of any feparated from the blood, becaufe its particles uniting firft, will have the greateft attractive force; confequently their particles muft be the moft fpherical and moft folid; and therefore their contact the leaft of any; and therefore the moft fluid. Yet *M. de Mortale*'s account publifhed in the memoirs of the *French* academy, fays, that the liquor contained therein has been found congealed into a confiftence, two fquare fingers thick about the heart, and fit to be cut with a knife.

The Heart, (L) which is the firft and beft feat of life, (for it no fooner moves than the *fœtus* begins to live; and the ceffation of its motion diffolves the whole machine) is a mufcular body, included in the *pericardium*, and fituated nearly in the middle of the breaft, between the lobes of the lungs; being the primary organ of the circulation of the blood, and confequently of life.

Its figure is nearly *conic*, the larger end being called its *bafe*, and the fmaller end its *apex*. Its lower part is plane, and the upper part convex. Its fituation is nearly tranfverfe, or horizontal; fo that its *bafe* is in the right, and its *apex*, with the greateft part of its bulk, is in the left fide of the thorax; and confequently, it is there that the pulfation is felt.

The plane furface of the *heart* lies on the *diaphragm*; the convex one is turned upwards. The *heart* is connected, 1ft, by the intervention of the *pericardium* with the *mediaftinum*, and with a large part of the middle of the *diaphragm*: this is contrived by nature, to prevent its being difplaced, inverted, or turned too rudely about, in confequence of the various motions of the body. 2. Its *bafe* is connected to its common veffels; but its *apex* is free, and is received into a kind of cavity in the left lobe of the lungs.

The length of the *human heart* is about fix fingers breadth: its breadth at the *bafe*, is about five fingers; and its circumference about thirteen. It is, both externally and internally, furrounded with a fmooth membrane (M). There is a quantity of fat about it, which covers its *bafe* and its *apex*, and ferves for lubricating it, and for facilitating its motions.

The fubftance of the *heart* is carnous and refembles that of other mufcles; but it is harder at the tip end, and its motions are involuntary. It confifts of an outer and inner flefhy *fibre*; both of which have their origin and infertion in the *bafis* of the *heart*; the *outer* defcending from the *bafis* in a fpiral line, from the right to the left, towards the tip, where they caft a femi-circle, and reafcending in a fpiral line from the left to the right towards the *bafis*: the *inner* fibres depending in a ftrait line from the *bafis* to the tip, and then afcending directly from the tip to the *bafis*, where they terminate. By thefe inner fibres are formed the little flefhy columns of the ventricles.

The

The *fibres* of the HEART (L) generally paſs for a real muſcle. Though ſome authors chuſe rather to make the *heart* a double muſcle, or two muſcles tied together. And certainly the two ventricles and their auricles are two diſtinct bodies, veſſels, or cavities; which may be ſeparated, and yet remain veſſels; the *ſeptum* conſiſting of fibres derived from them both.

The *Nerves* of the HEART are ſmall, and ariſe from the *par vagum*, or *plexus cardiacus*, and the intercoſtals.

The *arteries* of the HEART (N) are called *pulmonary* and *aorta*, or only *coronariæ*, becauſe they gird its *baſis* like a *crown*. They proceed from the great artery, as it ariſes from the *heart*, before it paſſes the *pericardium*. So that here the *heart* diſtributes the firſt portion of the blood juſt perfected in its *ventricles*.—Here is alſo a *vein* called *coronaria*, which pervades along the outer part, and conſiſts of ſeveral branches flowing from all parts of the *heart*. This vein depoſits the ſuperfluous blood in the *cava*, which paſſes from the *arteriæ coronariæ*.

The HEART is alſo provided with *lymphatic* ducts, which empty themſelves in the *thoracick* duct.

In the HEART are two great cavities called VENTRICLES. They are two ſeveral muſcles united together by the *ſeptum*, and ſeveral plans of fibres, ariſing from the outward *baſe* of the *heart*, and meeting at the apex, which entering the left ventricle line the *parietes* or ſides.

The ſeat of theſe *ventricles* is in the middle of thoſe fibres: and their orifice and valves are made by the dilatation of their tendons.

The right *ventricle* is the largeſt, and big enough to contain two, and ſometimes three ounces of blood.

They are divided by a fleſhy ſubſtance, alſo compoſed of the muſcular fibres, called the *ſeptum*, or partition; concave to the left *ventricle*, and convex to the right. The only communication between the *ventricles* is the paſſage for the blood into each other.

The left *paries*, or ſide, is much thicker and ſtronger than the right; becauſe its orifice is deſtined to force the blood through all the parts of the body; but the right only drives it with the aid of other veſſels, through the lungs; which accounts for the want of this ventricle in animals, which have no lungs

The *ventricles* encloſe certain little muſcles, called *columnæ carneæ*, or *lacertuli*: which are derived from the *parietes*, and connected by tendons to the valves of the *heart*: and from the concourſe of the tendinous fibres of theſe in the heart, there are formed peculiar membranes ſituated at the orifices of the *auricles* of the heart: and there are alſo other columns of this kind, which run tranſverſely from one ſide of the *ventricles* to the other: theſe ſerve partly to aſſiſt the contraction of the heart in its *ſyſtole*, and partly to prevent its too great dilatation in its *diaſtole*.

The ventricles are capped, each with an *auricle* (OO) which is a production or appendage made of a duplicate of the membranes of the veſſels in which they are placed.

The right *auricle* is the extremity of the *vena cava*; and the left of the *pulmonary* vein: To which they adhere in ſuch a manner, as to ſeem to make but one body with theſe veſſels; ſo that they agree in ſize with them.

Theſe *auricles*, as they receive the blood from the veins, ſerve for a meaſure to the *heart*, and to prevent a too large eruption, or precipitant courſe of the blood into the *ventricles*; which might ſuffocate the animal. Any ſtoppage in thoſe caps, either by paſſion, or accident, creates a difficulty of breathing, a rough and quick pulſe, and a continual palpitation of the heart.

The *Uſe* of the HEART, and its appendant *auricles*, is to circulate the blood through the whole body: in order to which, they have an alternate motion of *contraction* and *dilatation*. By the *dilatation*, called the DIASTOLE, their cavity is opened, and their internal dimenſions enlarged, to receive the refluent blood from the veins: and by their *contraction*, called the SYSTOLE, their cavity is ſhrunk, and their dimenſions leſſened, to expel the blood again into the *arteries*.

It muſt be obſerved that theſe alternate motions of the *heart* and *auricles* are oppoſite in time to each other; the *auricles* being dilated whilſt the heart is contracted again; and contracted whilſt it is dilated to drive the blood into it.

The blood being driven through the *pulmonary* vein, by the right ventricle, into the *pulmonary* artery, it is returned to the left *ventricle*; from which, by the *aorta*, it is diſtributed all over the reſt of the body, and thence returned to the right *ventricle* by the *vena cava*; making an entire circulation through the whole body.

The principle of *motion* in the *heart*, or the power, from which its alternate contraction and dilatation ariſes, has been greatly controverted among the late *Phyſicians* and *Anatomiſts*.

The *motive power*, it is certain, muſt ſurmount the *reſiſtance* made to it; and according to *Borelli*'s computation, the reſiſtance made to the motion of the blood through the arteries, is equal to 180000 pounds,

pounds, which therefore are to be removed by the *heart*, or elſe the circulation muſt ceaſe.

Now, whence comes the machine of the heart to have ſuch a power? And after the expulſion, what other power is it that ſurmounts the former, and reſtores its part to the dilatation, to produce a reciprocal *æſtus*?

Des Cartes alledges, that in each ventricle, there are ſome remains of the blood, which miſſing of an *exit*, when the heart was contracted. turn ſour, and become a ferment, qualified to ferment with the freſh blood, juſt as oil of tartar does with ſpirit of vitriol. Upon this foundation he accounts for the motion of the heart in the following manner.

When a groſs drop of *blood* falls by its own weight into either *ventricle*, it preſently ſwells, and rarifies, becauſe of its mixing with the ferment it meets with.——The drop thus fermented, taking up more room in the heart than before, removes its *parietes* from one another, enlarges it, and obliges the point or *tip* to approach to the *baſis*.—At laſt, when the heart admits of no farther dilatation, this *drop* tending ſtill to take up more room, ſtorms the *ſigmoides* valves, and repairs to the arteries.——But when its ebullition ceaſes, and the blood thus rarified has loſt its great motion, as being condenſated; the heart, by virtue of its *elaſtic* ſpring, lengthens itſelf, and removes its point from the *baſis*; upon which a freſh drop of blood, repairing to each ventricle (becauſe nothing then ſhuts the *tricuſpides* valves) is fermented by the ferment, or ſharp remains of the preceding blood; and after ſeparating the walls of the *ventricles*, paſſes into the arteries, as above.

Some believe this *hypotheſis* contrary to reaſon, and ſay, 'tis more probable that the *pulſation of the heart* is owing to the animal ſpirits; for if you cut or tie a ligature upon the *intercoſtal* nerve, and the eighth pair, it ceaſes in the ſpace of twenty-four hours. But this pulſation depends likewiſe on the blood; for, if you tie a ligature upon the veſſels, the *vena cava* for inſtance, the pulſation ceaſes, and recommences when the ligature is taken off, which recommencement is owing to the heat of the blood.

They come neareſt to the truth, who attribute this motion to the weight of the blood; for the heart being without an antagoniſt muſcle, would never dilate itſelf after contraction, if the weight and impetuoſity of the blood was not to force it to a dilatation. Thus in dying animals, five pulſations of the *vena cava* anſwer only to one of the right *auricle*, and two of the *auricles* correſpond to one of the heart; which in human bodies is in ſome meaſure promoted by the motion of the *midriff*; the point of the *pericardium* being faſtened to it.

To ſhew how, and in what manner this motion is compaſſed, let us conſider the double *ſpiral* formed by the *fibres* of the *heart*, and how theſe fibres croſs one another upon the inner ſurface of the *ventricles*.—As often as theſe fibres act, they endeavour, by all their parts, to deſcribe a ſtrait line, the conſequence thereof is, that the ſpiral muſt be ſhortened, and tend to the form of a double ring; ſo that the middle of the heart will be enlarged, and its *tip* approach to the *baſis*, in order to make an exact and forcible expreſſion of what is contained in the *ventricles*, which is what we call the *ſyſtole*, in which the heart beats againſt our left breaſt.——But when the *fibres* unbind, they tend to diſengage themſelves, and to re-aſſume their firſt natural ſtate; being aſſiſted therein by the impulſe and weight of the blood flowing from the veins, and the motion of the midriff, which draws the *tip* of the *heart* towards it; ſo that the heart is lengthened, and the blood fills the *ventricles*, which we call *Diaſtole*.

The *auricles* of the *heart* have likewiſe their *diaſtole* and *ſyſtole*, but different from thoſe of the *heart*; for when the *auricles* empty themſelves, the *heart* fills, and as often as the heart ſqueezes the blood out of its *ventricles*, the *auricles* ſwell; becauſe the auricles are the ciſterns of the heart.

At the *baſis* of the *heart* we meet with four large veſſels, *viz.* the *vena cava*, the *arteria pulmonaris*, the *vena pulmonaris*, and the *aorta*; of which the two former are inſerted in the right *ventricle*, and the other two in the left.

The Vena Cava (S) is the biggeſt of all the four veſſels, and terminates in the left *ventricle* of the *heart*, to which it is knit ſo faſt, that it cannot be ſeparated.——It opens into that ventricle by a wide mouth, and pours into it the blood that it has received from the ſeveral branches of veins.—Its membrane, which is thin every where elſe, is very thick, and full of fleſhy fibres at its mouth; and that prevents its being rent by the continual motion of the heart, as well as its being over-extended by a large quantity of blood.

The three *triangular* and *membranous* Valves, (T) called *Tricuſpides*, placed at the mouth of the *cava*, are formed of a dilatation of the tendons of the muſcles, of which the heart conſiſts, open from without inwards; and are ſo diſpoſed as to favour the paſſage of the blood from the *cava* to the heart, and oppoſe its retreat.

The *vena cava* ſerves to receive the blood from the branches of the veins in all the parts of the body, and to pour it into the cavity of the *auricle*, from

from which it falls into the right *ventricle* of the *heart*.

The *arteria pulmonaris*, or *vena arteriosa*, rises from the right *ventricle* of the *heart*, but its mouth is less than that of the *cava*.—This artery is divided into two great branches, which after a subdivision into several small shoots are dispersed upon the right and left, through the whole substance of the lungs.—The three valves (called *sigmoides* from their resemblance to the *Greek sigma*) are placed at the entrance of the *arteria pulmonaris*.—These *valves* are little membranes, seated by one another in a different manner from those of the *cava*, ; for they open from within outwards, to afford a passage for the blood from the right *ventricle* into the artery, and oppose its retreat.

The *arteria pulmonaris* serves to receive the blood from the right *ventricle* of the *heart*, and disperse it in the substance of the lungs.

The VENA PULMONARIS, (X) or *arteria venosa*, proceeds from the lungs by an infinity of small shoots, which, after uniting into one trunk, march out of the substance of the lungs, and empty themselves into the left *ventricle* of the *heart*.

At the entrance of this vein are placed two *valves* (called *Mitrales*, from their resemblance to a *bishop's mitre)* their situation is like that of the *tricuspides*, for they open from without inwards, to favour the blood's entry into the left *ventricle*, and oppose its return to the veins.—The capillary branches of the *vena pulmonaris*, being dispersed through the substance of the lungs, takes up the blood imported by the *arteria pulmonaris*, and convey it to the left auricle of the *heart*.—Together with the blood this vein imports likewise, the subtilest parts of the air, which passes from the extremity of the *trachæa* into its trunk.

The GREAT ARTERY, (Y) called *aorta*, is the trunk and source of all the other arteries of the body, those of the lungs excepted, which are the branches of the artery of the right *ventricle*.—It has several hard and thick coats, and proceeds from the left ventricle of the *heart*; at which part it seems to be cartilaginous, being thereby kept always open, and ready to receive the blood, which flows with great impetuosity from the *ventricle*.

The head of the *aorta* (Z) is provided with three *valves*, or membranous appendages.—They look from within outwards, in order to let the blood pass from the left *ventricle* to the *aorta*; and prevents its reflux from the *aorta* to the *ventricle*.

The *aorta* distributes the blood that flows into it from the *heart*, to all the parts of the body, which is effused in the following manner:

The blood sallying out with an impetuous force from the left ventricle, is thrown into the *aorta* by the contraction of the *heart*. The subtilest part of this blood mounts upwards through the upper trunk of the *aorta*, and is distributed into the arms by the axillary arteries, and into the head by the *arteriæ carotides*, and *cervicales*.—On the other hand the coarser sort of blood falls downwards through the lower branch of the same artery; and is dispersed to all the parts that lie below the *heart*, by the arteries called *celiac*, *mesenterick*, *emulgent*, *spermatick*, *iliac*, and an infinity of other branches.

In this *circulation* the several liquors contained in the mass of the blood are separated from it in several parts, by virtue of the configuration of the pores of the parts through which it passes, *viz*. The *animal juice* is separated in the brain; the secretion of the *saliva* is performed in the *parotides*, and the glands of the jaws; that of the acid liquor in the glands of the *æsophagus*, and the stomach; the *pancreatic juice* in the *pancreas*, or sweet-bread; the choler in the liver; the urine in the kidneys; the seed in the testicles; the milk in the breasts, and several other liquors in an infinity of other parts.

The blood being conveyed by the two trunks of the *aorta*, to all the parts of the body both above and below; marches out of the extremities of the capillary arteries, in order to nourish the parts: and for as much as the whole mass thus extravasated. is not quite consumed, the surplusage re-enters the orifices of the capillary veins, by the impulse of the fresh blood, which ouzes without intermission from the little arteries, and obliges its fore-runners to return through the small veins to those of a larger size; by which means the blood sent to the head, returns by the jugular veins, and that to the arms by the axillary, and both these terminate in the subclavian, which leads to the upper trunk of the *cava*, and so to the *heart*: In like manner, the blood dispensed to the lower parts, returns to the *heart* by the *iliack*, and all the other veins of the *abdomen*, which unload in the lower and ascending trunk of the *cava*, and with joint forces falls into the right auricle; where the disposition of the *tricuspides* valves, and the contraction of the *heart*, forward it to the *arteria pulmonaris*.

The *arteria pulmonaris* having received the blood, conveys it to the lungs, and disperses it through their whole substance, from whence being accompanied

panied with the fubtileft part of the air that joins it from the extremities of the *trachæ*, it paffes to the branches of the *vena pulmonaria*, from thence to the left *auricle* of the *heart*, and fo it enters the *ventricle* of that fide.—In that part the difpofition of the *valves* prevents its reflux; upon which, by the contraction of the *heart*, it flies out impetuoufly into the great artery, and this artery difpenfes it to all the parts of the body.—From all thefe parts it returns by the *capillary* veins to the great ones, and from thence to the upper and lower trunk of the *cava*, in order to renew the inceffant *circulation*, the ceffation of which, for one moment, would put a period to the animal life.

Mr. *Rohault* fuppofes that it is very eafy to difcover, by the pulfation of the *heart*, in what fpace of time the circulation of the blood can be accomplifhed.—He prefuppofes that a certain quantity of blood enters the *aorta*, at each pulfation of the *heart*, which he believes cannot be lefs than a drachm. This prefuppofed, he begins his calculation thus.

He finds by his pulfe, that there happen, fixty-four pulfations of his heart in the fpace of a minute; whence it follows, that his heart beat 3840 times in the fpace of an hour; and confequently, that 92160 drachms, or 11520 ounces, or 720 pounds of blood, pafs every day through the heart; fo that if it could be reafonably fuppofed, that there is fo much blood in a human body, there would be in twenty-four hours but one circulation of the whole mafs of blood. But as in Mr. *Rohault*'s opinion, there is fcarce more than ten pounds of blood in a human body; and he believes that the whole mafs paffes 702 times through the heart in twenty-four hours; confequently, there happens *three circulations* of the whole blood in the fpace of an hour.

Several ingenious perfons have, from time to time, attempted to make eftimates of the *force of the blood* in the *heart*, and *arteries*. According to Dr. *Keil*'s eftimate, the left *ventricle* of a man's heart throw out in each *fyftole* an ounce, or 1.638 cubic inch of blood, and the area of the orifice of the *aorta* be $=0.4187$: then dividing the former by this, the quotient 3.9 is the length of the cylinder of blood, which is formed in paffing thro' the *aorta* in each *fyftole* of the *ventricle*; and in the feventy-five pulfes of a minute, a cylinder of 292.5 inches in length will pafs; this is at the rate of 1462 feet in an hour. But the fyftole of the heart being performed in one third of this time, the velocity of the blood in that inftant will be thrice as much, *viz.* at the rate of 4386 feet in an hour, or 73 feet in a minute. And if the *ventricle* throws out one ounce in a pulfe; then in the feventy-five pulfes of a minute, the quantity of blood will be equal to 4.4lb. 11 oz. and in thirty-four minutes a quantity equal to a middle-fized man, *viz.* 158lb. will pafs through the heart. But if with Dr. *Harvey*, and Dr. *Lower*, we fuppofe two ounces of blood, that is, 3,276 cubic inches to be thrown out at each *fyftole* of the *ventricle*, then the velocity of the blood in entering the orifice of the *aorta*, will be double the former, *viz.* at the rate of 146 feet in a minute, and a quantity of blood equal to the weight of a man's body, will pafs in half the time, *viz.* 17 minutes.

If we fuppofe what is probable, that the blood would rife $7+\frac{1}{2}$ feet high in a tube fixed to the *carotide* artery of a man, and that the inward area of the left *ventricle* of his heart, is equal to fifteen fquare inches; thefe multiplied into $7+\frac{1}{2}$ feet give 1350 cubic inches of blood, which preffes on that ventricle, when firft it begins to contract, a weight equal to 51.5 pounds.

What the doctor thus calculates from fuppofition with regard to mankind, he actually experimented upon horfes, dogs, fallow does, &c. by fixing tubes, in orifices opened in their veins and arteries; by obferving the feveral heights, to which the blood rofe in thefe tubes, as they lay on the ground; and by meafuring the capacities of the ventricles of the heart, and orifices of the arteries. And that the reader may the more readily compare the faid eftimates together, he has given a table of them, ranged in the following order.

The

The several animals.	Weight of each. Pounds. Ounces.	Height of the blood in the tube from the jugular vein. Inches.	Height of the blood in tubes fixed to arteries. Feet.	Inches.	Capacity of the left ventricle of the heart. Cubic inches.	Area of the orifice of the aorta. Square inches.	Velocity of the blood in the aorta. Feet and inches in a minute.	Quantities of blood equal to the wt. of the animal in what time. Minutes.	How much in a minute. Pounds.	Weight of the blood sustained by the left ventricle contracting. Pounds.	Number of pulses in a minute.	Area of the transverse section of the descending aorta. Square inches.	Area of the transverse section of ascending aorta. Square inches.
Man	160	On straining.	7	6	1.659	0.4187	56.55	34.18	4.38	51.5	75		
					3.318		113.3	17.6	9.36				
Horse 1st			8	3									
2d.			9	8									
3d.	825	12 52	9	6	10	1.036	86.85	60	13.75	113.22	36	0.677	0.369
Ox	1600				12.5	1.539	76.95	88	18.14		38	0.912	0 85
													right. left.
Sheep	91	5½ 9	6	5½	1.85	0.172	174.5	20	4.593	36 56	65	0.094	0.07 0 012
Doe			4	2	9	0.476						0.38	0.246
													right. left.
Dogs 1st.	52	0 6	6	8	1.172	0.196	144.77	11.9	4.34	33.6	97	0.106	0.041 0 034
2d.	24	5 7	2	8	1	0.185	130.9	6.48	3.7			0.102	0.031 0.009
3d.	18	5	4	8	0.633	0.118	130	7.8	2.3	19.8		0.07	0.022 0.009
4th.	12 8	4	3	3	0.5	0.101	120	6.7	1.85	11.1		0.061	0.015 0.007

Dr. *Jurin* likewise deduces the force of the heart from the laws of *hydraulics*, in the following manner. He supposes $p =$ to the weight of the left ventricle, or a quantity of blood equal to the same weight; $S =$ the internal surface of the same; $l =$ the mean length of the filaments of blood issuing from the same; $s =$ the section of the *aorta*; $q =$ the quantity of blood contained in the left ventricle; $t =$ the time in which the blood would be expelled from the *heart*, taking away the resistance of the arteries, and of the blood going before; $v =$ the variable velocity with which the blood issuing from the heart would flow through the *aorta*, abstracting from the resistance; $x =$ the variable length of the *aorta*, described by the blood gushing from the heart; $z =$ the time in which the length x is described.

Hence the mean variable velocity of the blood contiguous to the ventricle, or the mean velocity of the ventricle itself, is $= \frac{sv}{S}$; the motion of the ventricle $= p \times \frac{sv}{S}$; the motion of the issuing of the blood $= sv \times \overline{l + x}$; the sum of these, or the power of the ventricle $= sv \times \overline{\frac{p}{x} + l + x}$. But it is $v = \frac{\dot{x}}{\dot{z}}$. Whence by *Newton*'s inverse method of fluxions, the power of the ventricle will be found $\frac{sx}{z} \times \overline{\frac{p}{S} + \frac{x}{2} + l}$. Now, since $z = t$, it will be $sx = q$. Hence the power of the ventricle $= \frac{q}{t} \times \overline{\frac{p}{S} + \frac{q}{2s} + l}$. In the same manner the power of the right ventricle will be found $= \frac{q}{t} \times \overline{\frac{\pi}{\Sigma} + \frac{q}{2\sigma} + \lambda}$. Here the same things are signified by the *Greek* letters in the right ventricle, as by the *Italic* letters in the left. Hence the whole power of the heart $= \frac{q}{t} \times \overline{\frac{p}{S} + \frac{\pi}{\Sigma} + \frac{q}{2S} + \frac{q}{2\sigma} + l + \lambda}$. Q. E. I.

If we suppose $p = 8$ ounces *avoirdupois* $=$ 13.128 cubic inches; $\pi = 4 = 6.564$; $8 = 10$ square inches, $\Sigma = 10$; $l = 2$ inches; $\lambda = 1\frac{1}{2}$; $q = 2$ ounces *avoirdupois* $= 3.282$ cubic inches; $s = 0.4185$ square inches; $\sigma = 0.583$; $t = 0.\ 1''$. The power of the *ventricles* will be equal to the motion of the underwritten weights, that is,

	lb.	oz.
Of the left *ventricle* ——	9	1
Of the right *ventricle* ——	6	3
Of the whole *heart* ——	15	4

Of which weights the velocity will be ſuch, as that a line of an inch long might be deſcribed by the ſame in a ſecond.

In a *fœtus*, the *apparatus* for circulation is ſomewhat different from that above deſcribed.——The *ſeptum* which ſeparates the two auricles of the heart, is pierced through with an aperture, called the *foramen ovale*; and the trunk of the pulmonary artery, a little after it has left the heart, ſends out a tube in the deſcending *aorta*, called the *communicating canal*.

The *fœtus* being born, the *foramen ovale* cloſes, by degrees, and the canal of communication dries up, and becomes a ſimple ligament.

This mechaniſm once known, it is eaſy to perceive its uſe. —— For, while the *fœtus* is incloſed in the *uterus*, it receives no air but that little, furniſhed by the umbilical vein: Its lungs therefore cannot ſwell and ſubſide as they do after the birth, and after the free admiſſion of the air. They continue almoſt at reſt and without any motion; their veſſels are, as it were full of themſelves, and do not allow the blood to circulate either in abundance, or with eaſe.

Nature, therefore, has excuſed the *lungs* from the paſſage of the greateſt part of the blood; and has contrived the *foramen ovale*, by which part of the blood of the *vena cava*, received into the right *auricle*, paſſes into the left *auricle*, at the mouth of the *pulmonary* veins; and by this means is found as far in its journey, as if it had paſſed the lungs.

But this is not all; for the blood of the *cava*, which miſſing the *foramen ovale*, paſſes from the right *auricle*, into the right *ventricle*; being ſtill in too great quantity to paſs by the lungs, whither it is driven through the *pulmonary* artery; the communicant canal intercepts part of it in the way, and pours it immediately into the deſcending *aorta*.

This is the doctrine of *Harvey*, *Lower*, and moſt other Anatomiſts. But Mr. *Mery*, of the royal academy, has made an innovation in it.

He aſſigns another uſe for the *foramen ovale*; and maintains that the whole maſs of blood, brought from the *cava* to the right *ventricle*, paſſes, as in adults, into the *pulmonary* artery, whence part of it is conveyed by the communicant canal, into the *aorta*; and the reſt brought from the lungs by the *pulmonary* veins into the left *auricle*, where it is divided into two parts, the one paſſing through the *foramen ovale*, into the right *ventricle*, without circulating through the *aorta*, and the reſt of the body; the other part puſhed, as in adults, by the contraction of the left *ventricle*, into the *aorta*, and the whole body of the *fœtus*.

Mr. *Du Verney* aſſerts, on the contrary, that the *foramen ovale*, has a valve ſo diſpoſed, as to be opened by the blood driving into the right *ventricle*, but ſhut the more firmly, by its puſhing into the left. Mr. *Mery* denies the exiſtence of any ſuch valve.

According to the common opinion, the *aorta* receiving more blood than the *pulmonary*, ſhould be bigger. ——— According to the opinion of Mr. *Mery*, the pulmonary artery ſhould be the biggeſt, as being eſteemed to receive a large quantity of blood.

Therefore, to judge of the two ſyſtems; it ſhould ſeem there needed nothing, but to determine which of the two veſſels were the biggeſt in the *fœtus*.

Mr. *Mery* always found the *pulmonary* artery half as big again as the *aorta*; and, on the other hand, Mr *Tauvry*, who ſeconded Mr. *Du Verney*, produces caſes where the *pulmonary* is leſs than the *aorta*. The facts on both ſides were examined by the *French* royal academy.

Mr. *Tauvry* adds, that though the *pulmonary* artery ſhould be greater than the *aorta*; yet this does not prove, that more blood paſſes the firſt, than the ſecond; ſince it may be accounted for, from the blood's preſſing more ſlowly towards the lungs, which it finds ſome difficulty to penetrate, and accordingly ſwells and is driven back.

Mr. *Littre*, upon diſſecting an adult, in whom the *foramen ovale* was ſtill open, and meaſuring the capacities of the veſſel on each ſide, declares for Mr. *Mery*.

For the ſource of the *circulation* in the *fœtus*, *Anatomiſts* are again divided. —— The popular opinion is, that during geſtation, the arteries of the *uterus* convey their blood into the *placenta*, which is nouriſhed by it, and the ſurplus conveyed into the root of the *umbilical* vein, which makes part of the navel-ſtring: Thence it is carried to the liver of the *fœtus*, where it enters the *vena cava*, and is thence conveyed to the right ventricle of the heart. and diſtributed as before.

Again, the blood brought from the *iliac* arteries of the *fœtus*, enters the navel ſtring, by the umbilical arteries; thence paſſes into the *pla.enta*, where it is reſumed by the veins of the *uterus*, which carry it back again to the mother; and perhaps alſo, by the roots of the umbilical veins, which mix it afreſh with the blood of the mother.

Therefore, according to this ſyſtem, it is the blood of the mother that ſupplies the child, which is here only regarded as a diſtinct member, or part of her frame.

The beating of her heart ſends it a portion of her blood; and ſo much of the impulſe is preſerved, as as suffices to maintain that languid circulation, which a *fœtus* enjoys: And in all probability, gives that feeble pulsation observed in the heart.

Other *Anatomists* maintain, that the *fœtus* is only supplied with chyle, from the glands of the *uterus*; which is further elaborated, and turned into blood, in the vessels of the *fœtus*; and circulates therein, without any further communication with the mother. — These allow of no reciprocal *circulation*, excepting between the *placenta* and the *fœtus*.

But the former opinion is best supported; for the *placenta* being separated from the *uterus*, during the time of gestation, neither yields any chyle, nor any thing but blood.

The *circulation of the blood* has been generally allowed to have been first discovered in *England*, in the year 1628, by the celebrated Dr. *Harvey*, though there are several authors, who have attempted in vain to prove the contrary.

The LUNGS (AA) which are the next part we are to observe in the *thorax*, are a collection of little membranous vesicles heaped one above another, and interlaced with branches of arteries and veins.

(BB) Those bladders are formed of the extremities of the inner coat of the *trachæa*, or windpipe, and all wrapt up in a membrane. — Their outside is convex, and raised upon the sides, where they touch the ribs, but their inside is concave, whereby they can embrace the heart with greater facility.

The LUNGS are connected above to the *fauces*, by means of the *trachæa*; and below to the *vertebræ* of the *thorax*; and to the *sternum* and *diaphragma* by means of the *pleura*, to which they sometimes adhere, even from the first conformation of those parts.

(CC) They are divided into two great *lobes* by the *mediastinum*, and those again subdivided into several other lobes or lobules; the right sometimes into three or four, by means of some fissures running from the fore to the back edge. — The great lobes, when inflated, resemble each of them a *horse's hoof* in figure, but together they are like an *ox's* inverted.

The whole substance of the *lungs* is covered with a common membrane, which is divisible into two coats, the outer, thin, smooth, and nervous; the inner, somewhat thicker and rougher, consisting mostly of the extremities of vessels and vesicles, through the impression of which it is pitted, and resembles, in some measure, a honey-comb.

The vessels of the *lungs* are the *bronchia*, the pulmonary and bronchial arteries and veins, nerves, and lymphaticks. — Of these vessels some are *proper*, and some *common*; the *common* are the *bronchia*, the pulmonary artery and vein, the nerves and lymphaticks; the *proper* are the bronchial artery and vein.

(EF) Before we inquire into the use of the *lungs*, it is proper to observe, that the *trachæa*, or wind-pipe, is a passage, which reaches from the mouth to the *lungs*: — 'Tis placed upon the *æsophagus*, or gullet, which it accompanies to the fourth *vertebra* of the breast, and there splits into two branches, which enter the *lungs*, one on each side. These branches are afterwards divided into as many twigs, as there are lobes; and the twigs are again subdivided into a number of smaller shoots, answerable to that of the lobules in each lobe; so that all the small vesicles in each little lobule are furnished with branches.

The branches of the artery and *pulmonary* vein, are constant companions of those of the *trachæa*, and they jointly terminate in the lobes and lobules; so that we may justly apprehend, that each lobule being composed of several little round vesicles, is a sort of little lungs.

The constituent parts of the *trachæa* are several cartilages, ligaments, and two membranes. — The cartilages are semicircular before, and upon the sides they are hard, and sometimes ossified; but their backside is membranous, which give them the form of an half moon. —— They are ranged one above another, and grow smaller as they approach to the *lungs*. They are so contrived, that by entering into one another, like the shells of a crab's tail, they lengthen themselves in inspiration, and shorten in expiration and expectoration.

They are all fastened to one another by ligaments, which run between them, and which some have mistaken for muscles.

The *trachæa* has two membranes; a very strong outer one, which ties the *cartilages* together, and hinders their dilatation; and the inner membrane, which is but a continuation of the palate of the mouth, and serves to line its inside in the *larynx*, or entrance of the *trachæa*. This coat is very thick, indifferent in the middle, and very thin in the branches inserted in the lungs. —— Its sense is so exquisite that it can suffer nothing; for when any portion of food, or drink falls into its cavity, we never cease coughing till we have dislodged it again. —— 'Tis liquored over with a fat humour that keeps it always supple, in order to form the voice, and prevent its being dry'd or injured by the sharp and fuliginous excrements that pass through the wind-pipe. The abundance of this humour causes a hoarseness; but its excessive redundancy occasions the loss of one's voice, which retrieves so soon as the humour is consumed.

The *trachæa* receives branches of nerves, from the recurrent branches of the eighth pair; arteries from the *carotides*; and its veins unload in the external *jugulares*. Its nerves being diſperſed through its whole inner membrane, cauſe its exquiſite ſenſe.

The *trachæa* and its *bronchia* ſerve to conduct the air into the *lungs*, in the *inſpiration*, and to return it again in the time of *expiration*.

The Inspiration is the ingreſs of the air, enſuing upon the dilatation of the *thorax*, and the *lungs*; and the Expiration, the egreſs of the air; together with a vaporous *lympha*, procured by the contraction of the ſame parts.

This ingreſs or admiſſion of the air depends immediately on its ſprings, or elaſticity, at the time when the cavity of the breaſt is enlarged, by the elevation of the *thorax* and *abdomen*, and particularly the motion of the *diaphragm* downwards: So that the air does not enter the lungs, becauſe they are dilated: but thoſe dilate, becauſe the air enters within them. Nor is it the dilatation of the breaſt, which draws in the air, as is commonly thought, but an actual intruſion of the air into the *lungs*.

Expiration is performed by a contraction of the cavity of the breaſt, and the parts employed in the inſpiration, re-aſſuming their firſt ſtation.

Inſpiration and *expiration*, form together what we call *reſpiration*.

But for a clearer explanation of this ſubject, and of the manner wherein *reſpiration* is performed, we muſt obſerve, that the *lungs*, when ſuſpended in the open air, by the contractive power of the muſcular fibres which tie together the ſquamous parts, the *bronchia* are reduced to leſs ſpace, than they poſſeſſed, while in the cavity of the *thorax*; and when thus contracted, if a quantity of new air be injected through the *glottis*, they again become diſtended, ſo as to poſſeſs an equal, nay, a greater ſpace, than that aſſigned them in the *thorax*.

Hence it appears, that the *lungs*, by their proper force, are always endeavouring to contract themſelves into leſs compaſs than they poſſeſs when incloſed in the *thorax*; and that therefore they are always in a ſtate of violent dilatation, while the man lives. —— For the air that encompaſſes them in the *thorax*, ſhut up betwixt their external membrane, and the *pleura*, is not of equal denſity with common air.

In effect, the ingreſs of the air, through the *glottis*, into the lungs, is always free; but that on the outſide, wherewith they are compreſſed, is impeded by the *diaphragm*, ſo as it cannot enter the *thorax* in a quantity ſufficient to make an *equilibrium*.

Since then in *inſpiration*, the air enters the lungs in greater quantity than it did before; it will dilate them more, and overcome their natural force. —— The *lungs* therefore are wholly paſſive in the matter: What it is that acts muſt be learnt from the *phænomena*.

1. Then it is obſerved, that in *inſpiration*, the nine upper ribs, articulated to the *vertebræ*, and the *ſternum*, riſe archwiſe towards the *clavicles*; and the three lower are turned downwards; and the eighth, ninth, and tenth are drawn inwards. 2. That the *abdomen* is dilated. And, 3. The *thorax* enlarged. 4. The *diaphragm* is brought from its convex, and ſinuous poſition to a flat figure.

Now as theſe are the only viſible actions in *inſpiration*, the cauſe of the operation muſt be referred to them; or rather to the muſcles of theſe parts, which are the intercoſtal, the ſubclavian, *&c.*

The capacity of the *thorax*, being enlarged by the action of theſe muſcles on the ribs, *&c.* a ſpace is left between the *pleura* and the ſurface of the *lungs*; ſo that the air entring the *glottis*, inflates them till ſuch times, as they become contiguous to the *pleura* and *diaphragm*. —— In this caſe now the air preſſes the *lungs* as much as the *thorax* reſiſts them; and hence the lungs become at reſt; the blood paſſes leſs freely, and is forced in leſs quantity into the left ventricle of the heart, and ſo leſs comes into the *cerebellum*, and its nerves, and the arterial blood acts leſs on the intercoſtal muſcles, and *diaphragm*.

The cauſes, therefore, which at firſt dilated the *thorax*, grow weaker; and conſequently the ribs become depreſſed, the diſtended fibres of the muſcles of the *abdomen*, reſtore themſelves, the *viſcera* thruſt the *diaphragm* up again into the *thorax*, the ſpace whereof being thus contracted, the air is drove out of the *lungs*; and thus is *expiration* performed.

Immediately the blood being quickened in its motion, begins to flow ſtronger, and more plentifully to the *cerebellum* and muſcles; and thus the cauſes of the contraction of the *intercoſtals*, and *diaphragm* being renewed, *inſpiration* is repeated. —— Such is the true, immediate, adequate manner of vital *reſpiration*.

The uſes and effects of Respiration are greatly diſputed among *Anatomiſts*.——*Boerhaave* takes the principal uſes thereof to be the farther preparation of the chyle, its more accurate mixture with the blood, and its converſion into a nutricious juice proper to repair the decays of the body.

Borelli takes the great uſes of *reſpiration*, to be the admiſſion, and mixture of air with the blood in the *lungs*, in order to form thoſe *elaſtick* globules it it consists of; to give its red florid colour: and to prepare it for many of the uses of the animal œconomy: But how such admission should be effected is hard to say.

Other authors, as *Sylvius*, *Etmuller*, &c. take the great uses of *respiration*, to be by the neighbourhood of the cold, nitrous air, to cool the blood coming reeking hot out of the right ventricle of the heart, through the *lungs*; and to act as a refrigeratory.

Mayow and others, assert one *grand use* of *respiration* to be, to throw off the fuliginous vapours of the blood along with the expelled air; and for *inspiration*, he asserts, that it conveys a nitro-aerial ferment to the blood, to which the animal spirits, and all muscular motions are owing.

But Dr. *Thurstow* rejects all these, from being principal uses of *respiration*, which he shews to be, to move or pass the blood, from the right to the left ventricle of the heart, and so to effect the *circulation*.

He instances an experiment made by Dr. *Croon* before the Royal Society, who by strangling a pullet, so as not the least sign of life appeared; yet by blowing into the *lungs*, through the *trachæa*, and so setting them a playing, he brought the bird to life again. — Another experiment of the same kind is that of Dr. *Hook*, who after hanging a dog, cut away the ribs, diaphragm, and pericardium, and also the top of the wind-pipe, that he might tie it on to the nose of a pair of bellows; and thus by blowing into the *lungs*, he restored the dog to life; and then ceasing to blow, the dog would soon fall into dying fits, but recover again by blowing, and thus alternately, as long as he pleased.

The Neck, (which being nothing else but an extention of the *thorax*, we'll examine in this place) commences at the *atlas*, which is the first *vertebra*, next to the *head*, and terminates at the first *vertebra* of the *thorax*. —— It has the length of seven *vertebræ*, and is not so broad as it is long. —— Its forepart is called the *throat*, and the back part the *nucha*, or nape. —— 'Tis divided into the *containing* parts, which are the same with those of the whole body; and the *contained*, among which the *trachæa*, the *larynx*, and the *æsophagus* are of the greatest note.

The Larynx (HH) is the principal organ of the Voice, and the upper part of the *trachæa*, placed on the fore-side of the neck, directly in the middle. —Its figure is circular.—It rises before, and is flat behind, to prevent its hurting the *æsophagus* just placed under it.—This rising is called *Adam*'s bit, upon the ridiculous opinion, that the forbidden fruit stuck in his throat, and so occasioned a bunch.

The magnitude of the *larynx* varies according to the difference of ages. In young persons 'tis strait, and renders the voice shrill; in persons of riper years 'tis larger, and renders the voice strong.— 'I is bigger in men than in women, or it does not appear so visibly in women, as in men; because the glands of the lower part of the *larynx* are larger in women, and thereby their neck becomes rounder, and their throat fuller.—It moves in deglutition, for when the *æsophagus* lowers itself, to receive the food, the *larynx* rises to press it down.

The *larynx* consists of cartilages, muscles, membranes, vessels and glands.

The whole body of the *larynx* is formed of five cartilages, *viz.* the *thyreoides*, *cricoides*, *arythænoides*, the *glottis* and *epiglottis*.

The *Thyreoides* is hollow within, and convex without, and divided in the middle by a line, which give occasion to say, 'twas double, though 'tis very rarely found to be such.——The *larynx* is square, and each of its angles has a production.—The two upper productions are the longest, and are tied to the sides of the *os hyoides* by a ligament; and by the two lower productions to the *cricoides* cartilages.

The *Cricoides* resembles a ring, and goes round the whole *trachæa*.—'Tis narrow before, but broad and thick behind.—It serves for a basis to all the other cartilages, and joins them all to the *trachæa*, and for that reason is immoveable.

The *Arythænoides*, (L) which is the third cartilage, is placed in the *thyreoides*, and supported by the annular cartilage.—It forms the back part of the *larynx*.

The *Glottis* (M) forms the upper and back part of the *larynx*, where 'tis narrowest, and renders the voice either shrill or strong, according as it contracts or dilates itself.

The *Epiglottis* serves for a cover to the *glottis*, resembles an ivy-leaf, and has a softer substance, than any of the other cartilages; which qualifies it to rise, or lower itself commodiously.—'Tis fastened to the concave and upper part of the *thyroides*.——The *orifice* of the *larynx* stands always open for *respiration*, except when the *epiglottis* shuts it. Now the weight of the aliment makes the *epiglottis* fall down upon it, least any thing should fall into the *trachæa*; but as soon as the aliment is passed the *æsophagus*, or gullet, the *epiglottis* recovers itself by a natural rebound, to afford a passage to the air.

The *larynx* is provided with fourteen muscles; seven on each side, which dilate or contract the wind-pipe, or *trachæa*; four of these are *common*, and ten are *proper*.

(OO) The two firft *common* proceed from the upper and lower part of the firft bone of the *fternum*, and mount along the cartilages of the *trachæa*, till they arrive at the lateral part of the *thyreoides*; —where they are inferted.

The two other common mufcles proceed from the fore-part of the *hyoides* bone, and are inferted in the outer and lower part of the *thyreoides*.——They ferve to raife the *larynx*, by contracting the upper, and dilating the lower part of the *thyreoides*.

The firft pair of the *proper* mufcles proceed from the lateral and fore-part of the *cricoides*; are inferted in the lower part of the wing of the *thyreoides*, and therefore placed in the fore and lateral part of the wind-pipe.

Of the remaining four pair, two ferve to open the *larynx*, and two fhut it.

The firft pair employed in opening the *larynx* proceed from the lower and back part of the *cricoides* cartilage; and are inferted into the upper and hinder part of the *arythænoides*.

The next couple for the fame ufe, take their origin from the edge of the lateral and upper part of the *cricoides*, and their infertion from the lateral and upper part of the *arythænoides*.

The firft pair that ferve to fhut the *larynx* fpring from the hinder and lower part of the *ærythænoides*, and have an oblique infertion in the fame cartilage.

The fecond couple, for that ufe, proceed from the hollow and inner part of the *thyreoides*, and terminate in the fore-part of the *arythænoides*.

The *larynx* has two membranes; an outer one, which is continuous with the outer cover of the *trachæa*; and an inner one, which is the fame with that of the palate, for it lines the whole mouth, and defcends as an inner coat through the *pharynx*, the *larynx* and the *trachæa*.

It receives two branches of nerves from the recurrents; and is moiftened by four large glands, two fituate above, called *tonfils*, and two underneath, called *thyroideæ*.

The *tonfils* are of a fpongy fubftance, feated on each fide the *uvula*, near the root of the tongue. The common coat of the mouth is their cover. Their nerves are derived from the fourth pair; their arteries from the *carotides*; and their veins unload in the jugular.

Thefe glands ferve to make a fecretion of the blood imported by the *carotides*. This *ferum* they unload in the bottom of the mouth, in order to keep the wind-pipe moift, and part of it trickles down the *trachæa*.

The two lower glands called *thyroideæ*, are placed under the *larynx*, by the annular cartilage, and the firft ring of the *trachæa*; one on each fide; they have the figure of a little pear. Their fubftance is more folid, vifcous, and inclining to a mufcular confiftence than that of the other glands.—Their nerves are from the recurrent branches; their arteries from the *carotides*; their veins run to the jugular, and their lymphatick veffels unload in the thoracick duct.

Thefe glands make a fecretion of a vifcous Humour, with which the *larynx* is done over, in order to facilitate the motion of its cartilages, to qualify the acrimony of the *faliva*, and to foften the voice.

The *larynx* is of a very confiderable ufe, not only in modulating and foftening the voice, by the different apertures of its *rima*, or chink, but alfo in compreffing the *lungs* to a greater or lefs degree by the air; for if the internal diameter of the *larynx* had been equal to that of the *trachæa*, the lungs could have undergone little or no compreffion at all; nor confequently without the *larynx* could we have reaped the advantage from breathing, in regard the air would not have refifted that force wherewith it is driven out in expiration, nor confequently could the compreffion have been made in the lungs, which is found neceffary for the communication of the globules of the blood; and the mixing of the two fluids, air and blood together.

2. Behind the *larynx* there is a very large cavity, called the Pharynx, which is only the orifice of the *æfophagus*, dilated to a great extent.——'Tis made like a funnel, and fome call it *gula*, or gullet, in which the action of diglutition commences, and where it is chiefly performed.

It is affifted by three pair of mufcles, which chiefly compofe the *pharynx*.——The firft, called the *ftylopharyngæus*, ferves to draw up and dilate the *pharynx*. The fecond, *pterygopharyngæus*, ferves to conftringe it; the third, which is called the *æfophagus*, ferves to clofe it.

The office of the *pharynx* confifts in receiving the aliment into its wideft part, and conveying through its narrower paffage into the *æfophagus*, which conducts it to the ventricle; and which is performed in the following manner. When the mufcles heretofore mentioned have widened the *pharynx*, then the *æfophagus* contracting itfelf, raifes the *larynx*, and preffes down the *pharynx*, which clings round the aliment on all fides, and obliges it to defcend through the *æfophagus* into the *ventricle*.

The Oesophagus, or *gullet*, is a membranous pipe or paffage, whereby our food and drink is conveyed from the mouth to the ftomach.

The *æfophagus* defcends from the *fauces* to the ftomach, between the *afpera arteria* and the *vertebræ* of the neck and back, in a ftrait line, excepting for a little deflexion about the fifth *vertebra* of the

the *thorax*, where it turns a little to the right to make way for the great artery, which runs along with it to the ninth; where turning again towards the last, it crosses the artery, and piercing the diaphragm, ends at the left orifice of the stomach.

It consists of three membranes, which qualify it for an easy dilatation upon the swallowing of a bone, or an ill chewed morsel.——Of these three membranes the outer one is a continuation of that, which invests the stomach.

The first proper or middle one is carnous, thick, and soft like a muscle, and is possessed of round and oblique fibres, which effect the motion of the *œsophagus*.

The second proper is nervous, and contiguous with that, which invests the mouth and lips, by which means it comes to pass that the lips tremble, when a vomiting approaches. This coat has long and strait fibres, and like that of the stomach, is strewed with an infinity of glandules, which strain out an acid humour into the *œsophagus*; and this humour gliding to the bottom of the stomach, affects it with the sense of *hunger*.

Mr. *Duncan* observes, that when any acid vapours proceeding from the stomach, irritate the nervous membrane of the *œsophagus*, by provoking the spirits to crowd particularly on that part, it never misses to make us *yawn*, and therefore this membrane is the true seat of yawning; for in that case, the nervous fibres of the inner membrane swell by the irritation; and by dilating the *œsophagus*, oblige the mouth to answer their motion, it being lined with the same membrane.

The *œsophagus* receives nerves from the *par vagum*; arteries from the *aorta*, and *cœliaca*; and two sorts of veins, one above, which runs to the *azygos*, and another below, which terminates in the stomachick *coronaria*.

The glands placed at the hinder part of the *œsophagus* serve to separate the viscous humour with which its cavity is moistened, and rendered more slippery in order to facilitate the descent of the aliment

The action of the *œsophagus* belongs to the animal class, and not to the natural, for it is effected by the means of the muscles: and swallowing is known to be a voluntary action.——Its motion is of undulation, like that of the intestines, and is performed by the oblique and circular fibres of its fleshy membrane.——When this motion tends from above downwards, 'tis called *peristaltick*, and the reverse of that *antiperistaltick*.

From the *neck* we proceed to the *parts contained in the head*. For the parts *containing* see page 40, &c.

The first part that offers itself to our view after the lifting up of the *skull*, is the DURA MATER, which consists of a double plan of fibres, that cross one another a thousand different ways; though sometimes one may divide it into two, very easily.—'Tis much thicker in young persons, and sticks very close to the skull, by a great many little vessels, which nourish the inner part of the *cranium*; of which this membrane is thought by many authors to be a continuation.

Arteries and veins rise above the outer surface of the *dura mater*, and so contrived that the arteries are always covered with veins to prevent any injury accruing to the *cranium* from the continual pulsation of the artery.—The arteries of the brain proceed from the inner *carotides*; and those of the *cerebellum* from the *vertebrales*.—The veins of the brain empty themselves into the inner jugular veins, and those of the *cerebellum* into the vertebral.—— In these vessels there are mutual *anastomoses* of arteries with arteries, and veins with veins, to the end that the blood being stopt on one side, the brain may be sufficiently supplied on the other.

To prevent the compression of the vessels, nature has run the vertebral artery through a bony gutter, digged out of the transversal processes of the neck, and conducted the same artery to the *cranium*, by the *foramen* of the *occiput*, where it is defended from pressure by being laid in a hollow cut of the first *vertebræ* of the neck.

'Tis to be observed, that some arteries run off obliquely, after they have gone some rounds upon the *dura mater*, to mitigate the boiling of the blood, which otherwise would occasion grievous *head-achs*.—These arteries unload in the longitudinal *sinus* of the *dura mater*, which does not happen in any other part of the body; for the blood of the arteries never mingles elsewhere with that of the veins, without passing first through some glands, or the fibres of some parts.——In effect the *veins* have no immediate communication with the *arteries* in any other part of the body.

The DURA MATER invests the whole substance of the brain and *cerebellum*; serves, 1. To keep the brain from rattling against the *skull* in the great commotion of the head; 2. To let in the more volatile parts, which are perpetually evaporated from the brain; 3 To fill up and stop the holes of the *skull*, through which the sanguine and nervous vessels pass; and, 4. For a cover to the nerves: and defends them from being annoyed by the hardness and roughness of the skull in passing through its perforations.

This membrane is endowed with an exquisite sense, independent from the brain, for if the brain is stript of the *dura mater*, it might be cut without pain.—This sense proceeds from its immediate contact

contact and union with the nerves, to which it is a cover, and from ſome threads it receives of the fifth pair of nerves, at the place of its perforation.

In that part, which runs out in length under the *ſagittal ſuture*, the *dura mater* is double, and by a gradual diminution enters the ſubſtance of the brain. This duplicature contracting itſelf, marches from the *cerebellum* to the fore-part of the head, and is faſtened to the hollow part of the *coronal* bone above the *criſta galli*.

(D) This duplicature is called Falx, from the reſemblance of a *ſickle*.—This membrane has another duplicature towards the *lamboides* future, where it is four times thicker, than in other places, the better to part the brain from the *cerebellum*; and to keep one ſide from preſſing the other (when one lies on one ſide of the head;) to keep up the ſecond longitudinal *ſinus*, and to hinder the corruption of one ſide to be imparted to the other.

The *ſecond* duplicature of the *dura mater* ſerves to guard the *cerebellum*, from the preſſure of the two hinder lobes of the brain, and to keep up the two lateral *ſinus's* in ſavage animals.—In this place called the *torcular*, or preſs, there ſtands a bony protuberance, which fortifies the laſt uſe of the duplicature.

The *dura mater* preſents us with ten *ſinus's* or cavities, *viz.* (E) the ſuperior longitudinal; (FE) the two lateral; (G) the ſtreight; (H) the inferiour longitudinal; one at the criſt of the *os occipitis*, and two upon the ſtony proceſs, (one above and the other below) which communicate with one another towards the *ſella* of the wedge-like bone, and after that communicate with thoſe of the other ſide towards the hinder *clinoides* proceſſes.

The upper longitudinal *ſinus* runs upon the *falx*, along the ſagittal ſuture, and terminates together with the *falx* above the *criſta galli*. The lateral cavities commence towards the *lamboides* ſuture, where the *falx* and the back longitudinal *ſinus* take their riſe. The ſtraight *ſinus* commences towards the union of the lateral, or the diviſion of the upper longitudinal, and marches ſtreight to the *glandula pinealis*.—The lower longitudinal runs along the extremity of the *falx*, and terminates the ſtreight *ſinus*.

The cavity that lies by the *criſt* of the *os occipitis*, extends no further than the *criſt*, and diſembogues in the lateral *ſinus's*; the other cavities in the baſe of the *cranium*, empty themſelves into the lateral *ſinus's*; ſome higher, and ſome lower, and commonly at that place, where they wind in the form of a Roman S; and then unload in the jugular and internal vertebral veins.

Theſe ten cavities ſerve to contain the blood in the brain, for ſome time, in order to heat it, by their moderate and cheriſhing heat, for the generation of animal ſpirits, and to check its rapid courſe, they ſerve alſo to receive the reſidue of the blood from the capillary veins of the brain, and convey it to the jugular and vertebral veins, in order to circulation.

The *dura mater* has a motion of *diaſtole*, and *ſyſtole*, which is cauſed by the arteries, which enter the *ſkull*.

(I) The Pia Mater lies immediately under the *dura mater*, and is a fine, thin membrane, which covers the brain ſo intimately, that it can ſcarcely be ſeparated from it: it accompanies the brain in all its circumvolutions, and conducts all the veſſels that either enter its ſubſtance, or depart from it.

Dr. *Willis* obſerves, that it is filled with a great many little glands, which ſerve to ſeparate a watery humour that moiſtens the two membranes.—'Tis alledged that this *pia mater* is extream ſenſible, and the ſeat of the head-ach.

(M) Under the *meninges* appears a large, ſoft, whitiſh maſs, wherein all the organs of ſenſe terminate, called Brain.

Its figure is the ſame with that of the bones that contain it, *viz.* roundiſh, oblong, and flat on the ſides; and is divided into three principal parts, *viz.* the *cerebrum*, or *brain*, ſtrictly ſo called, the *cerebellum*, and the *medulla oblongata*.

The Brain is divided by the *falx*, into two equal parts, called right and left *hemiſpheres*. It is alſo ſeparated from the *cerebellum*, by another duplicature of the *dura mater*.

(N) It conſiſts of two kinds of ſubſtance; the outward one is *cineritious*, or *aſh-coloured*, ſoft and moiſt, called the *cortex*, or cortical part of the brain, is about half an inch thick. The other or inner ſubſtance is white, more ſolid and dry than the *cortex*, and is called the *marrow*, or *medullary*, and ſometimes the *fibrous* part.

The *cortex*, according to *Malpighi*, is formed from the minute branches of the *carotides* and vertebral arteries; which being woven together in the *pia mater*, ſends from each point thereof, as from a *baſis*, little branches, which being twiſted together into the form of a gland, incloſe the *medulla*, ordinarily to the thickneſs of half an inch. Theſe little branches make circumvolutions like the inteſtines; each of which may be reſolved into other innumerable minute glands, contiguous to each other, deſtined for the *ſecretion of animal ſpirits* from the blood, brought hither by the *carotides*, &c. and likewiſe to filtrate the *nervous juice*, which is an oily, and very ſubtile liquor, affording a vehicle to the animal ſpirits, and aſſiſting the blood, in the nouriſhing of the parts.

(O) The inner or *medullary* part of the BRAIN, consists of infinitely fine fibres, arising from the minutest branches or filaments of the glands of the *cortex*; these receive the fluid separated and subtilized from the glands of the *cortex*; and by means of the nerves, which are no more than productions of this part, distribute it all over the body.

Ruysch, and *Leewenhoek*, deny any thing like glands in it; and allow nothing but little *cryptæ*, or sinks, opening laterally to the arteries; and thence receiving a juice already secreted from the blood, and transmitting it to the *medulla*.

In the space between the two *hemispheres* of the *brain*, under the *falx*, or rather under the longitudinal *sinus* of the *dura mater*, is a white substance, of a texture, more compact than the *medulla* of the *brain*, called *corpus callosum*, which runs along the whole tract of the *falx*, and receives from each side the terminations of the *medulla*, interspersed between the several windings of the *cortex*, and supposed by some to be a kind of base, or support to it.

(QQ) Under the CORPUS CALLOSUM, there are two great cavities, called by some, the upper, or front *ventricles*, and by others, lateral; tho' they have one besides, on each side of them. Both these cavities are of the same magnitude and figure; and their situation and uses are likewise the same. They are seated in the middle of the brain; begin from a narrow point towards the root of the nose; and enlarging by degrees, form each of them a great cavity towards the end.

These two *ventricles* are parted by a very fine portion of the medullary substance, enclosed between two membranes, or continuations of the *pia mater* (wherewith the inside of these two ventricles is lined) called, from its transparency, *septum lucidum*.

(RR) The CORPORA STRIATA (called thus from their streaks or furrows) are two considerable eminences, of a browner colour than the rest: there is one in each ventricle.

(S) The INFUNDIBULUM, which is a cavity in form of a *funnel*, descends to the *basis* of the *brain*, and terminates with a point in the *glandula pituitaria*, is formed of the *pia mater*, and placed in the middle of these *ventricles*.

The ancient Anatomists pretended, that these ventricles were nothing else but cisterns, from whence the animal spirits were sent by the nerves to all the parts of the body: but the moderns will have it that these *ventricles* are rather cisterns for the superfluous moisture of the *brain*.

Monsieur *de la Cambre* is of opinion that these *ventricles* were formed only to *facilitate the motion* of the *brain*; which could not perform its functions, if its whole body was full and solid; since it is like bellows, which can never enlarge their cavity without a *vacuum* in their sides.

(T) That which appears red in each of these ventricles, is part of the *plexus choroides*; of which hereafter.

The FORNIX is a production of the *medulla*; which at its extremities next the *cerebellum*, sends out two processes, by whose juncture is formed a kind of arch, thence called *fornix*, which separates the third *ventricle*, from the two upper ones——At the bottom of the *fornix* are two holes, by which the third *ventricle* has communication with the others; that before, is called *vulva*, and that behind, *anus*.

(V) The THID VENTRICLE, or *rima*, which is in the *medulla oblongata*, has likewise two apertures; the one is the orifice of the *infundibulum* or funnel; the other is a duct, whereby the third *ventricle* communicates with the fourth, in the *medulla oblongata*, under the *cerebellum*.—The whole cavity of the third *ventricle* is filled with the *plexus choroides*, which is an assemblage of minute veins and arteries; and with four eminences; the first the *corpora striata*; the others the *thalami nervorum opticorum*.—Some believe this assemblage or texture, to be like a water-bath to the *brain*, which by its gentle heat, preserves the motion of the spirits in the *corpus callosum*.—Others alledge, that the heat of this texture, keeps up the liquidness of the *serum* in the *ventricle*, which without the warm influence of its numerous vessels would thicken and condensate; so that it hinders the humours from stagnating, and causing obstructions in the *infundibulum*.

(X) At the entrance of the canal, reaching from the third ventricle to the fourth, is situated the PINEAL gland; so called from the figure of a *pine-apple*, which it resembles—This gland *Des Cartes* supposes to be the seat of the soul; but I am of opinion that the soul is not confined to any part, but the *soul* is *tota in toto*, and *tota in qualibet parte*, or it is entire in the whole body, and entire in each part.

The use of the *glandula pinealis*, is to separate liquor to be thrown into the *ventricles* of the *brain*.

Behind the *pineal gland* are four eminences; two upper and greater, called *nates*; and two smaller, and lower called *testes*.

(YY) The CEREBELLUM is the hind part of the *brain*, and esteemed a kind of little brain by itself. It is placed in the hinder and lower part of the *skull*, underneath the hind part of the *brain* or *cerebrum*: it lies open to the *cerebrum* at bottom; but is separated from it at the top by a duplicature of the *dura mater*. Its figure fomewhat refembles a flat bowl, broader than long; it is formed by two branches, which fetting out from the fides of the trunk of the *medulla oblongata*, make a fort of cradle, by joining in the middle, and leaving between them a cavity, called the *fourth ventricle*.

Its fubftance is harder, drier, and more folid than that of the *brain*, but of the fame nature and kind, being compofed, like it, of a *cortical*, or *glandulous* and a *medullary* part; the branches of which laft, when opened, refemble thofe of a tree, meeting in the middle, and forming a kind of ftem, which runs quite through it. Its colour is yellowifh; that of the brain whiter.

Its furface is unequal, and furrowed, but not fo much as that of the *cerebrum*; appearing rather as if laminated, like fome fhells; the middle circles being the largeft, and deepeft. Between the *laminæ* are duplicatures of the *pia mater*. The fore and hind parts of the *cerebellum* are terminated by *apophyfes*, called *vermiformes*, from the refemblance they bear to *worms*. It is joined to the *medulla oblongata*, by two proceffes, called by *Willis* Pedunculi.

Here are two or three more medullary proceffes, which, paffing acrofs the *medulla oblongata*, form an arch, called *pons Varolii*.

N. B. Thofe who took the animal fpirits to be formed in the *ventricles* of the *brain*, gave this part the title of *noble*; upon the apprehenfion that it raifed the fpirits to the laft degree of perfection, and difperfed them through the whole body, by means of the fpinal marrow.

The blood veffels of the *cerebellum* are the fame with thofe of the *cerebrum*, and their ufe the fame, *viz.* to feparate the nervous juice from the blood, and convey it through the feveral parts of the body.

Dr. *Willis*, however, diftinguifhes between the functions of the *cerebrum* and *cerebellum*, making the firft the principle of voluntary motions, and actions; and the laft the principle of involuntary ones, *viz.* that of refpiration, the motion of the heart, &c.

It is commonly afferted that a wound, either in the *cortex*, or the *medulla* of the *cerebellum* is mortal.

By turning up the *brain*, the origins of the nerves proceeding from it are diftinctly feen; thefe are in number ten pair, *viz.* the *olfactory*, *optic* movers of eyes, *pathetic*; the fifth pair and fixth pair, called alfo the *guttatoriæ*, the *auditory* nerves, the *par vagum*, and the ninth and tenth pair.

The Olfactory Nerves proceed from the *bafis* of the *corpora ftriata*, by a medullary fibre, which is largeft in that place, where they fetch a winding turn near the *optic* nerves.

The Optic Nerves rife from the extremity of the *corpora ftriata*, and the medullary part, called *thalami nervorum opticorum*. They unite above the *fella* of the wedge-like bone; and divide into two ftrings, which ftretch to the eyes.

Thefe nerves are furrounded with fmall branches of the *motores*. As the *carotide* arteries enter the *brain*, they run along the trunk of the *optic nerves*; whence Dr. *Willis* infers, that, after eating, thefe arteries, being then fulleft of blood, caufe fleep by preffing down the *optic nerves*.

The Motores, or movers of the eyes, proceed from the *bafis* of the *medulla oblongata*, near the *infundibulum*, pafs through a hole under the *optic nerves*, divide into four branches, which are diftributed to the mufcles of the eyes, and the eye lids, and oftentimes difperfe likewife a branch to the *crotaphites* mufcle, which occafions its communication with the eyes.—The *carotide* arteries, and the *infundibulum*, lie between thefe mufcles.

The Pathetic rifes from the lower part of the *medulla oblongata*; behind the *nates* and the *teftes*. They divide into four branches, one of which vifits the great oblique mufcle; the fecond the upper lip, the nofe, and the gums; the third, the membrane of the noftrils; and the fourth, the *crotaphites*.

The Fifth Pair, which is bigger than all the reft, commences from the fides of the annular protuberance behind the *pathetici*, and divides into three branches, *viz.* the *opthalmic*, the *maxillaris fuperior*, and the *maxillaris inferior*.

The Opthalmic, fo called from its repairing to the eyes, after detaching feveral threads, which furround the optic nerves, and are diftributed to the *carotides*, divides into two branches; the biggeft of which is fubdivided into two, *viz.* one that marches out by a hole, called the outer *orbital*, and another which paffes through the hole of the *eye-brows*, and is loft in the mufcles of the *forehead*, the great *orbicular* mufcle of the eye-lids, the *lachrymal* gland, and the nofe-bag. The laft branch paffing through the *orbital foramen*, is loft in the membranes of the bony *laminæ* of the nofe. The upper *maxillary* nerve is diftributed to the upper part of the teeth, as the lower *maxillary* to their lower part.

The Sixth Pair, improperly called *guttatoria* (fince it does not run to the tongue but to the eyes, as well as the *motores*, *pathetici*, &c.) rifes by the laft pair, in the lower part of the *annular* eminence, marches out of the *fkull* by the fame hole with the third and fourth pair, and is diftributed upon the mufcle of the eye, called *indignatorius*; after

after having ſent out a ſmall branch, which, together with two branches of the fifth pair, forms the *intercoſtal* nerves.

The INTERCOSTAL is beſtowed upon the *heart*, the *breaſts*, and the *privy parts*. By this mutual communication Dr. *Willis* explains ſeveral *phænomena, viz.* the mutual pleaſure that affects lovers in their careſſes and reciprocal kiſſes. Sometimes the *intercoſtal* is formed only by the *ſixth pair*.

The *intercoſtal* receives in its firſt *plexus* the *tenth pair*, with a branch from the firſt vertebral nerve of the neck, that's united with the *tenth pair*; and another branch from the ſecond *vertebral* of the neck; at laſt there ſprings from this *plexus*, a branch that ſerves the head of the *trachæa*. As ſoon as it arrives under the channel-bone it forms a ſecond *plexus*, which ſends out two twigs, which embrace the axillary arteries in the form of a ring; from whence proceeds a third *plexus*, formed by the junction of the *intercoſtal*, with ſeveral branches of the *bronchiales*, and *dorſales*, that deſcend along the *vertebræ*.

Of the productions of this nerve in conjunction with others from the *eighth* pair, are formed the *nervi cardiaci*, and thoſe of the lungs; and of three other productions, which join together in one trunk, before they enter the *abdomen*, are formed likewiſe, the *hepatic plexus* on the right, and the *ſplenic* on the left ſide.

From the *hepatic plexus* there ſpring ſeveral branches, ſome of which croſs over the *duodenum*, and the *vena porta*, and repair to the liver: ſome run to the *pancreas*, and to the right ſide of the *ſtomach*; and others to *Gliſſon*'s *capſula*; and two larger than the former, paſs over the emulgent artery, and run to the right kidney.

The *ſplenick plexus* furniſhes ſeveral branches to the left ſide of the ſtomach and *pancreas*, ſome to the ſpleen, and the left *capſula atrabilaria*, and two very conſiderable branches to the left kidney.

From the ſeveral branches, both from the *hepatic* and *ſplenick*, is formed the *meſenterick plexus*, which ſerves as a cover to the *meſenterick* arteries, and accompanies them through their whole diſtribution.

Further, there is a trunk on each ſide formed out of ſeveral branches, both from the *hepatick* and *ſplenic plexus*, which deſcending along the *aorta*, continues its courſe, accompanied with the twigs of the *intercoſtal*, to the diviſion of that vein. This done, 'tis diſperſed through all the parts of the *hypogaſtrium*, particularly the *rectum*, or ſtrait gut, the bladder, the womb and the *vagina* (in women) and the male ſeminal veſicles and *proſtates*.

At laſt the trunk of the *intercoſtal* deſcending along the *vertebræ*, is loſt in *capillaries* diſperſed thro' all the parts of the *hypogaſtrium*, particularly the bladder, the *anus*, the *rectum*, and the genitals.

The AUDITORY NERVE, proceeds from the lower part of the *annular* riſing, and paſſes through the perforation of the ſtony proceſs of the temple-bone. This nerve is compoſed of two branches, one ſoft, which ſerves the immediate organ of hearing, and forms the nervous membrane which cover the *cochlea*, and the inner ſide of the ſemicircular paſſages; and the other hard, which marches out through a hole that lies between the *maſtoides* and *ſtyloides* proceſſes, and goes to unite with the third branch of the *fifth pair*.

The PAR VAGUM, ſo called from its ſerving ſo many different parts, proceeds from the ſides of the *medulla oblongata*, and lies behind the *acouſtici*.——To this is joined another nerve, riſing from the ſpinal marrow, called *acceſſory* by Dr. *Willis*.—Theſe two nerves march out with joint forces thro' the perforation of the *os occipitis*, but as ſoon as they are out of the ſkull, the ſpinal ſeparates from the *eighth pair*, and is quite ſpent upon the *trapezium* muſcle.

The *eighth pair* it no ſooner departed from the *ſkull*, but it forms a *plexus*, as well to ſupply the *larynx* and *pharynx* with its branches, as to produce the recurrent nerve: the right branch whereof encompaſſes the axillary artery, as the left does the *aorta*.—Theſe two nerves return upwards by the ſides of the *aſpera arteria*, and ſend forth ſhoots to the *fibres* that faſten the *annulli*.

The *cardiaci* and the *pneumatici*, are alſo formed from the ſeveral ſhoots which the *intercoſtal* and *eighth pair* ſend to the *pericardium*, the *heart*, the lungs, and the *cava*.

The NINTH PAIR (9) proceeds from ſeveral fibres of the *eighth*, receives two branches from the firſt *vertebral*, and one from the ſecond, in its paſſage through the muſcles of the bone *hyoides*; one of theſe branches is diſperſed through the muſcles *ſterno-thyreoides*, and the other ſpent upon the muſcles of the bone *hyoides*.——Its trunk furniſhes the *baſis* of the tongue with ſeveral branches, and comes to a period.

The TENTH and laſt PAIR (10) proceeds likewiſe from ſeveral threads, and deſcends along the pith of the back-bone; marches between the firſt *vertebra* of the neck, and the *os occipitis*, ſends branches to the oblique muſcles of the head, and in its progreſs to the *plexus* of the *intercoſtal*, receives one from the firſt *vertebral* pair.

Though all the *nerves* proceed from the *brain*; yet it may be ſaid to have no nerves, ſince not one of them is inſerted in it; ſo that the proper ſubſtance of the *brain*, which diſpenſes ſenſe to the whole body, is of itſelf inſenſible.

(14) The BASIS of the *brain* has ſix great prominences lodged in the ſix great pits of the *cranium*; the four firſt and anterior are formed by the *brain*; two of them are lodged in the cavities of the *os frontis*, and the other two in thoſe of the *oſſa petroſa*; the two laſt and poſterior riſings, are placed in the cavities of the *os occipitis*, and formed by the *cerebellum*.

The *blood* (aa, bb) is conveyed into the brains by the *carotides*, and ſervical arteries; which, at their entrance, form one great trunk at the *baſis* of the *brain*; from whence they ſend an infinity of arteries throughout its whole ſubſtance.

The Union of theſe arteries (c) ſerves to mingle the arterious blood, before its diſtribution to the *brain*, and to check its rapidity.

MEDULLA OBLONGATA (Z) is the medullary part of the *brain* and *cerebellum*, joined in one, the fore-part of it coming from the *brain*, and the hinder-part from the *cerebellum*. It lies on the *baſis* of the *ſkull*, and is continued through the long perforation thereof into the hollow of the *vertebræ* of the neck, back, and loins, though only ſo much of it retains the name of *oblongata*, as is included in the *ſkull*.

The ſubſtance of the *medulla oblongata* is harder than that of the *brain*, and it riſes by four roots; of which the two greateſt ſpring from the *brain*, and the other two from the *cerebellum*.——Theſe parts uniting afterwards, are again divided into two, by the *pia mater*; whence it happens, that one ſide may be *paralytick*, while the other is ſound.

MEDULLA SPINALIS, or the *ſpinal marrow*, is a continuation of the *medulla oblongata*, or *medullary* part of the *brain*, without the *ſkull*. It conſiſts, as the brain does, of two parts, a white, or *medullary*, and a cineritious or glandulous; the former without and the other within.—The ſubſtance of the exteriour part is much the ſame with that of the *corpus calloſum*, only ſomewhat tougher, and more fibrous; which difference becomes more apparent as it deſcends the lower, by reaſon of the ſtreightneſs of the cavity, which growing gradually more narrow, preſſes the medullary fibres cloſer together, and renders them more compact, and gathers them into more diſtinct *faſciculi*, till having deſcended the whole tract of the *ſpina*, they end in the *cauda equina*. It is the origin of moſt of the nerves of the trunk of the body, and ſends out thirty pair, on each ſide, to the limbs, the great cavities, and other parts; which are nothing but *faſciculi*, of medullary fibres, covered with their proper membranes.

The *ſpinal marrow* is covered with four coats; the firſt, or external one, is a ſtrong nervous ligament, which ties the *vertebræ* together, to the inſide of which it firmly adheres. The ſecond is a production of the *dura mater*; it is exceedingly ſtrong, and ſerves to defend the *ſpinal marrow* from any hurt, from the flexures of the *vertebræ*.

The third is a production of the *arythænoides*, and is a thin pellucid membrane, lying between the *dura* and *pia mater*, or the ſecond and fourth membrane of the *medulla*.——This membrane gives a coat to the nerves that go out of the *ſpina*, which is the inner membrane of the nerves, as the *dura mater* gives the outer.——The fourth coat is a continuation of the *pia mater*, and is an extremely thin, fine, tranſparent *membrane*; ſtrictly embracing the whole ſubſtance of the *medulla*, dividing it in the middle into two tracts, and making, as it were, two columns of it.

The uſe of the *medulla oblongata*, as well as that of the *ſpinalis*, is to give an origin to all the nerves; for of forty pair of nerves, which march through the whole machine, ten proceed from the *medulla oblongata*, and thirty from the *ſpinalis*.

The FACE, which is the next to be examined, in the *ſuperior venter* or *head*, is divided into two parts, one above called *forehead*; and another below, extending from the eye-brows to the chin.

The FOREHEAD is alſo called *Front*, from the Latin *Frons*, and from the Geeek φρονεῖν, to think, perceive; of φρὴν, *Mens*, the Mind.

The motions of the *Forehead* (A) are performed by the means of two muſcles called *Frontales*, one on each ſide the *forehead*, which ſpring from the upper part of the head, near the crown; or rather it appears that the *frontal*, or *occipital muſcles*, are only one continued *digaſtric* muſcle, on each ſide, moving the ſcalp, and ſkin of the forehead and eyebrows.

The *frontales* begin to be thus denominated, after they have begun to paſs the coronal ſuture, with fibres paſſing obliquely to the eye-brows, where they terminate, and in the lower part of the ſkin of the forehead.

They have each two appendages; the ſuperior, or external, is commonly fixed to the bone of the noſe; the lower is fixed to the *os frontis*, and is, by *Volcherus Coiter*, made a diſtinct muſcle, and called *corrugator*, from its uſe in drawing the eyebrows to each other.

The face is divided, as well as the breaſt and the *abdomen*, into the *containing* and *contained* parts.

The

The former are either common or proper. The common are the teguments, which are the ſame with thoſe of the other parts of the body. The proper are the muſcles and bones. The contained parts are the organs of four ſenſes, *viz.* *ſeeing*, *hearing*, *ſmelling*, and *taſting*; for the ſenſe of the *taſt*, reaches all over the body.

The ſkin of the face reſembles that of the other parts. In children and women, 'tis ſmooth and and fine; but in men, it is covered with hair round the chin, after the age of maturity.

The *ſeed* and the *beard* appearing both about the ſame time, is a convincing proof that there is ſome correſpondence between them. In effect, they are both formed of the ſame matter, with this difference, that the ſubtileſt parts are ſtrained out by the teſticle, form the body of the *ſeed*, and the coarſer being conveyed to the ſkin, produce the *beard*. —— 'Tis upon this account, that thoſe who have the greateſt ſtock of ſeed, are always rougheſt; and that eunuchs are without a beard, as well as without ſeed. This opinion is confirmed by what happens to women; for we ſee they have hairs in the arm-pits, and the *pubes*, at the ſame time when they begin to have ſeed. 'Tis true, they have no beard upon the chin, as men have, and that muſt proceed from the evacuation of the matter in the menſtrual *flux*, which attends the arrival of the ſeed: And for a further proof of this matter, it is to be obſerved, that ſome women have had beards upon a ſuppreſſion of the *terms*.

The Eye is, without diſpute, the handſomeſt, and moſt wonderful part of the body. —— 'Tis ſeated below the forehead, in a cavity, called the *orbita* or ſocket, which is all over bony. —— If we conſider only its globe or ball, its figure is round; but if inveſted with its muſcles, 'tis oblong, and pyramidal, throwing its baſe outwards, and its point inwards.

The magnitude of the *eye* varies in different perſons. —— A large *bulging-eye*, is the handſomeſt; little eyes are more ſerviceable.

Men and horſes, are the only animals that have *eyes* of different colours; they are ſometimes *grey*, *black*, or *blue*; and this diverſity depends upon the different colours that appear in the *iris*.

The *eyes* are divided into external and internal parts; the former cover and guard it, and ſuch are the *eye-brows*, and *eye-lids*: The latter are lodged within the ſocket, and are the conſtituent parts of the globe of the *eye*.

The Eye-brows, are hairs, ranged in the form of a creſcent; the point next the noſe, is called the head; the other towards the temples, the tail of the *ſupercilia*.

The *eye-brows* conſiſt of four parts. 1. A membrane, which by its thickneſs forms a riſing eminence, and by its hardneſs, keeps the hairs faſt. 2. Muſcular parts, which ſerve to raiſe them. 3. The hairs to prevent ſweat, and other nuſances, falling down into the *eyes*. 4. Fat, which ſerves for nouriſhment to the hairs.

The *eyes* are alſo covered and defended with the *palpebræ*, or eye-lids; whoſe motion is ſo quick, in human bodies, that nothing is reckoned ſo ſhort as the twinkling of an *eye*.

The Palpebræ, or *eye-lids*, conſiſt of a thin, muſcular membrane, covered on the outſide with a ſtrong, flexible ſkin; and lined within with a production of the *pericranium*. —— Their edges are fortified with a ſtrong cartilage, to enable them to cloſe the better.

Out of theſe cartilages, grows a paliſade of ſtiff hairs, called *cilia*; of great uſe to warn the eye of the approach of danger, either in ſleeping or waking; to keep off motes, flies, &c. and break the too fierce impreſſion of the rays of light.

Theſe hairs, it is obſerved, only grow to a certain convenient length, and never need cutting, as moſt others do; add to this, that their points ſtand out of the way; thoſe of the upper *eye-lid* being bent upwards, as thoſe of the lower downwards.

At the joining of the upper and under *eye-lids*, are formed two angles called *canti*.

(G) In the inner of theſe, is placed the *glandula lachrymalis*, which is furniſhed with arteries that ſpring from the *carotides*, veins that unload in the *jugular*; nerves derived from the fifth and ſixth pair; and excretory veſſels, which perforate the inner coat of the *eye-lids*, near the *cilia*. —— This gland filtrates a viſcous feroſity, which it throws in between the body of the eye, and the *palpebræ*, in order to facilitate their motion.

Near the other angle is a gland, called *innominata*, which helping by ſeveral branches to irrigate the *eye*, the overplus is carried to the greater angle, and tranſmitted to the noſe, through the *puncta lachrymalia*, which are orifices of a little membranous bag, whoſe ulceration occaſions a *fiſtula lachrymalis*, and hinders the transfuſion of tears into the noſtrils.

The *eye-lids* are both moveable: eſpecially the upper, which has two muſcles to raiſe, and depreſs it, called *attollens* and *deprimens*, or *orbicularis*.

(H) The *attollens* ſprings from the bottom of the *orbita*, above the perforation of the optick nerve, and is inſerted with a broad tendon in the edge of the upper *palpebra*.

(I) The *deprimens* proceeds from the great, or inner corner of the *eye*, and paſſing above the up-

per

per *eye-lid*, marches to its inſertion in the little or outer corner. —— When this muſcle is employed, it draws down the upper *eye-lid*, and covers the *eye*; and in order to a more exact ſhutting of the *eye*, one part of it paſſes through the lower *eye-lid*, and is inſerted in the little corner; for by the two parts it ſhuts the eye very nicely.

Animals that have hard *eye-lids*, as lobſters, and the generality of fiſhes, have no *palpebræ*; as being ſufficiently ſecured without.

In the generality of brutes, is a kind of third *Eye-lid*, which is drawn like a a curtain, to wipe of the humidity, which might incommode the *eyes*; it is called the *nictitating membrane*.

We now ſhall examine the inner parts of the *eye*. —— The Eye, properly ſo called, is of a globular figure, and conſiſts of tunics, humours and veſſels. —— In ſome parts it is lined with fat, (as in the cavity of the *orbita*) and is moved with ſix muſcles; four of which are ſtrait, and two obliques.

(III) The *ſtreights* come from ſeveral points of the bottom of the orbit, and run immediately between the *ſclerotica* and *adnata*; they derive their ſeveral denominations from their ſeveral offices, *viz. attollens*, or *ſuperbus*, which draws the eye upwards: *Deprimens*, or *humilis*, which caſts it down; *adducens*, or *potator*, which draws the *eye* towards the noſe: And *abducens*, or *indignator*, which draws it the other way towards the leſſer angle.

(K) The two *obliques* are the upper, called *rotator*, which proceeds from the inner part of the *orbita*, aſcends along the bone to the upper part of the great corner, where its tendon paſſes through a little annular cartilage, called *trochlea*, and afterwards terminates in company with the *obliquus minor*, near the leſſer corner.

(L) The under *oblique* ſets out from the lower and outer part of the *orbita*, above the union of the two bones of the upper jaw, and is inſerted in the lower part of the *cornea*, near the leſſer angle. —— Theſe two muſcles move the eye obliquely, and wind it round.

When the muſcles of the *eyes* have not acquired an habit of acting in concert, (which falls out very often in children) they render the perſon *ſquint-ey'd*.

The nerves of the *eye* are the *optic pair*, which iſſuing through a perforation in the ſkull, behind the orbit, enter the ball of the eyes, deface and loſe themſelves therein: Beſides which the *motorii pathetici*, the firſt branch of the fifth pair called *opthalmicks*, and the ſixth pair are beſtowed on the muſcles of the eye.

The *eyes* receive arteries both from the internal and external *carotides*, and return the blood by veins that go to the jugular.

The *eye* has ſix membranes; four of which are common, *viz.* the *conjunctiva*, *cornea*, *uvea*, and *retina*: and two proper, *viz.* the *vitrea*, that contains the *vitreous* humour, and the *arachnoides*, in which is the *cryſtalline* humour.

(M) The Conjunctiva is ſmooth, poliſhed, and of an alabaſter white colour, in a ſound ſtate, and is faſtened by ſome ligaments to the *pericranium*. It terminates upon the edge of the *cornea*; and is ſtrewed with millions of arteries and veins.

(N) The Cornea proceeds from that part of the *dura mater*, in which the optick nerve is wrapped, and, paſſing under the *conjunctiva*, becomes conſpicuous in the gap, which that coat leaves in the fore-part of the *eye*. —— This membrane being tranſparent on the fore-ſide, bears the name of *cornea* in that part; but being thick and opaque at the bottom, where the *conjunctiva* covers it, that part of it is therefore called *ſclerotis, i. e. hard.*

(O) The third coat is the Uvea, called alſo *choroides*, from its reſemblance to the *chorion*. It proceeds from the *pia mater*, which covers the *optic* nerve. Of the duplicature of this part, is formed a ſtriped, variegated circle, called the *iris*. In its middle is an aperture, called the *pupil*, or *apple* of the *eye*, about which the *iris* forms a ring. From the inſide of this *tunic* ſpring certain fibres, which ſpreading round the chryſtalline humour, form the *ligamentum ciliare*.

(P) The Retina, ſo called, from its being drawn up in the form of a *net* behind the humours, conſiſts of a dilatation of the *optic* nerve, and receives the impreſſion of objects; for, of all the tunicles of the *eye*, this alone is opaque; ſo that the *ſpecies* of objects, after paſſing through the other membranes and humours, reflect upon the *retina*, which repreſents them to the *brain*, according as it receives them.

(Q) The Vitrea, from its *glaſſy* humour is the 5th coat, and the firſt of the proper ones; it ſpreads out through the whole ſubſtance of the humour, ſmall filaments, which hinder it from ſlipping out of its place; but when the coat, which is very thin, is broken, the humour melts, and turns all into water.

(R) The ſecond of the proper coat is entitled *arachnoides*, from its being thin, like a *cobweb*. This tunic ſerves for an immediate cover to the *cryſtalline* humour, and is tranſparent that the images of objects might appear in it as in a looking glaſs.

The *humours of the eye*, encloſed within theſe tunics, are three, *viz.*

1. The

1. The Aqueous, a limpid, tranſparent humour, ſituate in the fore-part of the *eye* immediately under the *cornea*, and occaſioning its protuberance.

(S) 2. The Crystalline is ſituated immediately under the aqueous, behind the *uvea*, oppoſite to the *pupil*.

(T) 3. The Vitreous, or glaſſy humour, which fills all the part of the cavity of the globe; and is that, which gives the ſpherical figure to the *eye*.

The whole ſtructure and *apparatus* of the *eye* tends to this, that there be produced a diſtinct and vivid collection in the bottom of the *eye*, directly under the *pupil*, of all the rays, which proceeding from any point of an object, and entering the *eye*, penetrate the cryſtalline humour; and that ſo many points being painted in the bottom of the *eye*, as are conſpicuous in an object, that ſo a ſmall image like thereto, may be repreſented in the *retina*.

The nobleſt and moſt excellent ſenſe next to *ſeeing* is that of Hearing; therefore let us examine the admirable ſtructure of the parts employed in this ſenſe.

The Ear is the organ of *hearing*, or that part whereby animals receive the impreſſion of ſounds.

The *ear* is divided into the outer and inner part. The former is that, which appears upon the external ſurface; the latter conſiſts of ſeveral particles and cavities within the *oſſa petroſa*.

(X) The outer part, or *auricle*, is a ſemicircular, and contains divers ſinuoſities. — Its upper part, which is the broadeſt, is called *ala*, or wing; and the latter, which is narrow, ſoft, and pendulous, the *lobe*, or *fibra*, being that, to which ear-rings, &c. are hung.

The outer *area*, or extent of the *auricle* is called the *helix*, and the inner, oppoſite thereto, the *anthelix*; the little protuberance of the ſide next the face, is called the *tragus*, or *tircus*; and the ridge juſt above, and oppoſite to it, an *antitragus*: And the cavity, leading to the beginning of the *meatus*, the *concha*.

The *auricula*, or the outer part of the *ear*, conſiſts of a thin cartilage covered with a ſkin, ligaments, nerves, arteries, veins, and muſcles. — The cartilage is not divided in men, as it is in other animals. — The ligament faſtening the ear to the *os petroſum* is ſtrong, and proceeds from the *pericranium*. — The nerves ſpring from the ſecond *vertebra* of the neck; the arteries from the *carotides*; and the veins repair to the *jugulares*.

Though the *auricula* has no manifeſt motion, yet 'tis provided with four muſcles; one ſuperior and three poſteriors.

(Y) The *ſuperior* proceeds from the *muſculus frontalis*, it being part thereof, and is inſerted in the *auricle*, which it pulls upwards. The other three, which make but one fleſhy body, riſe from the *os occipitis*, and the mamillary proceſſes, and is inſerted behind, at the root of the *ear*. — It ſerves to pull the ear backwards and downwards. (ZZZ)

The external *ear* is not the principal organ of hearing, though, at the ſame time, it contributes very much to the perfection of that ſenſe, in receiving the ſounds, and introducing them to the *meatus* of the internal *ear*; ſince thoſe, whoſe *ears* are cropt or cut off, have but a confuſed way of hearing, and are obliged either to form a cavity round the ear with their own hands, or elſe to make uſe of a horn, and apply the end of it to the inner cavity of the *ear*, in order to receive the agitated air.

Under the *ears* we meet with big conglomerated glands, for the ſecretion of the *ſaliva*, called *parotides*.

The inner part of the external *ear* is poſſeſſed by the *meatus auditorius*, or auditory paſſage, which commences from the bottom of the *concha*, called the *alvearium*, and is continued in a winding direction, turning ſometimes this way, and ſometimes that, to the *membrana tympani*. —— The *meatus* is dug out of the *os temporis*, and lined with a membrane, furniſhed with divers little *glands* that ſeparate a thick, yellow, glutinous humour, called *cerumen*, or ear-wax, ſerving to defend the *ear* from the ingreſs of vermin, and other extraneous bodies. —— The external *ear* is ſeparated from the internal by a thin, dry, round, and tranſparent membrane, called, improperly *tympanum*, or *drum*, and placed at the further end of the *meatus*.

Behind this membrane is a cavity, called the *barrel of the drum*, being three or four lines deep, and five or ſix broad.——In this cavity are three little bones, *viz.* the *malleus*, *incus*, and *ſtapes*, *i. e.* the hammer, the anvil, and the ſtirrop, which we have ſeen in the *Oſteology*.—Their articulation is ſuch, that the *malleus* is faſtened to the *tympanum*, which communicates to them that which it receives from the air.

To give motion to theſe bones is the office of a muſcle placed in the barrel of the *drum*, which produces a tendon, that faſtens it to the proceſs, which the handle of the hammer obliges to approach to its head.—The action of this conſiſts in pulling the handle of the hammer inwards, and in ſtretching

ſtretching the membrane of the *drum*, which afterwards unbends when the muſcle ceaſes to pull; for the little bones are ſo articulated, and mutually joined by ligaments, that they make a ſort of elaſtick ſpring, which in conjunction with that of the drum, ſerves for an antagoniſt to the muſcle.

Two *meatus* are ſituate at the ſide of the cavity, one opening into the palate, called *aqueduct*, which is partly cartilaginous, and partly membranous, and the other ſhorter and bigger, opening into the *ſinus* in the mamillary proceſs.

We come next to two gaps, or apertures, called *Feneſtræ tympani*, which are placed in the ſurface of the *os petroſum*, which is oppoſite to the membrane of the *tympanum*. The firſt, called *feneſtra ovalis*, is ſituate a little higher than the other, and receives the *baſis* of the *ſtapes*; the other *rotunda*, notwithſtanding its figure is oval like the former, and cloſed by a thin, dry, tranſparent membrane, reſembling that of the *tympanum*.

There is a *ſmall chord*, which lies in the cavity of the *tympanum*, and runs over the inner ſurface of the membrane, called *chorda tympani*. It is a branch of the fifth pair of nerves, which meets the *portio dura*.

The two *feneſtræ*, or *windows*, open into a cavity dug out of the *os petroſum*, which for its meanders, is called the *labyrinth*. But the pipes whereof the *labyrinth* conſiſts, are called by different names.

The beginning of the cavity is called *veſtibulum*, as leading into the other two. It has nine apertures. From the *veſtible* there ſet out three ſemicircular *meatus's*, which return to it by another road. All theſe ſurround the *forinx* of the *veſtible*. One of them is called *horizontal*, and the other two *vertical*.

N. B. In the *labyrinth* is ſuppoſed to be contained the innate air.

The Cochlea, *ſnail* or *ſhell*, is the laſt cavity, and conſiſts of a ſpiral, ſemi-oval canal, and of a *lamina* formed into a *ſpiral* flight. The *canal* makes two turns and a half round a newel, or *axis*, ſtill growing leſs as it aſcends. The *ſpiral lamina* divides this cavity into two, being faſtened by its baſe to this *axis*, and by its other extremity, to the ſurface of the canal, oppoſite to the *axis*, by a very fine membrane.—The cavity of the *cochlea*, thus divided, forms, as it were, two ſtaircaſes, both on the ſame newel, one cover the other; but without any communication between them.

The *aqueduct* is the *auditory nerve*, which conſiſts of two parts; the one ſoft, called *portio mollis*: and the other harder, *portio dura*. The firſt part is ſpent on the organ of hearing, being divided into five branches, which form a delicate web, that lines the *veſtibulum*, *cochlea*, &c. The hard part, paſſing out of the *cranium*, is diſtributed among the parts of the external ear.

The *ſenſe of hearing* is performed in the following manner.

The external air being toſſed by very quick and nimble concuſſions, enters the firſt *meatus*, and ſtrikes upon the drum; and that membrane being thus *connected*, ſhakes the ſmall ſtring behind it, and the three little bones that are knit to it; and by that means conveys the external motion to the internal air: upon which this air ſubtilizes itſelf, and fortifies its agitation in the windings of the *labyrinth*, and by entering into the ſpiral *cochlea*, as advancing from a broader to a narrower ſpace; the air thus ſubtilized, communicates itſelf to the nerve, which conveys it to the common *ſenſorium*. So that theſe different modifications of the air, move the imagination, to form the ſenſation, called *ſound*. For *hearing* is no action; but only the reception of the impreſſion of the air into the nerves, that viſit the *ear*.

Martial ranks large *ears* among the number of deformities.

The next ſenſe, which offers itſelf to our conſideration, is that of Smelling, and the *noſe* is the organ thereof.

The Nose is divided into the root or upper part, which lies between the two *eyes*; the lower or *dorſum*; the *ſpina* or pointed part, which is yet lower; the cartilaginous moveable tip; the little globe; the lateral parts; the *alæ* or wings; and the *columna* or pillar, which is the fleſhy part that advances in the middle, and ſeparates the two noſtrils.—Theſe are called its *external parts*.

The teguments of the *noſe* are common to the reſt of the face. Under theſe are the ſeven muſcles of the *noſe*, *viz.* one common, and ſix proper. Of the laſt ſort, four dilate it, and the other two contract it.

The *common* muſcle is a part of the orbicular muſcle of the lips; it draws the noſe downwards, to bring the upper lip towards the lower.

3. The *pyramidales* or *triangulares*, which are the two firſt of the proper claſs, proceed from the future of the *forehead*, and are inſerted with a broad tendon in the *alæ* of the *noſe*; which they ſerve to draw aſunder.

4. The *dilatantes*, which ſerve to widen the external apertures of the noſtrils, reſemble a *myrtle-leaf*, proceed from the bone of the *noſe*, near the *alæ*, and terminate in the round place of the ſame wing.

5. The *conſtringents*, which draw the wings of the

the nose downwards, and at the same time the upper lip also downwards, are hidden under the coat that invests the nostrils; spring from the inner part of the bone of the *nose*, and are inserted in the internal *alæ* of the *nostrils*.

The upper part of the *nose* being bony, there are five *cartilages* under these muscles, which form the lower part. The two superior *cartilages*, are broad upwards, but soften and grow narrow in their descent, and adhere to the bones of the nose: the other two, which form the *alæ*, are fastened to the extremities of the upper ones, by membranous ligaments; and the fifth is placed in the middle for a partition betwen the two nostrils.

The membrane of the *nose* is furnished with large arteries from the *carotides*, and veins which empty themselves into the jugular; and nerves from the fifth pair, as well as the *olfactory* nerve.

In this membrane is a great number of small glands, which filtrate a white viscous liquor, called *snot*.——Besides these two sinks, there are some others that convey a liquor like the former into the nostrils, which keeps the membrane soft, defends it from the injuries of the air; which must pass this way, when the mouth is shut.

The first of the *excretory* ducts is the *canalis nasalis*, formed by the coition of the two *lachrymal* points, that pass through the *foramen* of the *os unguis*.—Through this passage, part of the humour that waters the eye, distils into the *nose*.—The second is the two holes of the *sinus frontales*, which unload in the *nose*, a *snot* filtrated by the glands of their membrane.—The third is the two holes of the *sinus's* of the *os spheroides*, there being one on each side.—The fourth is the two orifices of the *maxillary* cavities.—The fifth is the *aqueduct*, some part whereof is invested with the glandulous membrane of the nostrils.

The NOSTRILS are the two apertures at the basis of the *nose*, or the commencement of two cavities, which afford a continual ingress and egress to the air.——Each of these cavities divides afterwards into two others; one of which ascends towards the sieve-like bone: and the other descends to the palate, to empty itself in the bottom of the mouth, and the throat.

There are two other conduits, which run from the *nostrils* to the mouth. They commence at the bottom of each *nostril*, and, passing over the palate, perforate it under the fore teeth, where they end.

The whole inner capacity of the *nose* is lined with a pretty thick coat, which is a continuation of the *dura mater*, at the lower part whereof generally grow some hairs, visible at the entry of the *nose*.

The internal *nose* is filled with several cartilaginous plates separated from one another, whose extremities terminate at the root of the *nose*, and which serve to support its inner coat, which having a very long extent, is therefore folded into the little cavities of the *nose*, runs quite round these *laminæ*, and covers their surface exactly.

In this inner tunicle of the *nose*, the *olfactory* nerves are diffused, and rendered capable of the perception of *odoriferous effluvia*, which is effected in the following manner.

The little atoms that exhale from *odoriferous* bodies, are carried along with the air to the *nose*; where, by striking upon its inner membrane, they jog the small pipes of the *olfactory* nerves, immediately the subtile matter with which they are filled, partakes of this commotion, which, by virtue of the continuity, flies in a moment to the *corpora striata*, from whence these nerves proceed, and whereof our imagination, sensible of the different undulations, which each object can occasion in the spirits, perceives that this is the impression of an odoriferous body; whence proceeds the sensation, called *smelling*, which is not an action, but a passive quality of the olfactory nerve.

The matter in animals, vegetables, fossils, &c. which chiefly affects the sense of *smelling*, BOERHAAVE observes, is that subtile substance inherent in the oily parts thereof, called *spirit*; for that, when this is taken away from the most fragrant bodies, what remains has scarce any smell at all; but this, poured on the most inodorous bodies, gives them a fragrancy.

WILLIS observes, that *brutes* have, generally, the sense of *smelling* in much greater perfection than *man*; and by this alone, they distinguish the virtues and qualities of bodies unknown before; hunt out their food at a great distance, as *hounds*, and *birds of prey*; or hid among other matters, as *ducks*, &c. *Man* having other means of judging of his food, &c. did not need so much sagacity in his nose; yet have we instances of a great deal, even in man. In the *Histoire des Antilles*, we are assured, there are *negroes* who, by *smelling* alone, can distinguish between the footsteps of a *Frenchman* and a *negro*.

The *chemists* teach, that *sulphur* is the principle of all *smells*, and that those are more or less strong, as the sulphur in the odorous body is more or less dried or exalted. Sulphur, they say, is the foundation of odours, as salt is of savours, and mercury of colours.

Smell, like taste, consists altogether in the arrangement, composition, and figure of the parts, as appears from the following experiments of Mr. BOYLE. 1. From a mixture of two bodies, each whereof is of itſelf void of ſmell, a very *urinous* ſmell may be drawn, that is, by grinding of quick-lime with *ſal ammoniac*. 2. By the admixture of common water, which, of itſelf, is void of all ſmell, and inodorous; another inodorous body may be made to emit a very rank ſmell. Thus *camphire*, diſſolved in oil of *vitriol*, is inodorous, yet, mixed with water, immediately exhales a very ſtrong ſmell. 3. Compound bodies may emit ſmells which have no ſimilitude to the ſmell of the ſimples they conſiſt of. Thus oil of *turpentine*, mixed with a double quantity of oil of *vitriol*, and diſtilled; after diſtillation, there is no ſmell but of *ſulphur*, and what is left behind, the retort being again urged by a more violent fire, yields a ſmell like oil of wax. 4. Several ſmells are only to be drawn forth by motion and agitation. Thus *glaſs*, *ſtones*, &c. which even when heated yield no ſmell, yet, when rubbed and agitated in a peculiar manner, emit a ſtrong ſmell; particularly *beech-wood*, in turning, yields a kind of roſy ſmell. 5. A body that has a ſtrong ſmell, by being mixed with an inodorous one, may ceaſe to have any ſmell at all. Thus if *aqua fortis*, not well dephlegmated, be poured on ſalt of *tartar*, till it ceaſes to ferment, the liquor when evaporated will yield inodorous cryſtals, much reſembling ſalt of *nitre*; yet when burnt, will yield a moſt noiſome ſmell. 6. From a mixture of two bodies, one whereof ſmells extremely ill, and the other not well, a very pleaſant *aromatic* odour may be gained, *viz.* by a mixture of *aqua fortis*, or ſpirit of *nitre*, with an inflammable ſpirit of wine. 7. Spirits of *wine*, by mixing with an almoſt inodorous body, may gain a very pleaſant *aromatic* ſmell. Thus inflammable ſpirits of *wine*, and oil of *Dantzic vitriol*, mixed in equal portions, then digeſted, and at laſt diſtilled, yield a ſpirit of a very fragrant ſmell. 8. A moſt fragrant body may degenerate into a fœtid one, without the admixture of any other body. Thus, if the ſpirit mentioned in the former experiment be kept in a well cloſed receiver, it will ſoon turn to the rankneſs of *garlic*. 9. From two bodies, one whereof is inodorous and the other fœtid, a very pleaſant ſmell may ariſe, much reſembling muſk, *&c.* by putting *pearls* into ſpirit of *vitriol*; for, when diſſolved, they yield a very agreeable ſmell.

The uſes of the Nose (beſides giving us the ſenſe of ſmelling) is its ſerving in the great office of *reſpiration*, and in modelling the voice; in receiving the abundant humours from the eyes, and in adding to the beauty of the face. It is certain, that there is no paſſage to the brain for the air, much leſs for the powders ſnuffed up the noſtrils.

Wounds of the *noſe* are generally cured by the dry ſuture; but where the wound divides the *cartilage*, and penetrates ſo deep, that its lips cannot be kept in contact, by the application of ſticking plaſters, the true ſuture muſt be made through the ſkin, on each ſide of the wound. Roonhuys, in his *Obſerv. Chirurg.* xxiv. gives an inſtance of a noſe ſlit down longitudinally, and cured by ſuture. M. Blegny, in *Zod. Med. Gall.* ſpeaks of a ſoldier, whoſe noſe was cut off by a ſcymeter, and afterwards ſewed on again ſo well by the ſurgeon, that the ſcar could ſcarcely be perceived; and M. Garengeot, in tom. iii. p. 55. of his ſurgery, gives an account of a noſe that was conjoined again by ſuture, after it was bit off. When the naſal bones are fractured, it is uſual to place ſmall tubes, of ſilver or lead, under them, for ſome time, to prevent the paſſage of the noſe being ſtopped by the ſhooting out of the new fleſh. Externally, ſome vulnerary balſam or glutinous powder is to be uſed, and covered with ſticking plaſters, which muſt be kept on with the four-headed bandage.

In the Nose, both the *bone* and *cartilages* are ſubject to *fractures*; and if the injury is very great, they can never be ſo perfectly cured, but that ſome deformity will remain; beſides, the vicinity of this part to the brain, which is frequently injured at the ſame time, renders caſes of this kind often dangerous: a *caries* alſo, or a *polypus*, are no uncommon attendants on this diſorder. In order to reſtore the bones of the noſe to their proper ſituation, the patient is to be placed in a ſeat oppoſite to the light, and his head is to be held back, while the ſurgeon raiſes the depreſſed part with a *ſpatula*, a *probe*, or a *quill*, applying externally the thumb of one hand, and the fore-finger of the other. If the bones are fractured on both ſides, they are to be raiſed on each in this manner, and the cavity of the noſtrils is to be filled up with long doſſils, to prevent the bones from collapſing; covering the part alſo, for this end, with a plaſter, applying firſt the dreſſings common to recent wounds. If the bone be fractured into ſeveral ſplinters, they are to be reduced into their proper places, by the fingers; but if a ſplinter is ſo entirely ſeparated from the bone, that it will not eaſily unite with it again, it is to be taken out with the forceps. If no *caries* or abſceſs intervene, the bones will unite in about fourteen days. If the bone ſhould require a ſtronger ſupport than what has hitherto been mentioned, one may be formed out of ſtrong paper, either ſingle or double; adapted to each ſide of the noſe, and ſupported by bolſters, and the whole muſt be kept in its place by a four-headed bandage, not tied too tight. When the fracture of this part is accompanied with an external wound, after the bones are replaced, dreſs the wound firſt with dry lint, covering it with a vulnerary plaſter, afterwards uſe balſamic medicines; but all thoſe that are oily or greaſy, are to be carefully avoided, both here, and in all other caſes where the bones are injured.

When the *bones* are *ſeparated* from each other, or *diſtorted* out of their places, they are to be replaced by a probe, or quill, thruſt up the noſtrils, guiding the parts thus raiſed up, with the other hand, into their proper places, as above deſcribed, under *fractures*; after which there is ſcarce any thing to be done, but to let a piece of ſticking plaiſter lie upon the noſe for ſome time.

Another diſorder, to which the noſe is liable, is that of the *preternatural cloſing of the noſtrils*, which is ſometimes owing to careleſs treatment in the *ſmall-pox*, in the bad ſort of which the noſtrils have been known to cloſe, and adhere ſo ſtrongly to the upper lip, which is turned back at the ſame time, as to leave no poſſibility of ſhutting the mouth. In this unhappy caſe, the only relief is by the knife, ſeparating the lip from the noſe, and then opening a paſſage through each of the noſtrils, which are to be kept open with leaden pipes, and the lip preſſed down into its natural poſition by a compreſs and bandage, and this continued till the wounds are cicatrized.

The diſeaſes of the *noſe* are a *coryza*, *ozæna*, *polypus*, *ſarcana*, *noli me tangere*, *ſneezing*, and the *loſs of ſmelling*.

The figure and magnitude of the *noſe* cannot be nicely adjuſted, becauſe ſome have bigger *noſes* than others. But a great hawk noſe is preferable to a flat one; upon the account of the conveniency of reſpiration, as well as beauty.

We proceed to the TONGUE, which is the organ of TASTE. But firſt let us premiſe an account of the *mouth*, which contains it.

The MOUTH has an upper and an under *lip* made of a fungous fleſh, and covered with a very thin coat.

Theſe LIPS have ſeveral glands placed under the coat that covers them, and which are furniſhed with little arteries from the *carotides*, and veins which carry back the blood to the external jugulars. Beſides they have eight proper muſcles and five common. Of the proper, four belong to the upper, and four to the lower *lips*: of the common, two are allotted to each *lip*; the other is an odd one.

(7) The firſt of the propers, proceeding from the upper jaw-bone, where the fore-teeth *inciſores* are placed, is called *inciſivus*, and inſerted in the upper *lip*, which it pulls upwards.

(8) The ſecond, called *triangularis*, ſprings from the lateral and external part of the *baſis* of the lower jaw-bone; is inſerted near the corner of the mouth in the upper *lip*, and pulls it down.

(9) The third, called *montanus*, allotted to the lower *lip*, proceeds from the fore and lower part of the chin, and from the root of the fore teeth of the lower jaw; and terminates in the brim of the lower *lip*; which it draws down.

(10) The fourth is called *caninus*, from its proceeding from the upper jaw-bone above the *eye-teeth*; is inſerted in the lower *lip*, near the corner of the mouth, and ſerves to draw up this *lip*.

(11) The *zigmaticus*, proceeds from the *zygoma*, is the fifth muſcle, and the firſt of the common ſort, is inſerted in the corner of the mouth, and draws it towards the *ears*.

(12) The ſixth riſes from the roots of the *grinders* of both jaws, and terminates in the circumference of the lips. 'Tis called the *buccinator*, from its action in ſwelling and enlarging the cheek, when we ſound a trumpet.

(13) The *odd muſcle*, called *orbicularis*, is the fleſh that encompaſſes the two *lips*, like a *ſphincter*, and ſhuts the mouth, by drawing them together.

The nerves of the *lips* come from the fifth, ſixth, and eighth pair of the head, and ſome from the *par acceſſorium*.

When the mouth is well made, with ruby lips, it contributes much to a beautiful face. A little mouth is always handſomeſt.

Under the *eyes*, between the *noſe* and *ears*, lies a round prominence called the POMUM, ſtiled *the ſeat of ſhame*; becauſe it reddens or grows pale in the receſs of that paſſion; the looſe part under it is called the *cheek*, or *bucca*; the upper part of the upper lip, *myſtax*; the ſlit between the two lips, *mouth*; the prominent parts of the *lips*, *prolabia*; the lower part of the *under-lip*, *chin*; and the fleſhy part *under* the chin, *buccula*.

Within the mouth are contained the *gums*, the *palate*, the *uvula*, and the *tongue*.

The GUMS ſerve to keep the teeth faſt in their ſockets, and conſiſt of a hard and ſolid ſort of fleſh, that poſſeſſes the upper part of thoſe ſockets or *alveoli*.

The PALATE, called the roof of the mouth, from being its upper part, is formed by the *maxillary* bones, and the bones of the *palate*, and covered with a thick, ſhrivelled membrane.

The ſubſtance of this *tunicle*, is ſtrewed all over with conglomerate glands, which are continued to the *tonſilæ* or almonds,——Theſe glands ſeparate a ſort of ſeroſity, which they diſcharge into the mouth by an infinity of little pipes like a ſieve.

The UVULA is a ſmall pyramidal prominence, which hangs down from the palate upon the root of the *tongue*.——It is formed by the union of two little round muscles, that spring from the *septum* of the nose. These muscles serve to raise it: and when the action ceases, it falls by its own weight. —Upon the sides of the *uvula*, are two arches, called *rimæ nasales*, which consist of semi-circular fibres, covered with a thin skin, upon which are dispersed little glandulous grains When the semi-circular arches stretch themselves lengthwise, they become strait, and serve to confine the air within the mouth; when we blow or heave up the cheeks, they likewise stop the entry of the *larynx*, and so hinder the air to spring from the *aspera arteria*, when we breathe, in performing the same action.

(15, 15) The motions of the *uvula* are very manifest in some persons, and are performed by four muscles, two called *peristaphylini externi*, and two *peristaphylini interni*. The two first proceed from the upper jaw under the last grinder; and terminate by a slight *tendon* in the *uvula*.

(16, 16) The *peristaphylini interni* rise from the inner wing of the *pterigoides* process, where there stands a little moveable *cartilage*, that ministers to their motion. Then they mount along the wing of the process, and are inserted in the *uvula*. These four muscles serve to advance, and draw back the *uvula*, when we swallow victuals.—— When the *uvula* is swelled and inflamed, the vulgar call it the falling of the roof of the mouth. Sometimes it runs out to such a length, that it is necessary to cut off its tip.

(17, 17) Upon each side of the *uvula*, betwixt the *larynx* and the muscles of the *os hyoides*, stand the *tonsillæ* or *amigdalæ*, the conglomerate glands, mentioned with the *larynx*. They are furnished with all sorts of vessels, and strain out the *serum* that moistens the tongue, the *larynx*, and the *œsophagus*.

The TONGUE, which is the organ of TASTE, and the principal instrument of *speech* and *deglutition*, is seated in the *mouth* under the arch of the palate.

The *tongue* is fastened to the *os hyoides*, the *larynx*, and the *fauces*, by the *frenum*, a membranous ligament, running about half way along the lower side of it.

It is generally proportioned to the size of the mouth: when it is too short we cannot shoot it out; when too thick, it makes us stammer; and when too flabby and moist, as in children, we can't well articulate our words.

The main body of the *tongue* is made up of muscles, covered on the upper part with a papillary nervous substance, over which is spread a pretty strong membrane, instead of the *epidermis*, and full of *papillæ* of a pyramidal figure, especially towards the tip: which *papillæ* stand pointing towards the root of the tongue in a bending posture, which make their figure to be *concavo-convex*.—— These *apices* or *papillæ* are so very minute and slender in men, that they make the coat appear on the upper part to be viscous; especially as they approach towards the root. The figure of the *papillæ* in human *tongues*, is not so plainly discernable to the naked eye, as not to need the *microscope*.

Under this lies a soft reticular sort of coat, full of holes like a sieve, and always lined with a thick yellowish *mucus*. This membrane on the upper side next the outward, appears white with a cast towards yellow, but black on the side next the *tongue*.

The greatest part of the body of the *tongue* is musculous, consisting of plans of fibres in different directions: the first or external plan, consists of strait fibres, which cover the *tongue* from one extreme to the other; when these contract they shorten it. Under this are several other plans running from the under to the upper side, which serve to make it broad and thin. These two kinds of fibres lie *stratum super stratum*, a plate of the one, and then a plate of the other.—'Tis by the means of these fibres that the *tongue* moves itself, and turns like an eel in the mouth.

It is also furnished with eight muscles for the performance of its great motions.

(23, 23) The first pair is the GENYOGLOSSI, which proceed from the lower part of the chin, and are inserted in the anterior and interior part of the *tongue*; which muscles pull the *tongue* forwards, and put it out of the mouth.

(24, 24) The second is the STYLOGLOSSI, which spring from the *styloides* process, and terminate in the lateral and upper part of the *tongue*, to pull it up.

(25, 25) The BASIOGLOSSI, which move the *tongue* towards the bottom of the mouth, are the third, proceed from the upper part of the *basis* of the *os hyoides*, and are inserted in the root of the *tongue*.

(26, 26) The fourth pair is the CERATOGLOSSI, which rise from the upper part of the *cornu* of the *os hyoides*, and are inserted in the sides of the *tongue*, which they pull aside and backwards. When these four muscles on each side act successively, they move the *tongue* round.

Mr. *Cowper* allows no more than three genuine pair of muscles to the *tongue*, viz. the *genioglossum*, *ceratoglossum*, and *styloglossum*.

Down the middle of the *tongue*, length-wise, runs a seam, called *linea mediana*, which divides it

to

to the bottom into two equal parts, but not ſo effectually, but that the blood veſſels of one ſide communicate with thoſe of the other. Theſe veſſels are arteries from the *carotides*, and veins called *ranulæ*, and are very conſpicuous about the *frænum* under the *tongue*, ſerving to re-convey the blood to the external jugulars.—Theſe veins are frequently opened in the *angina*, and are the laſt reſort of old women in this caſe. —— The nerves of the *tongue* come from the fifth, ſixth, and ninth pair, the two firſt of which have been called *guttatorii*, and the latter *motorii linguæ*.

The TONGUE ſerves for four *uſes*. 1. To aſſiſt the *chewing* faculty, by turning the morſels in the mouth. 2. To promote *deglutition*. 3. To join with the lips in *articulating* the voice; for it is by their joint-motion that the air ſpringing from the lungs is formed into words. 4. To be the principal organ of *taſte*.

The TASTE conſiſts in the fluttering of the ſpirits of the *tongue*, cauſed by the ſalts of the aliment, which ſtrike upon the nerves, in which they are contained; which ſalts grating againſt the papillary prominences, occaſion undulations with them, which in the ſame moment are imparted to the ſpirit contained in the nerves, and by them tranſmitted to the *corpora ſtriata*, with which they are continuous, and which repreſent to the imagination ſuch impreſſions as they receive.

We will conclude SPLANCHNOLOGY with a demonſtration of the four *ſalivary veſſels:* Two upper, which proceed from the *parotides*, and two under, which riſe out of the *maxillary* glands.

(29) The *parotides* are large conglomerate glands placed behind the ears, and fill all the ſpace between the hinder corner of the lower jaw and the *maſtoides* proceſs. —— They receive arteries from the *parotides*, which reach within their ſubſtance; and their veins run to the jugulars. The *ſaliva* is ſecreted from the blood, which paſſes through their ſubſtance; which *ſaliva* is received by two veſſels, called *ſalivares*, and formed out of ſeveral little branches, which unite upon their departure from the glands, and marching along the cheeks, make a breach through the middle of them, in order to terminate in the mouth.

3. The MAXILLARY GLANDS (alſo of a conglomerate nature) are placed under the lower *maxilla*, between the *larynx* and the *os hyoides*. Their arteries, veins, and *ductus ſalivares*, are formed by the joint-union of ſeveral branches under the *digaſtrick* muſcle. —— The *ſaliva*, filtrated through theſe glands, is taken up by thoſe ſalivary ducts, which unload it in the mouth, under the tip of the *tongue* upon the two ſides of the *frænum*, by the lower fore-teeth.——This *ſaliva* acts the part of the firſt diſſolver of the aliment.

The next ſubject of enquiry in the diſſection of the *human body*, after this hiſtorical demonſtration upon the TRUNK and *all* its *parts*, is a plain deſcription of the EXTREMITIES compriſed in the *four limbs*. But as their parts, except ſuch as have been particularly demonſtrated in *Oſteology* (ſee page 50.) are almoſt entirely *muſculous*, ſuch deſcription will be moſt properly conceived under that part of ANATOMY called *Myology*. So that we ſhall proceed with a general hiſtory of the *muſcles* and of their motions.

Of MYOLOGY.

MYOLOGY (Gr. μυς, μυος a *muſcle*, and λογος *treatiſe*) is a deſcription of the *muſcles*.

The MUSCLE contains many thin parallel plates, divided into a great number of *faſciculi*, or little *muſcles*, each incloſed in its proper membrane; from the internal ſurface whereof, paſs an infinite number of tranſverſe filaments, interſecting the muſcles into ſeveral diſtinct *areas*, filled with their reſpective *faſciculi* or fibres.

A *muſcle* is uſually divided into *head* and *tail*, two *tendons*, at the two extremes of the *muſcle*; the firſt fixed to the ſtable part; the latter to the part intended to be moved.

And into the *venter*, or *belly*, which is the body of the *muſcle* or a thick fleſhy part, into which are inſerted arteries and nerves; and out of which iſſue veins and *lymphatick* ducts.

All theſe parts of a *muſcle*, the *belly*, and the *tendons* are compoſed of the ſame fibres; their only difference conſiſts in this, that the fibres of the *tendons* are more cloſely and firmly bound together than thoſe of the *belly*, which are more looſe. Hence in the *belly* there is room for a ſufficient quantity of blood to give them an appearance of redneſs; and the whiteneſs of the *tendons* only proceeds from the blood being in ſome meaſure excluded from the tightneſs of their contexture

As the *muſcles* act by having their belly inflated or ſwelled. All the difficulty then, in muſcular motion, is, to aſſign their fabrick and the cauſe of their ſwelling.

Every ſingle *muſcle* may be divided into others ſimilar, though leſs, to a degree of ſubtilty. The laſt, therefore, being ſimilar to the firſt, muſt, in like manner, have its *belly* and *tendons*; which is called a *muſcular fibre*; in an aſſembly of ſeveral whereof a *muſcle* properly conſiſts.

Dr.

Dr. *Boerhaave*, is of opinion that the *muscular fibres* are nothing else but extremely slender expansions of the nerves stript of their integuments, hollow within, and of the figure of a *muscle*, and full of a spirit communicated by the nerve from its origin in the *cerebellum*, by the continual action of the heart.

Of these *fibres* united are formed *fasciculi*, or bundles; which again have their several membranes wherein they are involved, and kept distinct from others. This membrane is extremely slender and porous within, full of oil, which is accumulated in time of rest, and spent in motion, furnished by the arteries; and this oil, in conjunction, with a smooth mucous juice, secreted by small mucilaginous glands, interspersed among these *fasciculi*, serves to lubricate the parts, and preserve the *fasciculi* from fretting on each other.

There are arteries also carried into the *muscles*, in such abundance, and of such contexture, as to create a belief that the whole body of the *muscles* is composed of them.

A Muscle has two sorts of motion, *viz.* contraction and extension; in the first it shortens, and lengthens itself in the second. Hence arise all the different *motions* of the body.

The *motions* are either simple or compound. Those, which tend directly upwards, downwards, forwards, backwards, to the right, or the left, are called *simple*; as performed by one sort of *muscle*; but the motion is compound when several *muscles* act jointly and successively, as when the arm moves quite round.

It is generally believed that the cause of their *motion* proceeds from the *brain*. But we must not think that the animal juice is conveyed from the *brain* to the *muscles*, at the same time, that the soul wills the motion; for the motion follows so close upon the resolution of the will, that the juice cannot go so far in that time. But the case lies here; the *nerves* are so many conduits full of animal juice; and when the soul resolves to move any *muscle*, the *fibres* of the *brain* press gently upon the *extremity* of the *nerves*; this compression forwards the animal juice, with which the *nerve* is filled, and obliges it to march through the *muscles*; where mixing with the blood, never wanting in such places, it makes an ebullition, which is followed by an intumescence or swelling.

Dr. *Boerhaave* finding all that's requisite in the nervous juice, for the motion of the *muscles*, makes no scruple to attribute the whole business to it alone; for says he,

Suppose the *spirit* from any cause to be moved more swiftly from the origin of some one nerve than through the rest; the *influx* will be here greater into the *muscular fibre* open to this nerve than into another: This will therefore be more dilated; and the other *phænomena*, mentioned above, will succeed. The same cause continuing, the effect will be increased, so that in a moment the whole will be swelled up; and while the same determination lasts, will remain contracted; and this obtaining in an infinite number of *fibrillæ* at once, the whole *muscle* will be inflated.

Hence it necessarily follows, that as the celerity is increased in one nerve, the motion will be less in another; this therefore being relaxed, the effort in contraction will be stronger; for which reason all the *turgid fibres* of a *muscle* will compress the intermediate place and blood, with a great force; whence the veins will be emptied, and the arteries, being compressed, will repel the grosser, that is the red parts of the blood, but will drive the more subtile parts, by the force of the heart, and their own into the most minute canals; thus the *cruor* being expelled, the whole body of the muscle will be found to act by a subtile humour, concurring from the nerves and arteries.

All the *phænomena* are accounted for in this manner without any other assumption than an *accelerating force* in the origin of the nerves; which is common to all *hypotheses*, and cannot be traced any further.

Dr. *Lower* and Mr. *Cowper*, and after them Dr. *Morgan* and others of the latest authors on that subject, setting aside all adventitious fluids, account for *muscular motion*, from the *intrinsick elasticity* of the nervous *fibrillæ*, contracting and restoring themselves against the stretching force of the circulating blood.

All the *muscles* employed in the same motion are called *congeneres*; and those which perform opposite motion *antagonistæ*.

From the definition of a muscle it appears that nothing can be more difficult than to ascertain the number of the musculary parts in the human body: it may be proper to mention nevertheless, that some writers have aimed at their numeration: and some have fixed the number at 529. But it is not fit for us to attempt to circumscribe a division, which may be divided into similars to a degree of subtility that exceeds all imagination. Let it therefore suffice to be acquainted with the parts or muscles contained in the following *Analysis*.

The Muscles of the Lower Jaw, with which we shall enter upon this demonstration, are

1st, The *Crotophites* (A) which proceed from the *coronal*, *parietal* and *petrosum*, and is inserted by a nervous tendon in the *corona* of the lower jaw.

N. B. Its nerves come from the 3d and 5th pair:

the arteries from the *carotides*, and the veins empty themſelves into the *jugulares*.

2. The *Pterygoides exterior* (B) which proceeds from the pterygoides proceſs, and are inſerted in the interſtice betwixt the head and *corona* of the lower jaw.

3. The *Maſſeter* (D) which proceeds from the cheek-bone, and the lower part of the *zygoma*, and is inſerted in the external corner and middle of the jaw.

4. The *Pterygoides interior* (C) which proceeds from the inner part of the *Pterygoides* proceſs to the internal part of the corner of the lower jaw.

5. The *Cutaneus* (F) proceeding from the upper part of the *ſternum*, *clavicula* and *acromium*, is inſerted in the external part of the baſis of the lower jaw. And

6. The *Digaſtrius* (G) which proceeds from a *fiſſure*, between the *os occipitis* and the *maſtoides* proceſs, and fixes in the lower and inner part of the chin.

N. B. Each of theſe muſcles have ſomewhat remarkable.—The *crotophites* is knit to the outſide of the *corona*; and when wounded brings on convulſions and ſometimes death. — The *pterygoides exterior* is knit to the inſide: — The *maſſeter* to the outſide corner of the jaw, and the *pterygoides interior* to the inſide.

Theſe four muſcles aſſiſt jointly in the action of chewing, by drawing the jaws together. And it is the office of the *cutaneus* and *digaſtrius* to open or pull down the lower jaw.

The MUSCLES of the OS HYOIDES are

1. The *Geniohyoideus* (AA) proceeding from the lower and inner part of the chin, to be inſerted in the upper part of the *baſis* of the *os hyoides*: which it pulls down.

2. The *Mylohyoideus* (BB) which proceeds from the inner part of the ſide of the lower jaw near the grinders, is inſerted in the lateral part of the *os hyoides*, which it pulls both upwards and ſideways.

3. The *Stylohyoideus* (CC) proceeding from the extremity of the *ſtylohyoides* proceſs, to be inſerted in its *cornu*, which it draws aſide.

4. The *Caorcohyoideus* (DD) which proceeds from the *caracoides* proceſs of the ſhoulder blade, and is inſerted in the lower and lateral part of the baſis of the *hyoides*, which it draws obliquely downwards.

5. The *Sternohyoideus* (EE) which proceeds from the inner part of the firſt bone of the *ſternum* to the *baſis* of the *os hyoides*, which it pulls down.

N. B. There are five of theſe muſcles on each ſide of the *os hyoides*. They keep it ſecure in its ſituation, and facilitate the action of *ſwallowing*.

The MUSCLES of the HEAD are,

1. The *Sterno-Clinomaſtoideus* (F) proceeding from the upper and lateral part of the firſt bone of the *ſternum* and middle of the *clavicula*, and inſerted in the upper part of the proceſs *maſtoides*. By this we bow the head, and make what is called a *nod*.

2. The *Splenicus* (G) proceeding from the tops of the ſpinal proceſſes of the five uppermoſt *vertebræ* of the back and three lowermoſt of the neck, and inſerted in the back and lateral part of the *occiput*.

3. The *Complexus* (H) paſſes from the tranſverſe proceſſes of the *vertebræ* to the hinder and middle part of the *occiput*. *N. B.* This and the *ſplenicus* croſs each other.

4. The *Rectus major* (I) proceeds from the extremity of the acute proceſs of the 2d *vertebra* of the *neck*, and is inſerted in the *occiput*.

5. The *Rectus minor* (K) paſſes from the 1ſt *vertebra* of the *neck* into the *occiput*.

6. The *obliquus major* (L) riſes in the ſpine of the 2d *vertebra* of the *neck*, and ends obliquely in the tranſverſe proceſs of the firſt.

7. The *obliquus minor* (M) proceeds from the *occiput*, and is inſerted obliquely in the tranverſe proceſs of the firſt *vertebra*, at the ſame place with the former.

Obſerve: There are theſe ſeven *muſcles* on each ſide of the head: four of which are employed to raiſe the head: and only one to pull it down. Which diſparity is occaſioned by the backward ſituation of the *vertebræ* of the neck. This ſerving as an *axis* or pivot for the head to turn upon, the head falls naturally forward by its own weight; one muſcle is ſufficient to bow it: but it is work enough for four to hold it upright. *Note* alſo, that, as the head moves, not on the firſt, but upon the ſecond *vertebra*, which has a tooth-like proceſs, round which the firſt *vertebra* turns, as a wheel round its *axis*, the two *oblique* muſcles make the head perform a ſemicircular motion.

The MUSCLES of the NECK are,

1. The *Scalenus* (N) from the upper part of the firſt rib, and the *clavicula*, to the extremities of the tranſverſe proceſſes of the three and four uppermoſt *vertebræ* of the *neck*.

2. The *Longus* or *Rectus* (O) from the lateral part of the body of the four upper *vertebræ* of the back

back to the body of the upper *vertebra* of the *neck* or to the *occiput*.

3. The *Spinosus* (P) from the *spinosus* processes of the fourth and fifth uppermost *vert.bræ* of the *back* to all the spines of the six *vertebræ* of the *neck*, which this impulse serves to extend.

4. The *Transversus* (Q) from the transverse processes of the five upper *vertebræ* of the *back* to the extremity of the third and fourth uppermost *vertebræ* of the *neck*, which it extends.

Where *Note*, that these four muscles are so many on each side of the *neck*: that two of these *muscles* serve to bend, and two to stretch the *neck*: that when they *all* act together, they keep the neck strait and steady: and that the head is bent to one shoulder by an *inflexor* and an *extensor*, acting in concert.

In the interstices of the muscles are fourteen glands united by membranes and vessels, resembling the *maxillares* in substance: whose office is to separate the lymph carried off by the lymphatic vessels of all the muscles.

The Muscles of the Shoulder-Blade are,

1. The *Trapezium* (P) from the hard part of the *occiput* from the *spinæ* of the six lower *vertebræ* of the *neck*, and the nine uppermost of the *back*, to the whole *spine* of the *shoulder-blade*, and to the external part of the *claviculæ*.

2. The *Rhomboides* (Q) from the *spine* of the three lower *vertebræ* of the *neck*, and the three upper *vertebræ* of the *back*, to the whole basis of the *scapula*: which it pulls back.

3. The *Levator proprius* (R) proceeds, by different heads, from the transverse process of the four upper *vertebræ* of the neck, to the upper angle of the *scapula*; which it draws up.

4. The *Pectoralis minor* (S) proceeds by way of digitation, from the second, third and fourth upper ribs of the *thorax*, to the *carocoides* process of the *scapula*: which it pulls forward.

Besides you are to take notice that the *shoulder-blade* is assisted in its motion, in some degree, by the muscles *latissimus* and *profundus*: for, though it is manifest, that nature designed them for the arm, they are fastened, in their passage, upon the *shoulder-blade*.

The Superior Limb is divided into the *arm*, *cubitus* and *hand*.

The Arm, which is the part between the *shoulder* and the *elbow*, is cloathed with these muscles.

1. The *Deltoides* (I) so called from its resemblance to a *Greek* Δ, proceeding from the *clavicula*, the *acromium* and the whole spine of the shoulder-blade, is inserted with a strong tendon almost in the middle of the arm; and compounded of twelve simple muscles.

2. The *Supraspinatus* (V) from the external part of the *base* of the *shoulder-blade*, and is inserted under the neck of the shoulder-bone. It encompasses the arm with a broad tendon, and moves upwards.

3. The *Latissimus* (X) proceeding from the three of the four lower *vertebræ* of the loins, from the spine of the *os sacrum*, the hinder part of the *os ilium*, and the outward part of the lower short rib; is inserted in the upper and inward part of the shoulder-bone, which it pulls downwards.

4. The *Rotundus major* (Y) proceeds from the outward part of the lower angle of the *scapula*, and is inserted with the *latissimus* for the same use.

5. The *Pectoral major* (Z) proceeds from the middle of the *clavicula* upon the side that faces the *sternum*, and from the lateral and middle part of the *sternum*, is inserted by a short tendon in the upper and fore part of the shoulder-bone, and moves the arm forward.

6. The *Carocoides* (1) from the *carocoides* process of the *scapula*; is inserted in the middle and inner part of the shoulder-bone; moves the arm forwards, and is perforated to give way to the nerves that repair to the muscles of the *cubitus*.

7. The *Subspinatus* (2) from the outer part of the base of the *scapula* to the upper back part of the shoulder-bone, which it draws back.

8. The *Rotundus minor* (3) proceeding from the lower side of the *scapula*, near to the foremost corner to the hinder and upper part of the shoulder-bone, which it moves backwards.

9. The *Subscapularis* (4) proceeding from the inner *labium* of the base of the *scapula*, is inserted in the inner and upper part of the shoulder-bone, which it draws close up to the ribs.

Where *Note*, that the *arm* performs five sorts of motions: *viz.* two muscles draw it upwards; two downwards; two forwards; two backwards: the *scapularis* draws it into the side of the body: and it moves round by the alternate actions of the other eight muscles.

The Cubitus is divided into the *ulna* and *radius*.

The Ulna is moved by the following muscles, *viz.*

1. The *Biceps* (4) which proceeds from the *Carocoides* process, and from the upper part of the cartilaginous edge of the *glenoides* cavity of the *scapula*, is inserted by one tendon in a knob at the upper and inner part of the *radius*, and moves the elbow.

2. The *Brachiæus internus* (5) from the inner and upper part of the shoulder-bone, is inserted in the upper and inner part of the *ulna*, and together with the *biceps* bows the *cubitus*.

3. The *Longus* (6) from the upper part of the *scapula*, near its neck, is inserted by a strong tendon in the *olecranum*.

4. The *Brevis* (7) from the upper and hinder parts of the *humerus* to the *olecranum*.

5. The *Brachiæus externus* (8) from the hinder part of the *humerus*, and is inserted in the same place and manner as the two last named muscles.

6. The *Anconæus* (9) proceeds from the lower part of the *condylus*, and is inserted by a tendon in the lateral part and back of the *ulna*, about two or three fingers breadth under the elbow.

Observe, that the *ulna* has only an extending motion and a *bending* motion. The first kind is effected by the means of the four latter muscles: the second by the two first muscles.

The RADIUS is moved by four muscles, *viz.*

1. The *Rotundus* (10) which proceeds by a carnous head from the internal process of the shoulder-bone, and is inserted obliquely by a membranous tendon upon the outside of the *radius*, a little below the middle.

2. The *Quadratus* (11) from the lower and almost external part of the *ulna*, is inserted in the lower and external part of the *radius*.

3. The *Longus* (12) proceeds from about three or four fingers breadth above the outer process of the shoulder-bone to the inner part of its lower process.

4. The *Brevis* (13) from the lower part of the lower and external *condylus* of the shoulder-bone, is inserted in the upper and fore part of the *radius*.

Observe, that the first and second are named *pronatores*, whereby the palm of the hand is moved downwards: and that the third and fourth are named *supinatores*, because they turn it upwards.

The HAND is the *third* part of the upper limb or extremity. It begins at the articulation of the *wrist*, and terminates at the finger-ends. — Its inner part is called the *palm*: the outward is called the *back* of the hand; and it is divided into the *carpus*, *metacarpus* and *digiti*.

The CARPUS or *wrist* contains six muscles, *viz.*

1. The *Cubitus externus* (14) proceeding from the lower and inner *condylus* of the shoulder-bone, is inserted by a thick tendon in the small bone of the *carpus*, that lies above the rest.

2. The *Radicus internus* (15) proceeding from the lower and inner *condylus* of the shoulder bone, is inserted in the first bone of the *carpus* that supports the *thumb*.

3. The *Palmaris* (16) proceeding from the same place is inserted in the skin of the *palm* of the *hand*.

4. The *Cubitus externus* (17) proceeding from the hind part of the *ulna* is inserted in the upper and external part of the bone of the *metacarpus*, that supports the *little finger*.

5. The *Longus* (18) proceeding from the inner part of the shoulder-bone, is inserted in that bone of the *carpus*, which supports the *fore-finger*.

6. The *Brevis* (19) proceeds from the lowest part of the shoulder-bone, and is inserted in the bone of the *carpus*, which supports the *middle finger*.

Note, Here also are *two* distinct motions performed: the three first muscles are named *flexores*, because they serve to bend: and the other three called *extenders*, because they serve to extend the *wrist*.

Here also is a ligament called *annular*, which bracing the wrist joins the two bones of the *cubitus*, and keeps fast all the tendons of the muscles, and prevents their slipping out of their place, when in action.

At the root of the hand, under the *mons veneris*, is a square muscular lump of flesh, which begins at the *thenar* and ends in the eighth bone of the *carpus*, and is said to serve to make the hollow of the hand, by drawing the fleshy part that lies under the little finger towards the *thenar*.

The FINGERS contain *three and twenty* muscles; of which thirteen are *common*, so called because they serve *all the fingers*, viz.

1. The *Sublimis* (20) which proceeds from the inner part of the lower and inner *condylus* of the shoulder-bone; is inserted in the second row of the four fingers, being fastened in its passage to those of the first, and is divided into four tendons.

2. The *Profundus* (21) proceeding from the upper and inner part of the *ulna* and *radius*, is inserted in the third row of the bones of the fingers, and divides also into four tendons.

3. The *extensor communis major* (22) proceeding from the hinder of the outward and lower *condylus* of the shoulder-bone, is inserted in the second and third phalanx, and before it arrives at the wrist, divides into four flat membranous tendons.

4, 5, 6 and 7. The four *Lumbricales* proceeding from the tendons of the *profundus*, and the *annular* liga-

ligament, are inſerted in the ſecond articulation of the fingers, to pull them down.

8, 9, 10. The three *oſſei interni* proceeding from the upper part of the interſtices between the four bones of the *metacarpus*, are inſerted in the lateral part of the bones of the fingers to move them downwards, and join their tendons with the *lumbricales*.

11, 12, 13. The *oſſei externi* proceeding from the ſame place are inſerted in the laſt articulation of the finger-bones.

Obſerve, that the true action of the hand is performed by the *ſublimis* and the *profundus*, which is the reaſon of their great ſtrength. Beſides the tendons of the *ſublimis* are perforated by thoſe of the *rotundus*, to give a ſtrong and circular flexion to the fingers.

Thoſe tendons are incloſed in a long, ſtrong membranous ſheath, which prevents their flying off in any motion, and contains an oily fat humour to moiſten them.

The tendons of the *extenſor communis major* are flat to prevent any diſproportion in the back of the hand, thro' which they paſs. And there is but one *extenſor* for two *benders*; becauſe the ſtrength of the hand conſiſts in its flexion.

The other muſcles are called *proper*, becauſe they are peculiarly adapted part to the *thumb*, part to the *fore-finger*, and part to the *little-finger*.

The Thumb has *five* peculiar *muſcles*, viz.

1. The *flectens proprius* (23) proceeding from the upper and inner part of the *radius*, is inſerted in the firſt and ſecond bone of the *thumb*, which it bends.

2. The *Longus* (24) proceeding from the upper and outer part of the *ulna*, is inſerted in the ſecond bone of the *thumb*, which it ſtretches by a forked tendon.

3. The *Brevis* (25) proceeeding from the ſame place is inſerted in the third bone of the *thumb* for the ſame uſe.

4. The *Thenar* (26) proceeding from the firſt bone of the *wriſt* and the *annular* ligament, is inſerted in the ſecond articulation of the *thumb*, and moves it from the other fingers.

5. The *Antithenar* (27) proceeding from the bone of the *metacarpus*, that ſupports the middle finger, is inſerted in the firſt bone of the *thumb*, and pulls it towards the fingers.

The Forefinger has *three* muſcles, *viz.*

1. The *indicator* (28) proceeding from the middling and hinder part of the *ulna*, is inſerted in the ſecond phalanx of the *index* or *forefinger*, and in the tendons of the *extenſor major* by a double tendon.

2. The *indicis adductor* proceeding from the fore part of the firſt bone of the *thumb*, is inſerted in the firſt bone of the *fore finger*, to draw it towards the *thumb*.

3. The *indicis abductor* proceeding from the outward and middle part of the *ulna*, is inſerted in the lateral and outer part of the bones of the *index*, to bend it towards the other fingers.

The Little-finger has *two* muſcles, *viz.*

1. The *extenſor proprius* (29) proceeding from the lower part of the outward *condylus* of the ſhoulder bone, is inſerted by a double tendon in the ſecond articulation of the *little finger*, to aſſiſt the *extenſor communis* in the ſtretching out of the *little finger*.

2. The *hypothenar* proceeding from the little bone of the *carpus*, that lies above the reſt, is inſerted on the outſide of the firſt bone of the little finger, which it pulls away from the reſt.

The next ſubject to be examined is the Arm, in regard to the nerves, arteries, and veins it contains.

We have obſerved already, that the nerves proceed from the *medulla oblongata*, and the *medulla ſpinalis*. The *firſt* ſends forth ten pair of nerves, which we have ſeen; and the *ſecond* thirty more, which we are to ſee.

Of the thirty pair which proceed from the *ſpinal* marrow, ſeven belong to the neck, twelve to the back, five to the loins, and ſix to the *os ſacrum*.

The firſt pair of the *cervical nerves* ariſe between the firſt and ſecond *vertebra* of the *neck*, and contrary to the reſt comes out before and behind; whereas the other ſix pair come out laterally from the junctures of the *vertebræ*, thro' particular perforations near the tranſverſe *proceſſes*. — They go to the muſcles of the head and ears.

The ſecond pair contributes the main branch towards the formation of the *diaphragmatick nerves*, which, ſpring only from the fourth and fixth pair.

The three laſt pair of the *neck*, joining with the two firſt of the *dorſum*, or *thorax*, make the *brachial nerves*.

Theſe *brachial nerves* are ſix, which range all over the arm to the very fingers ends.

(32) The firſt, which is the uppermoſt, and leaſt, is ſpent upon the *deltoides* muſcles and the ſkin of the arm.

(33)

(33) The ſecond is larger, and paſſes through the middle of the arm. It detaches branches to the *biceps* and the *ſupinator*; and, when it arrives at the cubit, divides it into three branches, the firſt of which marches by the outer part of the arm to the *thumb*; the ſecond deſcends obliquely to the *wriſt*; and the third keeping company with the *baſilica*, runs to its period in the ſkin of the *cubitus* and the *hand*.

(34) The third joins the ſecond under the *biceps*, furniſh the muſcles called *brachiales*, with ſome of its branches, the *thumb*, *fore-finger*, and *middle-finger*, with ſmall twigs, and is ſpent upon the benders of the fingers.

(35) The fourth, which is the greateſt of all, lies very deep in the *arm*, and accompanies the artery and vein, called the *baſilica*. It diſpenſes ſhoots to the external muſcle of the *cubitus*, and the ſkin of the inſide of the *arm*; but as ſoon as it arrives at the elbow, it ſlits into two branches, one of which glides along the *radius*, and the other the *ulna*. — The firſt of theſe ſends out five branches, two of which repair to the *thumb*, two to the fore-finger, and the fifth to the middle-finger. —— The other branch diſpatches twigs to the extenders of the fingers, and then is loſt in the wriſt.

(36) The fifth joins in with the fourth, and deſcending along the inner part of the arm, diſtributes branches upon the *ulna*; thence it comes to paſs, that when one leans upon any of theſe branches, the arm is benumbed.

Then it is divided into two branches, one of which viſits the benders of the fingers and the wriſts, and looſe the remainder in the ſame quarter with the former; the other creeps along the inner and lateral ſide of the *arm*, in order to ſend two branches to the *little-finger*, two to the *ring-finger*, and one to the *middle-finger*.

(37) The ſixth, almoſt all over cutaneous, deſcends along the inner part of the *arm*, in company with the *baſilica*, and is loſt in the ſkin of the elbow, and *cubitus*.

The *arms* are alſo provided with arteries and veins. —— The *arteries* have their origin from the aſcending great artery, which divides itſelf into the right and left *ſubclavian*, which paſſing through the chink that lies between the two heads of the *ſcalenum* muſcle, proceeds to the *arm*; and at the arm-pits, is called *axillary artery*, which paſſing under the head of the ſhoulder-bone, is loſt between the two extenders of the *cubitus*.

The trunk itſelf continuing its deſcent along the inner part of the *arm*, diſpenſes branches to the *biceps*, and the *brachiæus internus* and *externus*, and above the bending of the elbow ſends out a twig, which is loſt in the inner, and back part of inner and lower part of the arm.

(40) At the bending of the elbow this arterious trunk ſplits into two branches, one *internal*, and the other *external*.

(41) The *external* creeps along the *radius*, and ſhoots forth a branch, which re-aſcends, and comes to a period between the *ſupinator longus* and *brachiæus internus*. In its deſcent it diſtributes branches to the benders of the wriſt and fingers. At the wriſt it affords a branch to the head of the *thenar*; which is the artery we meet with when we feel the pulſe. After that it ſlides under the tendon of the extender of the thumb, and having beſtowed branches on the outſide of the *hand*, terminates into two ſhoots, one of which runs to the thumb, and the other to the fore-finger.

We muſt trace the *veins* in a different manner from the *arteries*; for as the *arteries* import the blood from the heart to the circumference, ſo the *veins* export it from the circumference to the heart; thereſore they have both a different origin: The *arteries* of the *arm* proceeding like thoſe of the other parts from the heart; and the *veins* of the *arm* from the extremities of the fingers, like the roots of a tree, which by their ſmalleſt ſtrings receive the ſap, in order to convey it to the bigger roots, and from thence to the trunk itſelf.

The *cephalica*, *baſilica* and *mediana*, are the three conſiderable veins of the *arm*, formed from ſeveral branches of *veins* proceeding from the five fingers.

(44) The CEPHALICK conſiſts of ſome ſmall branches, which form a vein between the little and the ring-finger, called *ſalvatella*. It lies between the ſkin and the muſcles, and is divided into two branches, *external* and *internal*. The external goes down to the wriſt, where it joins the *baſilica*, and turns up to the back of the hand. The internal branch, together with a ſprig of the *baſilica*, makes the *mediana*.

N. B. It is thus called, in regard the antients uſed to open it in the diſorders of the *head*; from a miſtaken notion, that it had a nearer concern with the *head* than any of the other veins.

(45) All the little veins which ſpring from the five fingers to the *hand*, form that great *vein* which runs the whole length of the arm, and is called BASILICA, from its being ſeated almoſt on its *baſis*. —— The *baſilica* is divided into three great branches, one of which is uſually opened when we are blooded in the arm, as being the more ſuperficial and apparent. —— The other is deeper, and conſiſts of two branches, one directing its courſe to the inner part of the hand, and the other to the outer. —— The third is the *cubitalis*, which

lies nearest the *os cubiti*. —— These three branches ascend towards the arm, and in the way receive a vein from the *median*, after which they slip under the tendon of the *pectoral* muscle, and unload in the *axillary* vein.

From a branch, which arises between the *thumb* and the *fore-finger*, joined to another that springs between the *middle* and the *ring-finger*, is formed a large vein, which ascends along the middle of the arm to the bending of the *elbow*, called the Mediana, which afterwards divides itself into two branches in the form of an Y, one of which terminates in the *cephalica* and the *basilica*, where it is lost; while the *cephalica* and *basilica* continue their course to the *axillary*, where they unload theselves; the *axillary* into the *subclavian*, and the *subclavian* into the *cava*.

The Thorax or Breast also has its peculiar muscles; *thirty* serve to *dilate* it, and *twenty-six* to contract it.

The *dilating* muscles are *fifteen* on each side, and known by the names of

1. The *subclavian* (AA) which proceeds from the inner and lower part of *clavicula*, is inserted in the upper part of the first rib, which it pulls upwards and outwards.

2. The *serratus major* (BB) proceeding from the inner base of the shoulder-blade, is inserted by digitation in the five lowermost long ribs, and the two uppermost short ribs, to pull them out and delate the *breast*.

3. The *serratus posterior* and *superior* (CC) proceeding in a broad tendon from the acute processes of the lowermost *vertebræ* of the *neck*, and from the first of the *loins*, is inserted in four points in the lowermost ribs, to pull them down and outward.

4. The *intercostales externi* (EE) proceeding from the lower and outer part of each upper rib, is inserted obliquely from behind forwards in the upper and outward part of each of the lower ribs, which they pull backwards and outwards, to promote the dilatation,

5. The *triangularis* (F) proceeding from the lower part of the *sternum*, on which it lies is inserted in the cartilages of the upper rib, reaching to the twelfth, to draw the ribs downwards, and to contract the breast.

6. The *sacro lumbaris* (GG) proceeding from the outer part of the *os sacrum*, and the *spinæ* of the *vertebræ* of the loins, is inserted in the back parts of the ribs, near the root, gives two tendons to each rib, one on the outside, the other on the inside, by which it contracts the breast.

Note, That there are two *serrati posteriores*, eleven *intercostales externi*, and eleven *intercostales interni*.

Besides we are to include the diaphragm, which being employed indifferently in both motions makes the fifty-seventh muscle in the *thorax*.

Some modern *anatomists* are of opinion that the internal and external *intercostals*; make but one muscle, which has two plans of fibres with contrary directions.

The action of these *muscles* is effected in this manner. When the internal air is pressed by the external, the diaphragm, being forced thereby to dilate itself, the dilating muscles are also in action; and when that air, after having passed through the lungs, is forced to sally out, the diaphragm contracts itself, as well as the muscles *antagonists* to those that acted before; though some of our modern Anatomists believe, that it is not the air that causes the dilatation, or contraction of the *muscles* of the *thorax*, but the dilatation and contraction of those *muscles* that procure the ingress and egress of the air, into or out of the breast.

(H) The *diaphragm*, which is the principal organ of the respiration, also called *septum transversum*, is a nervous *muscle*, separating the breast or *thorax* from the *abdomen*, or lower venter, and serving as a partition between the natural and vital parts. —— Its figure is round, resembling a ray or thornback. — It consists of two circles, the one membranous, the other fleshy. Though others will have both of them muscular.

The first, or superior circle arises from the *sternum*, and the ends of the last ribs; the second or inferior comes from the *vertebræ* of the loins. The upper is covered a-top with a membrane derived from the *pleura*; and the lower lined at bottom with another from the *peritonæum* (I).

Its situation is oblique, being extended from the cartilage *xiphoides*, by the extremes of the ribs, to the region of the loins.

(L) It is pierced in the middle for the passage of the *vena cava*; and in its lower part for the *œsophagus*; and between the productions of the inferior circle pass the *aorta*, *thoracic duct*, and *vena azygos*.

(MM) It receives two sorts of nerves, one from the *par vagum*, and the other from the interstices of the four lowermost *vertebræ* of the neck. Both the one and the other pass through the cavity of the *thorax*, and being supported by the *mediastinum*, are dispersed in three or four branches all over its substance.

It receives likewise two arteries, called *phrenicæ*, which spring from the trunk of the *aorta*; and two *veins* of the same name, which march to the trunk of the *cava*.

The

The *diaphragm*, in its natural difpofition, is convex on the upper fide towards the breaft, and concave on the lower, towards the *abdomen*. Hence it has two motions, the one of *contraction*, and the other of *relaxation*.

By the *contraction*, or fwelling of the fibres, the *diaphragm* becomes flat on each fide: the confequence of which is, that the cavity of the *breaft* is enlarged to give liberty for the lungs to receive the air in infpiration; and the cavity of the *abdomen* leffened, and confequently the *ftomach* and *inteftines* preffed, for the diftribution of the *chyle*. —— In its *relaxation*, whereby it refumes its natural fituation, the cavity of the *breaft* is diminifhed, and the *lungs* preffed, for the expulfion of the air in expiration.

On the *diaphragm* alfo, in great meafure, depends the action of *coughing*, *fneezing*, *yawning*, *laughing*, the *hiccups*, &c.

The Back and Loins contain the following mufcles in common with each other.

1. The *facer* (P) proceeding from the back part of the *os facrum*, and the back part and upper edge of the *os ilium*, is inferted in the fpines of the *vertebræ* of the back.

2. The *femi-fpinatus* (Q) proceeding from the fpines of the *os facrum*, and from thofe of the *vertebræ* of the *loins*, is inferted obliquely in the tranfverfe proceffes of the *vertebræ* of the back, reaching to the neck.

3. The *triangularis* (R) proceeding from the back part of the *cofta* of the *os ilium*, and the lateral and internal part of the *os facrum*, is inferted in the laft of the fhort ribs, and in all the tranfverfe proceffes of the *vertebræ* of the *loins* with its fellow, to bend the back bone forward.

Obferve, that thefe mufcles are double, one on each fide to ferve for the extenfion, flexion, and bending fideways of the *back* and *loins*, and thefe are the mufcles that give a genteel carriage to the body both of men and women: and when thefe mufcles are injured either by difeafe, accidents, or bad habit or cuftom of bending the body forwards, people grown round fhouldered, and fometimes *bunch-backed*.

The *lower limb* is divided into the *thigh*, the *leg*, and the *foot*.

The Thigh is divided into the forepart, backpart, infide and outfide. The forepart of the lower end is called the *knee*, and the backpart of the *knee* is called the *ham*. In *this* part of the lower limb are included the following mufcles.

1. The *pfoas* (S) proceeding from the tranfverfe proceffes of the lowermoft *vertebra* of the *back*, and the uppermoft part of the loins, is inferted by a ftrong and round tendon in the leffer *trochanter*, feated in the *abdomen*.

2. The *iliacus* (T) proceeding from the whole edge of the inner cavity of the *os ilium* is inferted in the fame manner and place.

3. The *pectineus* (V) proceeding from the firft part of the *os pubis* is inferted in the forepart of the *thigh-bone* under the little *trochanter*.

N. B. Thefe three mufcles make the *thigh* to *bend*.

4. The *glutæus major* (X) proceeding from the lateral part of the *os facrum*, and from the back and outer part of the hip of the *os ilium* is inferted in the bone of the thigh, about the breadth of four fingers under the great *trochanter*.

5. The *glutæus intermedius* (Y) proceeding from the backpart of the tip of the *os ilium* is inferted about three fingers breadth under the great *trochanter*.

6. The *glutæus minor* (Z) proceeding from the deepeft and holloweft part of the external cavity of the *os ilium*, is inferted in a little cavity at the root of the great *trochanter*.

N. B. Thefe three *ftretch* out the *thigh*.

7. The *triceps fuperior* (1) proceeding from the upper and outer part of the *os pubis*, is inferted in the upper part of a line that runs along the infide of the thigh.

8. The *triceps medius* (2) proceeding from the middle of the *os pubis* is inferted in the middle of the line laft mentioned.

9. The *triceps inferior* (3) proceeding from the lower part of the *os pubis* and the lower part of the *os ifchium* is inferted in the lower part of the fame line.

10. The *pyramidales* (4) proceeding from the upper and lateral part of the *os facrum* and the lateral part of the *os ilium*, is inferted in a fmall cavity at the root of the great *trochanter*.

11. The *quadratus* (4) proceeding from the outer and lateral part of the rifing of the *os ifchium*, is inferted in the back and outward part of the great *trochanter*.

12 and 13. The *gemini* proceeding from two little proceffes in the hinder part of the *os ifchium* are inferted in a fmall cavity at the root of the great *trochanter*, feparated by the tendon of the *obturator internus*, and joining with the *quadratus* in opening the thigh.

14. The *obturator internus* proceeding from the whole circumference of the oval foramen of the *os ifchium*, is inferted by a tendon in a fmall cavity at the root of the great *trochanter*.

15. The

15. The *obturator externus* proceeds from the outward circumference of the ſame hole, and is inſerted in the ſame place and manner.

N. B. Theſe two muſcles ſerve for the turning the thighs round.

The Tibia or Leg begins at the knee and ends at its articulations with the *foot*; whoſe prominent ſides are called *malleoli* or *ancles*.

In the part of its lower limb are found the following muſcles, *viz.* 1. The *rectus* (5) proceeding from the fore and lower part of the *os ilium*, is inſerted in the upper and fore part of the *leg*, comes in a tendon and covers the whole part of the *knee-pan* or *rotula*.

2. The *vaſtus internus* (6) proceeding from the inner and upper part of the *femur*, a little below leſſer *trochanter*, is inſerted in the upper and inner part of the *tibia*, marching in a broad tendon.

3. The *vaſtus externus* (7) proceeding from the upper and fore-part of the *thigh-bone*, marches and is inſerted with the foregoing muſcle

4. The *cruralis* (8) proceeding from the foremoſt and upper part of the *thigh* between the *trochanters*, is inſerted as the two laſt mentioned.

N. B. Theſe four muſcles *ſtretch out* the *leg* by pulling it forward.

5. The *Biceps* (9) proceeding from the lower part of the knob of the *os iſchium*, and the outer and middle part of the *thigh*, is inſerted in the upper and back part of the upper appendage of the *perone*.

6, 7. The *ſeminervoſi* (10) proceeding from the knob of the *os iſchium*, are inſerted in the hinder part of the upper *epiphyſis* of the *tibia*.

N. B. Thoſe three *muſcles bend* the *leg* by pulling it backwards.

8. The *longus* (12) proceeding from the upper and fore-part of the ſpine of the *os iſchium*, is inſerted obliquely in the internal and upper part of the *tibia*, and pulls it in.

9, 10. The *graciles* (13) proceeding from the lower and fore-part of the *os pubis*, are inſerted in the upper and inner part of the *tibia*; and ſerve to draw the leg inwards.

11. The *membranoſus* (14) proceeding from the external and lateral part of the lip of the *os ilium*, is inſerted by a broad membrane in the upper and outer part of the *fibula*.

12. The *popliteus* (15) proceeding from the outer and lower knob of the *femur*, is obliquely inſerted in the upper and inner part of the *tibia*.

N. B. Thoſe two muſcles form the abduction of the *leg*, by drawing it to the outſide.

The Foot is that part of the *lower limb*, which extends from the *ancles* to the end of the *toes*. Its upper part is called the *cubitus* or *inſtep*, and the under part is the *ſole of the foot*. Beſides, it is divided, as has been noted under *Oſteology*, into the *tarſus*, *metatarſus*, and *toes*. Each of which parts is aſſiſted in their motions by ſeveral *muſcles*.

In the Foot are thoſe *muſcles*, viz.

1. The *crureus anterior* (16) proceeding from the upper and fore-part of the *tibia*, is inſerted by two tendons, one to the firſt wedge-like bone, and the other to the bone of the *metatarſus*, that ſupports the *great toe*.

2. The *peroneus anterior* (17) proceeding from the outer and middle part of the *perone*, is inſerted on the fore-ſide in the bone of the *metatarſus* that ſupports the *little toe*.

N. B. The two muſcles bend the leg by pulling it forwards.

3, and 4. The *gemelli* (18) proceeding from behind the two lower *condyli* of the thigh-bone, are inſerted by one tendon, and the two following muſcles, in the back and upper part of the *heel-bone*.

N. B. Theſe, with the two following, form the *calf* of the *leg*.

5. The *ſoleus* (19) proceeding from the back and upper part of the *tibia* and *fibula*, is inſerted by a tendon in the *heel-bone*.

6. The *plantaris*, proceeding from the outer knob of the bone of the thigh, is inſerted by a ſlender tendon in the ſame place with the three laſt mentioned muſcles.

7. The *crureus poſterior* (20) proceeding from the back part of the *tibia*, is inſerted in the inner part of the *ſcaphoides* or *navicular bone*.

N. B. This is called the tendon of *Achilles*: becauſe it is ſaid, this warrior died of a wound in that part; which is always very dangerous.

8, and 9. The *peronei poſteriores* (21), the firſt of which proceeds from the upper and very near the fore-part of the *perone*, and is inſerted in the upper and near the external part of the *metatarſus* that ſupports the *great toe*.—The other proceeds from the lowermoſt part of the *perone*, and is inſerted in the bone of the *metatarſus*, that ſupports the *little toe*. They both ſtretch out the foot by pulling it backwards.

Obſerve, that here are but *two flexores* or bendors; but there are *ſeven extenſores*. For which diſparity it is alledged, that the great number of *extenſores* or muſcles that draw the foot back were neceſſary to counterpoiſe the center of gravity, and to keep the body from falling: whereas two are ſufficient to bend the *foot*, which rarely bends too much.

The Toes make the extremity of the *lower limb*, and have *ſixteen common* and *ſix proper* muſcles.

The

The *common* mufcles are thofe, which ferve to the motion of the toes in general, and are,

1. The *extenfor communis* (22) proceeding from the upper and fore-part of the *tibia*, where it joins to the *fibula*, and is inferted by four tendons in the four articulations of the four *toes*, which it extends.

2. The *pidieus* (23) proceeding from the lower part of the *fibula* and *annular* ligament, and being divided with four tendons, is inferted in the outer part of the firft articulation of the four *toes*, to perform their extention.

3. The *fublimis* (24) proceeding from the lower and inner part of the *heel-bone*, and divided into four perforated tendons, is inferted in the uppermoft of the firft rank of the bones of the four *toes*, to bend them.

4. The *profundus* (23) proceeding from the upper and back part of the *tibia*, and the *fibula*, and divided into four tendons, is inferted in the laft row of the bones of the *toes*.

N. B. All thefe *mufcles bend* the four *leaft toes*.

5, 6, 7, 8. The *lumbricales*, proceeding from the tendons of the *profundus*, are inferted in the lateral and inner part of the firft bones of the four *toes*, and form the *fole of the foot*.

9, 10, 11, 12. The *interoffei interni*, proceeding from the bones of the *tarfus*, and the intervals of thofe of the *metatarfus*, along with the *lumbricales*, are inferted in the upper and inner part of the bones of the firft articulation of the four leffer *toes*, which move towards the *great toe*.

13, 14, 15, 16. The *interoffei externi*, proceeding from the upper part of the interftices of the bone of the *inftep*, are inferted in the lateral and external part of the firft bones of the *toes*, which they move from one another by abduction.

The *proper* mufcles are thofe peculiar to the motions of particular *toes*.

Thus the Great Toe has,

1. The *Flexor proprius* (26) which, proceeding from the upper and back part of the *perone*, is inferted in the bone of the firft phalanx, retaining and bending the *great toe*.

2. The *extenfor proprius* (27) which, proceeding from the fore and upper part of the *perone* between the bone and the *fibia*, is inferted in the upper part of the firft bone of the great toe, and bends it.

3. The *Thenar* (28) which, proceeding from the lateral and internal part of the heel-bone, the navacular-bone and the *offa innominata*, is inferted in the upper part of the fecond bone of the *great toe*, and pulls it in.

4. The *Antithenar* (29) which, proceeding from the bone of the *metatarfus*, that fuftains the *little toe*, is inferted in the inner part of the firft joint of the great toe, which it pulls outwards towards the other *toes*.

The Second Toe has only the *abductor* of the *Index* (30) proper to it, which proceeding from the inner part of the firft bone of the *great toe*, is inferted in the bones of the *fecond toe*, to pull it towards the *great toe*.

The Little Toe alfo has only one mufcle, the *hypothenar*, whofe courfe is from the outer part of the bone of the *metatarfus*, which fuftains the *little toe*, to its infertion in the upper and outer part of the bones of the *little toe*, which it draws off from the reft.

Here ends the *hiftorically mechanical* account of the *mufcles*; in which are defcribed their fituation, natures, ufes, procefs and number, *viz.*

MUSCLES

In the *forehead*	2	The *ulna*	12
The *occiput*	2	The *radii*	8
The *eye-lids*	6	The *carpi*, or *wrifts*	12
The *eyes*	12	The *fingers*	48
The *nofe*	7	*Refpiration*	57
The *external ears*	8	The *loins*	6
The *internal ears*	4	The *abdomen*	10
The *lips*	13	The *tefticles*	2
The *tongue*	8	The *bladder*	1
The *uvula*	4	The *yard*	4
The *larynx*	14	The *anus*	3
The *pharynx*	7	The *thighs*	30
The *os hyoides*	10	The *legs*	22
The *lower-jaw*	12	The *feet*	18
The *head*	14	The *toes*	44
The *neck*	8		
The *fhoulder-blades*	8	In all	434
The *arms* or *fhoulder-bones*	18		

To render this treatife of *Anatomy* a perfect one, we fhall finifh with Angiology; which is a defcription of the *nerves*, *arteries*, and *veins* of the *inferior extremity* of the body.

We have feen, already, feven of the thirty pair of nerves, which march out from the fpinal marrow, through the holes of the *vertebræ*, and belong to the *neck*: now we muft difcover thofe that belong to the *back*, *loins*, and *os facrum*.

The twelve pair of nerves, which come from the *vertebræ* of the neck, extend no further than the circumference of the *Thorax*; each of which divide into two branches; the larger whereof are placed before, and the leffer behind.

The

The *fore branches* are distributed into the internal and external *intercostal* muscles, in each of the *interstices* of the ribs; send shoots to the muscles of the *breast*, and to the oblique descending of the *abdomen*.—The *hinder branches* bend back, and are lost in the muscles of the back, and in those, which adhere to the *vertebra*.

Each of the five pair, which proceed from the *vertebræ* of the loins, is likewise divided into a *fore*, and a *hind* branch; distributed partly in the muscles of the *loins* and the *hypogastrium*, and partly in the *thigh*.

Of the six pair of the *os sacrum* (that pair between it and the *vertebræ* of the loins included) none, but the first, marches out by its lateral part; the other five make their way before, and behind; because the articulation of its lateral parts, with the bones of the *ilia*, obstruct its perforation in those places; but it has ten *foramina* before, and ten behind; and of these, five on each side; which give an egress to as many nerves.

The *spinal marrow* terminates in a *nerve*, which is distributed in the skin between the *buttock* and the *anus*, and sends branches to the muscles of the *thighs*, both on the right and left side.

The biggest branches of the three lowermost pair of the *loins*, and those of the four uppermost of the *os sacrum*, joining together in their descent, form four branches of nerves; two of which are no lower than the *thighs*: a third terminates in the *leg*, and a fourth reaches to the *foot*.

The first pair of the nerves of the *thighs* (33) is formed of the third and fourth pair of the *lumbares*; and, passing near the lesser *trochanter*, it is distributed in the skin and muscles of the *thigh*, and in some of those, which move the *leg*.—'Tis quite spent above the *knee*.

The second (34) which springs from the same source, and accompanies the *crural* artery and vein, is distributed to the fore muscle, the skin of the thigh, and the circumference of the knee, and sends out a branch to accompany the *saphana* to the inner ancle, where it sinks.

The third (35) which rises between the fourth and fifth *vertebræ* of the loins, and passes through the *foramen* at the end of the *pubes*, is dispersed in the muscles of the upper part of the *thigh*, the *pudenda*, and the *triceps*, and lost in the skin of the *groin*.

The fourth (36) is formed of the four upper nerves of the *os sacrum*, which together form the *cruralis*; and descends, in an entire body, to the ham, after having passed near the prominence of the *os ischium*. — At the *ham* it divides again into two branches, the outermost thereof runs from the outside of the foot to the muscles of the *perone*, and then turns back to the outer ancle, where it terminates.——The inner branch descends along the *leg* to the muscles of the foot, and after spreading itself upon the inner ancle, is spent upon the sole of the foot, and all the toes; to each of which it dispenses two branches.

As to the *arteries* and *veins* in the *lower limb*; let it be observed that an Artery is a hollow fistulous canal, appointed to receive the blood from the ventricles of the heart, and distribute it to all parts of the body, for the maintenance of heat and life, and the conveyance of the necessary nutriment.

The *arteries* are ordinarily composed of three; the first or outermost, is nervous or tendinous, being a thread of fine blood-vessels, with nerves for nourishing the other coats. The second is *muscular*, and made up of spiral fibres; of which there are more, or fewer *strata*, according to the bigness of the *artery*. These fibres have a strong *elasticity*, by which they contract themselves with force, when the power, by which they have been stretched out, ceases.——The third, and inmost coat is a fine, dense, transparent membrane, which keeps the blood within its channels, which otherwise, upon the dilatation of an *artery*, would easily separate the spiral fibres from one another.—As the arteries grow smaller, these coats grow thinner.

All the *arteries* are conical. They begin with a trunk, and growing less and narrower, end in branches so minute, that they escape the sight, unless assisted with microscopes.

The *coats* of the *arteries* are of a very dense, close, contexture; and the blood not being visible through them, they generally appear white.—The blood proceeding in the vessels from a greater capacity to a less, is thereby somewhat obstructed in its passage; but being forced on by the motion of the heart, it distends the coats, and thereby occasions a *saliant* motion, called the *pulse*.——By this thickness and whiteness of the *arteries*, with the pulsation observed therein, *arteries* are distinguished from *Veins*.

The *pulse* of the *arteries*, as that of the heart, consists of two reciprocal motions, a *systole*, or contraction, and a *diastole*, or dilatation; but they keep opposite times; the *systole* of the one answering to the *diastole* of the other.

All the *arteries* of the body arise in two large trunks from the two ventricles of the heart, *viz.* the *pulmonary artery* from the right ventricle, and the *aorta* from the left.

The Aorta, or *great artery*, after it leaves the heart, divides itself into two large trunks, called the *ascending*, or upper; or *descending*, or lower *trunks*.

The

The *defcending trunk* (for we have already defcribed the afcending one) or *aorta defcendens*, carries the blood to the trunk and the lower parts of the body.

Out of this arife the *bronchial*, *intercoftal*, *cæliac*, *phrenic*, *mefenteric*, *emulgent*, *fpermatic*, *iliac*, *umbilical*, *epigaftric*, *hypogaftric*, *crural*, &c. with their feveral ramifications.

The ARTERIA ILIACA, (37) which is one of thofe great branches of the *aorta defcendens*, changes its name, at its egrefs out of the *abdomen* into that of *arteria cruralis*, upon its arrival into the *thigh*; where it produces three or four branches, which are fpent upon the fkin, and mufcles of the upper and fore part of the *thigh*; but at the diftance of three or four fingers breadth, under the groin, it produces,

1. The MUSCULARIS INTERNA (38) fo called from its fituation in the inner mufcles of the thigh, which fends out four fprigs, one to the *abductores* of the thigh, and to the *triceps*, *biceps*, and *semi-nervofi*, and the *femi-membranofi*; one to the upper part of the *triceps*; the two others to the body of the *triceps*, and to the *gracilis*.——After this, the trunk of the fame *artery* divides into three branches: the firft of which paffing by the end of the third of the *tricipites*, is loft in the *femi-membranofus*; the fecond paffing under the thigh-bone, is fpent in the *vaftus externus*; and the third moving downwards, fends out branches at the end of the third of the *tricipites*, and is loft in the *femi-nervofus*, and the head of the *biceps*.

The MUSCULARIS EXTERNA (39) is the fecond which runs to the outer part of the thigh, and paffing under the *fartorius* and the *gracilis rectus*, fends out branches at the end of the *iliacus*, to the *vaftus externus*, the *cruralis*, and the *membranofus*.

The third fprings from the *cruralis* (40) detaches branches to the *cruralis* and *vaftus externus*, and is loft in the membranes and fat of the thigh.

The *cruralis* (41) in its farther progrefs to the *lower limbs*, furnifhes the adjacent mufcles with feveral branches, paffes near the tendons of the *triceps*, and at its arrival at the ham, fends out little branches to the tail of the mufcles of the hinder part of the thigh, which are loft in the fat.——Below the ham it produces the two *popliteæ*, which embrace the knee, one on the infide, and the other on the outfide; and a little lower the *furales*, which direct their courfe to the *gemelli*; the *foleus*, the *plantaris*, and the *popliteus*; and encompafs the bones of the leg by feveral branches, that terminate there.

Here the *cruralis anterior*, and the *pofterior* (42) begin. The former runs a-crofs the membrane that joins the bones of the leg, and continuing its courfe, difpenfes branches to the *tibæus externus*, and *extenfores* of the *toes*.

The *cruralis pofterior* (43) which is the largeft of the two, divides itfelf into the *primus pofticus*, which difpenfes branches to the *foleus*, *peroneus pofterior*, and the bender of the *great toe*, afcending by the outer ancle, is loft in the upper part of the foot; and the *fecundus pofticus*, which in its defcent fends out fprigs to the *foleus*, the benders of the toes, and the *curcus pofticus*; and then paffing through the cavity of the *fibula*, is divided into two branches, one that paffes under the *thenar* to the great toes, and another between the *brevis*, and the *hypothenar*, under the fole of the foot, and is fpent upon the four other toes.

The VEINS are veffels or canals, which receive the blood from the divers parts of the body, to which the arteries had conveyed it from the heart. They are only a continuation of the capillary arteries, reflected back again towards the heart; and in their progrefs uniting their channels, as they approach the heart, they at laft form three large veins, or trunks, *viz.* the *vena cava defcendens*, which brings the blood back from all the parts above the heart:—— The *afcendens*, which brings the blood back from all the parts below the heart:———And the *porta*, which carries the blood to the liver.

The *anaftomofis*, or inofculation of the *veins* and *arteries*, was firft feen by the microfcope, in the feet, tail, *&c.* of frogs, and other amphibious animals, by *Leewenhoek*; but has fince been obferved in other animals, particularly the *omentum* of a cat, by Mr. *Cowper*.

The *coats* of the *veins* are four, the fame with thofe of the arteries; only the mufcular coat is thin in all the *veins*, as it is in the *capillary* arteries; the preffure of the blood againft the fides of the *veins*, being lefs than againft the fides of the arteries; becaufe the force of the heart is much broke in the *capillaries*.

In the *veins* there is no *pulfe*, becaufe the blood is thrown into them with a continual ftream; and becaufe it moves from a narrow channel into a wider; but they have a *periftaltick* motion, which depends on their mufcular coat.

The capillary *veins* unite with one another, as has been faid of the capillary arteries, only their courfe is directly oppofite; for inftead of a trunk diftributed into branches and capillaries, a *vein* is a trunk, formed out of a concourfe of capillaries.

In all the *veins*, which are perpendicular to the horizon, excepting thofe of the *uterus*, and the *porta*, there are one or more fmall membranes or *valves*, like fo many half thimbles, ftuck to the fides of the *veins*, with their mouth towards the heart, which in the motion of the blood towards the heart, are preffed clofe to the fides of the *vein*; but fhut the *veins* againft any reflux of the blood by that way from the heart, and thereby sustain the weight thereof in the great trunks.

The Veins are distinguished into *upper* and *under descending*, and *ascending*; *right*, as the *mesenterick*; and *left*, as the *splenick* branch; *internal*, as the *basilica*; and *external* as the *humeral*, &c. according to their situation.

One of the principal among the Ascending *veins*, is the *cruralis*, formed by six branches of other *veins*, inserted in that part; the first whereof is,

The Ischiadica Major (45) which proceeds from ten sprigs of *veins*; two whereof come from each *toe*, and form a branch which is joined by another that comes from the *fibula*, and the *heel-bone*; and both *ascending* by the muscles of the *calf* of the *leg*, unload, by a joint stream, in the *cruralis*.

The Suralis (46) is the second, formed by almost all the *veins* that creep along the *foot*, and by those that come from the *calf* of the *leg*.

The third is the Poplitea (47) produced by the sprigs of the *heel*, and part of those of the neck of the *foot*; from whence it *ascends*, passes by the *ham*, and terminates in the *cruralis*.

The Muscular (48) is the fourth, and comprehends the *muscular external*, which proceeds from the *external* muscles of the thigh; and the *internal* from the *internal* muscles.— These two branches enter the *cruralis* opposite to one another.

The Ischiadica Minor (49) and least, the fifth, is produced by several ramifications from the *skin*, and the *muscles* that surround the jointing of the *thigh*.

The longest and biggest of all the *six*, is the Saphæna (50) which begins at some branches from the *great toe*, and by *ascending* by the inner ancle along the leg, and the inner part of the thigh, between the skin and the fleshy membrane, terminates in the *cruralis*; which mounting upwards, and having passed the *groin*, empties itself into the *iliaca*; the *iliaca* into the *cava*, and the *cava* into the *right ventricle* of the *heart*.

Angiology treats likewise of the *lymphatick* vessels; which are small pipes, consisting of a very thin coat, full of *valves*, that open, like those of the *veins*, towards the heart, and shut upon the reverse. —— They have no common cistern, for some of them unload in the *thoracick* duct, and others immediately in the *veins*.——Some proceed from the *viscera*, and others from the glands dispersed all over the body. — Those that spring from the conglobate glands, convey their lymph to the *veins*; and those from the conglomerate disembogue into particular cavities, as the *eyes*, *mouth*, *duodenum*, &c.

The number of these vessels is infinite; but not to be all discerned with the eyes. — Their *lymph* proceeds from the serosities of the blood filtrated in the glands. It is generally clear and transparent; but it changes its colour, in proportion to the tinctures it receives from the *chyle*, the *bile*, and the other humours contained in the blood. — Of itself it is insipid; but sometimes it has been found, acid, bitter, or brackish. —— It fixes and congeals by the mixture of humours, and the dissolution of salts, as well as the *serum* of the blood.

I shall conclude this treatise on Anatomy with a few observations on the *nails* and *hair* of the *human body*. The Nails are hard, round, white and transparent bodies, seated at the ends of the *fingers* and *toes*: and are nothing more but the covers, or sheaths of the *papillæ pyramidales* of the skin, on the extremities of the *fingers* and *toes*, which dry, harden, and lie upon one another.

Their *use* is to strengthen, and defend the end of the fingers, in handling any hard and rugged bodies; that part being extremely sensible, by reason of the great number of nerves, which terminate here, for the sensation of feeling.

The *nails* are formed, and grow after the same manner as the rest of the body; their nourishment they receive from their roots. The Hairs, according to *Malpighi* have *roots* that resemble those of the bulbous heads of tulips; and these roots are nourished by *blood-vessels*, accompanied with *nerves*; so that the *hairs* grow, and sometimes become so big, that they are carnous and sensible of pain, and bleed plentifully when they are cut.

Tho' the *hairs* ordinarily appear round and cylindrical; yet the *microscope* discovers triangular and square ones; which diversity of figures arises from that of the pores, to which the *hairs* always accommodate themselves. Their *length* depends on the quantity of the proper humour to feed them; and their *colour*, on the quality of that humour; whence at different stages of life the colour usually differs.

The antient writers of Anatomy, *Hippocrates*, *Democritus*, *Aristotle*, *Galen*, and others, look upon this as the most important part of physick, and that without which, the uses of the parts of an human fabrick, and consequently the causes of diseases incident thereto. could no way be discovered. And yet this art, useful as it is, was intirely discontinued for several ages; till in the sixteenth century, it began to flourish afresh. —— The dissection of an human body was looked upon as sacrilege before that time; and we have seen a consultation which the Emperor *Charles* V. appointed to be held by the divines of *Salamanca*, in order to be satisfied whether or no it were lawful in point of conscience to dissect diffect a dead carcafe. — We may add, that to this day the ufe of *Anatomy*, and fkeletons is forbid in *Mufcovy*; the firft as inhuman, the latter as fubfervient to witchcraft; and *Olearius* affures us, that one *Quirin*, a *German* furgeon, being found with a fkeleton hardly efcaped with his life; and the fkeleton, after being folemnly dragged about the ftreets, was burnt in form.

ANATOMY is fometimes ufed to denote the *fubject to be anatomized*. Thus (by 32 *Hen*. VIII. *cap*. 42.) the company of *Barbers* and *Surgeons* may have and take yearly, four perfons condemned, adjudged, and put to death for felony, for *Anatomies*; and to make incifion of the fame dead bodies. And by a late act of King *George* II. fince the *Surgeons* have been feparated and made a diftinct company from the *Barbers*, they are intitled to *all the bodies* executed at LONDON for *murder*.

Of ANTIQUITIES.

IT is not to be expected that we fhall be able to give a minute collection of antique pieces. Our province is to treat this ftudy as a *fcience*, and to form our treatife in fuch a manner, as to render it ufeful to the curious fearcher into *Antiquities*, and entertaining to our readers in general.

For this purpofe this fubject fhall be confidered under thefe heads; *temples*; *obelifks*; *pyramids*; *columns* and *pillars*; *amphitheatres*; *circus's* and *fquares*; *maufoleums* or *tombs*; *ftatues*; *fculptures*; *paintings*; *infcriptions*; *hieroglyhics*; *manufcripts*; *medals*; *urns* and *mummies*, in particular; and, in general, other curious pieces that may afford any light into Antiquity.

A TEMPLE, the derivative of the *Latin*, *templum*, from *templare*, to contemplate or meditate, is a place fet apart for the public worfhip of the true GOD, or of the *deities* of the heathens.

Authors differ in their opinions about the firft inftitution of temples. *Apolonius* pays the firft compliment of this kind of building to *Ducalion*, in *Greece*. *Herodotus* and *Strabo*, with more credit, lay the firft foundation of *temples* in *Egypt*; and that they were built for the reception of certain *quadrupeds*, *reptiles*, or *infects* and *fifhes*, worfhipped by the *Egyptians*. And *Clemens Alexandrinus* and *Eufebius* refer us to the fepulchres built for the dead, for the origin of thofe places of prayer or worfhip.

Whatever gave rife to thefe edifices, it is not very material. But authors of the greateft reputation inform us, that they were very early propagated throughout the known world: and that it became a part of the grandeur of civilized nations to excel in thofe ftructures.

Some writers are for confining the name *temple* to places of pagan worfhip and fuperftition. But they muft forget that the houfe built for the worfhip and prefence of the LIVING GOD at *Jerufalem*, is an exception to their opinion. Tho' it muft be granted that this name has almoft univerfally amongft *Chriftians* yielded to that of *church*.

In our enquiries on this fubject, the firft object in view is that very *temple* at *Jerufalem* built by *Solomon*, by the direction of the CREATOR of the univerfe, and for the refidence of his divine *Shechinah*: and which exceeded all other buildings of the kind, as much in its magnificence, furniture, and miniftry, as in the object of their worfhip.

To enter into particulars relating to this *temple* would be only copying from the HOLY BIBLE, which is in every body's hands to perufe at leifure. See 1 KINGS, chap. v. vi. vii. viii. ix. and 1 CHRONICLES, chap. xvii. xxii. xxiii. xxiv. xxv. xxvi. xxviii.. 2 CHRON. chap. ii. iii. iv. v. vi. vii. where you have an account of a building of fixty cubits, or 105 feet long; twenty cubits, or 35 feet broad; thirty cubits, or 52 feet high; with a porch twenty cubits long and ten wide in the fore front or weft end of the *temple*; and three ftories with ftairs up to them round the outfide of the *temple*.

There was alfo a gate on the right fide. The roof was raifed five cubits; and all the timber-work was cedar furnifhed by HIRAM, king of *Tyre*. The walls were of fquare ftones wainfcoted from top to bottom with cedar alfo: and a cedar partition feparated the *fanctuary* from the reft of the temple, adorned with carving, and at the diftance of twenty cubits from the end of the building.

The infide of the fanctuary was covered with plates of gold. The ark ftood in the midft of the fanctuary; over which fpread the wings of two cherubims of olive wood covered with gold, ten cubits high, with wings five cubits long. There were two doors to enter by into this fanctuary.

The porch was adorned with a brafs pillar, JACHIN and BOAZ, eighteen cubits high. In the court was a large brafs bafon five cubits high and ten cubits in diameter, which ftood upon twelve brafs oxen refting on ten bafes, each of which had four wheels: this baſon was called the *brazen ſea.* Beſides which there were ten lavers of braſs, four cubits high, each ſtanding on ten baſes.

The altar for ſacrifices was twenty cubits long, twenty broad, and ten high. The table for ſhew-bread was maſſy gold, on which ſtood five gold candleſticks; as were all the cenſers, veſſels, and inſtruments for ſacrificing. But the kettles, caldrons and baſons were of braſs.

All the work of the temple was made under the inſpection of maſter Hiram, the widow's ſon, and a moſt ſkilful architect, born at *Tyre*.

This *temple* was rivalled by another erected on mount *Garezim*, by the *Samaritan* or *ſchiſmatical Jews*, who erected an altar there in oppoſition to the temple at *Jeruſalem*; and is the firſt inſtance of a *diſſenting* congregation in the church of God. This temple was deſtroyed by *Hyrcanus* the *Aſmonean*.

The *temple* at *Jeruſalem*, which was built by Solomon in the year of the world 2993, before Christ 1012, flouriſhed till the invaſion of *Judea* and its deſtruction by *Nebuchadnezzar*, king of *Babylon*, who in the year of the world 3398, before Christ 606, burnt both this temple and the city.

This temple of the *true* God remained in ruins till *Cyrus* and his ſucceſſor *Artaxerxes Longomannus* gave the *Jews* leave to rebuild it; and it was reſtored accordingly in the year 454 before Christ.

Herod *the Great* (in whoſe reign the Messiah was ſent to abrogate the law of ſacrifices, and to eſtabliſh a ſpiritual worſhip and intercourſe with heaven) found this *ſecond* temple ſo decay'd in its materials, that he pulled it down and rebuilt it in a magnificent manner.

In this temple Jesus Christ was preſented by his parents according to the rites of the *Levitical* law. This is the temple, over which Jesus wept and propheſy'd that it ſhould be ſo deſtroy'd; that one ſtone ſhould not remain upon another; and this is the temple, which was rent from top to bottom by the violent concuſſion of the earth, when the ſun was darkened and the graves opened at the crucifixion of Christ.

Titus, the *Roman* general, in the year 70, after the birth of Christ, put an end both to this temple and to the *Jewiſh* nation. The temple was burnt to the ground in this general cataſtrophe of an abandoned people: and when Julian the apoſtate, in defiance to the prophecy of Jesus againſt them and their temple, attempted to reſtore the *Jewiſh* ſtate, to rebuild *Jeruſalem*, and the temple on its former ſcite, heaven interpoſed, and drove the adventurers and labourers from the work, by throwing fire out of the bowels of the earth, from whence they had dug up every ſtone of the ancient foundation. By which the prophecy of Jesus was fully accompliſhed.

This *temple* ſtood due eaſt and weſt, with the ſeat of devotion in the eaſt, and the chief entrance on the weſt. And from this accident aroſe the cuſtom amongſt the worſhippers of the *true* God, always to build their churches, chapels, and temples in the ſame direction; a few modern examples excepted.

The *Grecians* boaſted much of their *temple* of *Diana* at *Epheſus*, and of *Apollo* at *Delphos*. But we muſt travel to *Rome* for number and variety.

The *Romans* built *temples* not only to their ſupreme deities, but to their virtues, their diſeaſes, their bleſſings, their wants, and to their heroes and emperors, and to ſome of them in their life-time; as may be collected, of *Auguſtus*, from theſe verſes of *Horace*.

Preſenti tibi maturos largimur honores;
Jurandaſque tuum nomen, ponimus aras.
Epiſt. ad Auguſt.

Some remains of theſe ancient edifices are ſtill ſeen.

1. In the *Pantheon*, which till about a year ago, when it fell a ſacrifice to time, was the moſt celebrated, compleat and perfect of them all.

This temple is ſaid to have laid the foundation of its body, during the time of the *Roman* republic, and to have been finiſhed with a portico by *Marcus Agrippa*, about fourteen years after the death of Christ.

It was dedicated to Jupiter and *all the gods*; and thence called the Pantheon; and was of the *Corinthian* order, both within and without. On the frieze of the beautiful *portico* was this inſcription.

M. Agrippa L. F. Cæs. III. Fecit.

In this temple was placed, amongſt other ſtatues of their deities, the celebrated ivory ſtatue of Minerva, by *Phidias*, and the ſtatue of Venus, with a pearl in her ear valued at 250,000 ducats: the half of that ſame pearl, which *Cleopatra* had diſſolved and drank at ſupper to out-do the liberality of *Mark Anthony*.

This Pantheon ſuffered much by age, and was repaired by the emperors *Septimius Severus* and *Marcus Aurelius*. It was firſt conſecrated for *Chriſtian* worſhip by Pope *Boniface*; who dedicated it to the Virgin Mary, and from thence known by the name of St. *Mary Rotunda*, alluding to its circular form.

It received all its light from an opening at top. And the height, from the floor to that opening, was the diameter of its breadth from one wall to another.

Near

Near the trophies of *Marius* ſtands another circular temple erected with a noble portico by *Auguſtus*, in memory of his grand-children *Caius* and *Lucius*. It is commonly called *La Galluce*.

This temple was built of brick. The nave is perfectly circular and divided into ten parts, in each of which is a chapel ſituated within the thickneſs of the wall.

St. MARY's is the ancient temple built by SERVIUS TULLIUS to *Fortuna Virilis*, whoſe ſtatue, which was of gilded wood, is ſaid to have reſiſted the flames, and was preſerved when the temple was on fire. This piece of great antiquity is built of *peperino* covered with *ſtuc*.

St. STEPHEN's is the remains of the temple of VESTA, built by NUMA POMPILIUS. It is alſo circular; and built in the *Corinthian* order.

Near the church of *Santa Maria nova* are to be ſeen the ruins of the temple of PEACE. It was begun by the emperor CLAUDIAN, upon the ſcite of the *Curia* of *Romulus* and *Hoſtilius*, the houſe of *Melius*, the *Baſilica Portia* and the houſe of *Cæſar* demoliſhed by *Auguſtus*.

VESPASIAN (after his return with the trophies of victory taken in the ſacking of *Jeruſalem* and its temple) finiſhed this foundation, ſo as to make it excel all the other temples at *Rome* in magnificence and riches. Here he depoſited all the decorations and veſſels of the temple of *Jeruſalem*; after he had expoſed them in his triumph to public view. And tho' this magnificent ſtructure was deſtroy'd by fire in the reign of COMMODUS, the ſtrength of its walls has tranſmitted to us a ſtrong idea of its priſtine grandeur.

AUGUSTUS erected a temple to MARS the *Avenger*, in memory of the victory obtained by him and *Mark Anthony* at *Philippi* over *Brutus* and *Caſſius*, in revenge of the treacherous murder of *Julius Cæſar*.

The ſituation of this temple added greatly to its magnificence. It had the *Forum* juſt before; into which, they who were honoured with a triumph carried the trophies of their enemies, and other marks of their victories. And their ſtatues were alſo dedicated by *Auguſtus* in its two portico's.

Without, it was a moſt beautiful and ſtupendous fabric. Within, it was particularly adorned with two exquiſite paintings of a *battle*, and of a *triumph*: and with two altars drawn by *Apelles*; the one repreſenting *Caſtor* and *Pollux*; the other, the goddeſs *Victory* and *Alexander* the *Great*.

The remains of this beautiful temple is ſtill to be ſeen near *Torre de Conti*.

AUGUSTUS erected another temple at the foot of the capitol, to *Jupiter* the *Thunderer*, in memory of his deliverance from death by an arrow that paſſed thro' his litter, and killed a ſlave before him; as he was purſuing the *Cantabrian* war in the night.

Between the *Capitol* and mount *Palatin*, ſtood the temple of *Vulcan*, near the *Forum*; on the place where are now three columns of the *Corinthian* order: but thoſe columns are controverted; ſome being of opinion that they are part of a temple dedicated to *Romulus*: others ſay that both thoſe and the columns below the capitol, are part of the bridge made by *Caligula*'s direction, for paſſing the mount to the capitol.

FURIUS CAMILLUS built a temple to CONCORD near to the arch of *Septimius*, at the entrance of the *Forum*, the columns of whoſe portico are ſtill to be ſeen.

This was erected for the debates of public affairs, which were frequently held here. And amongſt other pieces of furniture there was the image of *Latona*, with her children *Apollo* and *Diana* in her arms; the ſtatue of *Æſculapius*, with his daughter *Hyginia* or *Health*: the ſtatues of *Mars*, *Minerva*, *Ceres*, *Mercury*, and that of *Victory*, placed in the front of the portico, and deſtroyed by thunder and lightning in the conſulſhip of *Marcus Marcellus* and *Marcus Valerius*.

It was afterwards deſtroyed by fire, and rebuilt at the expence of the public: as appears by the following inſcription ſtill to be read on the frize.

S. P. Q. R. INCENDIO CONSUMPTUM RESTITUIT.

I ſhall not trouble you with a deſcription of any *Chriſtian temples* or churches; becauſe Architects never allow any of them to be conſidered as pieces of Antiquity. But perhaps I may be admitted to place *Stone Henge*, that wonderful pile of huge ſtones, on the plain, about ſix miles from *Saliſbury*, in the number of ancient temples.

This monument of antiquity, which baffles all our conjectures, conſiſts of the remains of four ranks of rough ſtones, ranged one within another: ſome of them, eſpecially in the outermoſt and third rank, being twenty feet high and ſeven broad, and ſuſtaining others laid acroſs their heads and faſtened by mortiſes, which ſhews that they originally did hang together.

Some have conſidered this to be a temple of the *Druids*: others aſcribe it to the *Romans*, and dedicate it to *Celus*; becauſe it was open at top: while a third party won't allow its antiquity to aſcend higher than the coming in of the *Saxons*; thinking it to be a monument in memory of *Hengiſt*, their firſt general in *England*; or a funeral monument to the memory of the *Britiſh* prince *Aurelius Ambroſius*. *Inigo Jones*, who has given a fine ſcheme of this piece of antiquity, endeavours

to

to fix it to a *Roman* epocha. But Doctor *Langwiſh*, after examining this ſcheme upon the ſpot, declares that tho' he could not reconcile the meaſures with the ſcheme; he is of opinion that it was a temple dedicated to the *ſun* and *moon*.

Obelisks and Pyramids were raiſed by the antients both for ornament and for preſerving the memory of ſome perſon, thing, or event, by inſcriptions carved or cut upon ſome part of them.

A Pyramid, takes its name from πῦρ, and is a ſolid maſſive building, which forms a ſquare, triangular or other baſe, and riſes to a *vertex* or point.

Pyramids are ſometimes uſed to preſerve the memory of ſingular events; and ſometimes to tranſmit to poſterity the glory and magnificence of princes. But as they are eſteemed a ſymbol of immortality, they are moſt commonly uſed as funeral monuments. Such is that of *Ceſtius* at *Rome*, and thoſe other celebrated ones of *Egypt*, as famous for the enormity of their ſize, as their antiquity. Theſe are ſituated on the weſt ſide of the *Nile* almoſt oppoſite to *Grand Cairo*; the baſe of the largeſt covers more than ten acres of ground, and is, according to ſome, near ſeven hundred feet high, tho' others make it ſix hundred, and ſome but little more than five hundred.

The *pyramid* is ſaid to have been, among the *Egyptians*, a ſymbol of human life; the beginning of which is repreſented by the baſe, and the end by the *apex*; on which account it was, that they uſed to erect them over ſepulchres.

An Obelisk in *Greek* ſignifies a *broach*, ſpindle or ſpit; and is a triangular *pyramid*, very ſlender and high. It differs from a *pyramid* only in being cut out of a ſingle ſtone, whereas a *pyramid* is built up with many.

F. Kircher reckons up 14 *obeliſks*, celebrated above the reſt; *viz.* that of *Alexandria*, that of the *Barberini*, thoſe of *Conſtantinople*, of the *Mons Eſquilinus*, of the *Campus Flaminius* of *Florence*, of *Heliopolis*, of *Ludoviſio*, of St. *Mahut*, of the *Medici*, of the *Vatican*, of *Marcus Cælius*, and that of *Pamphilia*. — The firſt *obeliſk* we know of, was that raiſed by *Rameſes*, King of *Egypt*, in the time of the *Trojan* war. It was 40 cubits high, and according to *Herodotus*, employed 20,000 men in the building. — *Phicus*, another King of *Egypt*, raiſed one of 45 cubits; and *Ptolomy Philadelphus* another of 88 cubits, in memory of *Arſinoë*. — Theſe three *obeliſks* are of *porphyry*, and ſtill ſtanding. — *Auguſtus* erected an *obeliſk* at *Rome*, in the *Campus Martius*, which ſerved to mark the hours on an horizontal dial. drawn on the pavement.

This kind of monument, which is very antient, was firſt made uſe of, we are told, to tranſmit to poſterity the principal precepts of philoſophy, which were engraven in hieroglyphical characters thereon. In after times they were uſed to immortaliſe the actions of heroes, and the memory of perſons beloved.

Some of the antients have confined the uſe of Columns and Pillars to tranſmit hiſtories and ſciences to poſterity; and mention the documents of huſbandry engraved by *Piſiſtratus* on ſtone pillars. But this was only one ſort: for we have an account of the hiſtorical, chronological, funeral, inſtructive, itinerary, lactary, legal, limitrophous or boundary, manubiary, memorial, menian, milliary, military, ſtatuary, ſymbolical, triumphal and zoophorick *columns*.

The *hiſtorical columns* were thoſe whoſe ſhafts were adorned with a *baſſo relievo*, running in a ſpiral line its whole length; and containing the hiſtory of ſome great perſonage. Of theſe kind are the *Trajan* and *Antonine columns* to be ſeen ſtill at *Rome*.

That of *Trajan* is of the *Tuſcan* order, though ſomewhat irregular; its height is eight diameters, and its pedeſtal *Corinthian*; it was built in the *forum Romanum*, or *Roman ſquare*. —— Its baſe conſiſts of twelve ſtones of an enormous ſize, and it is raiſed on a ſocle, or foot of eight ſteps. Withinſide is a ſtair-caſe illuminated with forty-four windows. It is 140 foot high, which is 35 foot ſhort of the *Antonine* column; but the workmanſhip of the former is much more valued. It is adorned from top to bottom with *baſſo relievo's*, repreſenting the great actions of that emperor.

The *Antonine* column has 199 ſteps, with 56 windows; and each of theſe is divided by tambours of white marble.

At *Athens* there were *chronological columns*, containing the whole hiſtory of *Greece*, digeſted into *Olympiads*.

The *funeral columns* had ſometimes their ſhafts overſpread with *tears* or *flames*, ſymbols of *grief*, and of *immortality*; and were erected to ſupport an *urn*, incloſing the aſhes of a deceaſed hero.

We do not learn from hiſtorians that there were ever more than two *inſtructive columns*, one, which *Joſephus*, lib. i. cap. 3. pretends to have been erected by the ſons of *Adam*, whereon were engraven the principles of Arts and Sciences; and that by *Piſiſtratus*, abovementioned.

Feſtus informs us, that at *Rome*, in the herb-market, now the place *Montanara*, was erected a column called *lactary*, which had a cavity in its pedeſtal, wherein young children, abandoned by their parents, out of poverty or inhumanity, were expoſed to be brought up at the publick expence.

None but the *Lacedæmonians* have ever erected *legal columns*, whereon were engraven the fundamental laws of their state; and those columns were always erected in publick places, for the better instruction of the people.

Alexander, according to *Pliny*, erected a *limitrophous* or *boundary column* at the extremities of the *Indies* to shew the limits of his conquests; and the *Romans* afterwards followed his example.

The *Romans* were very industrious in erecting *manubiary columns*, built in imitation of trees, and adorned with trophies, whereon they hung the spoils of the enemies.

Suetonius and *Ascanius* refer to one *Menias* for the origin of the *Menian column*, who having sold his house to *Cato* and *Flaccus*, consuls, to be converted into a publick edifice, reserved to himself the right of raising a column without side, to bear a balcony, whence he might see the shews.

Augustus had a column of white marble (the same with that which is now seen on the balustrade of the *Perron* of the capitol at *Rome*) erected in the middle of the *Roman forum*, which was called *milliary*, and from whence, as a centre, the distances of the several cities, *&c.* of the empire, were reckoned by other *milliary columns*, disposed at equal distances on all the grand roads. This column was called *milliarium aureum*, as having been gilt, at least the ball, by order of *Augustus*. —— Its proportion is massive, being a short cylinder, the symbol of the globe of the earth. —— It was restored by the emperors *Vespasian* and *Adrian*; as appears by the inscriptions.

The *Romans* had two sorts of *military columns*, one whereon was engraven a list of the forces of the *Roman* army, ranged by legions in their proper order; with design to preserve the memory of the number of soldiers, and of the order observed in any military expedition. —— And another called *columna bellica*, standing before the temple of *Janus*, (whose gates were always open in time of war, and shut in time of peace) at the foot whereof the consul declared war, by throwing a javelin towards the enemy's country.

The *columns* adorned with the beaks or prows of ships and galleys, with anchors and graplers, erected either in memory of a naval victory, as the *Tuscan column* in the capitol, or in honour of some admiral, were called *rostral columns*.

There was dug up in the temple of *peace*, a flatted column of the *Corinthian order*, whose shaft is a single block of white marble, 49 foot and a half high, and five foot eight inches diameter; which *Paul* V. pope, caused to be erected on a pedestal, before the church of St. *Maria major*, at *Rome*, to support a statue, of gilt brass, of the *virgin Mary*, from whence it is called a *statuary column*, as are all other columns which support a statue.

The *caryatides* and *termini* were also a sort of statuary columns. —— The *caryatides* were, and are still, a kind of order of columns or pilasters, under the figures of women, dressed in long robes, serving to support entablatures. —— *Vitruvius* pretends, that the origin of *caryatides* is owing to the *Greeks* having taken the city of *Caria*, led away their women captives; and to perpetuate their servitude, represented them in their buildings, as charged with burdens, such as those supported by columns.

Termes, or *termini*, (from the *Roman* god *Terminus*, the *protector* of land-marks) was a statue made without hands or feet (that he might not change his place) planted at the bounds of lands to separate them.

The two famous statues of *Pasquin* and *Marforio* at *Rome*, might be ranked among these sorts of statues, since otherwise, I do not know where else to place those two great satyrists, who for several centuries have, by their witty *repartees*, diverted all *Europe*.

Pasquin is a mutilated statue at *Rome*, in a corner of the palace *Ursini*. —— It takes its name from a Cobler of that city, called *Pasquin*, famous for his sneers and gibes; and whose shop was the resort of a number of idle people, who diverted themselves with bantering folks as they passed by. —— After *Pasquin*'s death, as they were digging up the pavement before his shop, they found a statue of an antient *gladiator*, well cut, but maimed, and half-spoiled. This they set up in the place where it was found, at the corner of the deceased master *Pasquin*'s shop; and by consent, called it by the name of the defunct. —— From that time all satires and lampoons are ascribed to this figure, are put in its mouth, or pasted against it; as if they came from *Pasquin Redivivus*.

Pasquin usually addresses himself to *Marforio*, another statue in *Rome*; or *Marforio* to *Pasquin*, whom they made reply. —— The answers are usually very short, poignant, and unlucky: When *Marforio* is attacked, *Pasquin* comes to his assistance; and *Pasquin* is assisted by *Marforio* in his turn, *i. e.* the people make the statues speak just what they please. —— The dialogues between these two statues are called *Pasquinades*.

There was another kind of *statuary columns*, called *zoophoric*, whereon was placed a figure of some animal, as that at *Sienna*, which bears the wolf which suckled *Romulus* and *Remus*; and one of the two columns (though not a piece of antiquity) whereon is the lion of St. *Mark*, and the arms of the republick.

The

The *ſymbolical column* repreſented ſome particular country, by the attributes proper thereto, as the *Corvinian column*, on which was a crow, erected to *Valerius Maximus*, ſurnamed *Corvinus*, in memory of his defeating a giant in the army of the *Gauls*, by the aſſiſtance of a crow.

The *triumphal columns* were erected by the antients in honour of a hero; the joints of the ſtones, or courſes whereof, were covered with as many crowns as he had made different military expeditions. — Each crown had its particular name; as *Vallaris*, which was beſet with ſpikes, in memory of having forced a palliſade. *Muralis*, adorned with little turrets, or battlements (which ſort of crowns have place at preſent in our *blazon)* for having mounted an aſſault. *Navalis*, of prows and beaks of veſſels, for having overcome at ſea. *Obſidionalis*, or *graminalis* of graſs; for having raiſed a ſiege. *Ovans*, of *myrtle*, which expreſſed an ovation or little triumph; and *triumphalis*, of laurel, for a grand triumph. — *Procopius* tells us of a *column* of this kind erected in the place, called *Auguſteum*, before the imperial palace at *Conſtantinople*, ſupporting an equeſtrian ſtatue of the emperor *Juſtinian*.

The Amphitheatres, from the *Greek*, αμφι, about; and θεατρον *theatre*, are another kind of antient publick edifices, of which there are ſtill ſome ſtanding at *Rome*, *Pola*, *Niſmes*, *Douay &c.*

The *amphitheatres* were a ſpacious building of an oval figure, having its *area* or *arena*, encompaſſed with rows of ſeats, riſing gradually one above another; with portico's both within and without ſide.

The *amphitheatres* were appointed for the exhibiting of ſpectacles or ſhews to the people: As the combats of *gladiators*, and thoſe of wild beaſts; and as the *theatres* of the antients were built in form of a ſemi-circle, only exceeding by one fourth part of the diameter; the *amphitheatres* were nothing elſe but a double *theatre*, or two *theatres* joined together; ſo that the longeſt diameter of the *amphitheatre*, was the ſhorteſt, as 1 ½ to 1.

The *amphitheatre* at *Pola*, an antient republick of *Iſtria*, is very intire, conſiſts of two orders of *Tuſcan* pillars, one above the other. —— The lower has pedeſtals, which is extraordinary; this order having ſcarce ever more than baſes to ſupport them.

The *amphitheatre* of *Titus* is computed to have been capable of holding 85000 ſpectators.

That of *Verona*, is one of the beſt preſerved; the beſt ſtones of the outſide are picked out, yet the great vault, on which the rows of the ſeats are laid, is entire: The rows alſo, (which are forty-four in number) are entire. Every row is a foot and a half high, and as much in breadth; ſo that a man ſits conveniently in them; and allowing for a ſeat a foot and a half, the whole will hold 23000 perſons.

The moſt entire of all thoſe, now ſtanding, is that of *Douay*, a ſmall town, upon the confines of the provinces of *Anjou*, and *Poitou*, in *France*; it don't want ſo much as a ſtone, and could contain, by ſupputation, 25000 ſpectators.

There is alſo, a very magnificent *amphitheatre* at *Niſmes* in *Languedoc*; and ſome remains of *amphitheatres* at *Arles*, *Bourdeaux*, &c.

The *Roman* gladiators were at firſt only ſlaves, who fought of neceſſity; or captives appointed to fight with each other, and do their beſt to ſave their own life, by killing their adverſary.

Junius Brutus, who expelled the *Tarquins*, is ſaid to have been the firſt, who honoured the funeral of his father with theſe inhuman diverſions. —— They were at firſt performed near the ſepulchre of the deceaſed, or about the funeral pile (they being firſt inſtituted inſtead of the ſacrifices of captives, or priſoners of war, offered at firſt to the *manes* of the great men who had died in an engagement) but were afterwards removed to the *circus* and amphitheatres, and became ordinary amuſements.

The emperor *Claudius* reſtrained them to certain occaſions; but he ſoon afterwards annulled what he had decreed, and private perſons began to exhibit them, at pleaſure as uſual; and ſome carried the brutal ſatisfaction ſo far, as to have them at their ordinary feaſts; and not ſlaves only, but other perſons would hire themſelves to that infamous office.

The maſter of the gladiators made them firſt ſwear that they would fight to death; and if they failed therein, they were put to death, either by fire, ſwords, clubs, whips, or the like.

It was a crime for the wretches to complain when they were wounded, or to aſk for death, or ſeek to avoid it when overcome; but it was uſual for the emperor, or the people, to grant them life, when they gave no ſigns of fear, but waited the fatal ſtroke with courage and intrepidity. *Auguſtus* decreed that it ſhould always be granted them.

From ſlaves and freed men, the wanton ſport ſpread to people of rank and condition; and *Nero* is related to have brought upwards of four hundred ſenators, and ſix hundred *Roman* knights upon the *Arena*; though *Lipſius* takes both theſe numbers to be falſified, and not without reaſon, reduces them to forty ſenators and ſixty knights; yet *Domitian*, that other monſter of cruelty, refined upon *Nero*, exhibiting combats of women in the night time.

The

The combats of *gladiators* were first forbidden in the east by *Constantine the Great*, who, by an order to the *præfectus prætorii*, dated at *Berytus* in *Phœnicia*, the 1st of *October*, 325, and still extant, condemned the criminals employed therein to the mines.

The practice was not entirely abolished in the west before *Theodoric*, king of the *Ostrogoths*; though the emperor *Honorius* had first forbidden them at *Rome*; but that prohibition does not seem to have been executed 'till the year 500, when it was entirely abolished by the said *Theodoric*.

Programma's, or bills, were distributed among the people, some time before the day of battle, by the persons, who gave the shews, containing the names of the *gladiators*, and the marks whereby they were to be distinguished; for each had his several badge, which was most commonly a peacock's feather, as appears from the scholiast of *Juvenal*, on the 158th verse of the third satyr. —— They also gave notice what time the shews would last, and how many couples of *gladiators* there were; and it even appears from the 52d verse of the seventh satyr of the second book of *Horace*, that they sometimes made representations of these things in painting; as is practised among us by those, who have any thing to shew at fairs.

The day being come, they began the entertainment by bringing two kinds of weapons; the first were staves, or wooden foils, called *rudes*; and the second effective weapons, as swords, poniards, *&c.* —— The first were called *arma lusoria*, arms for diversion; the second *decretoria*, as being given by decree, or sentence of the *prætor*; or of him at whose expence the spectacle was exhibited. —— They began to fence or skirmish with the first, which was to be the prelude to the battle; from these, when well warmed, they advanced to the second with which they fought naked. —— The first part of the engagement was called *ventilare*, *præludere*, to prelude; and the second *dimicare ad certum*, or *versis armis pugnare*; and some authors think, with much probability, that it is to these two kinds of combats, that St. *Paul* alludes in the passage 1 *Cor.* ix. 26, 27. 'I fight not as one 'that beateth the air; but I keep under my body, 'and bring it under subjection.'

If the vanquished surrendered his arms, it was not in the victor's power to grant him life; it was the people during the time of the republick, and the prince or people during the time of the empire that were alone impowered to grant the boon.

The reward of the conqueror was a branch of palm-tree, and a sum of money; sometimes they gave him his *congé*, or dismissed him; by putting one of the wooden foils or *rudes* in his hand; and sometimes they even gave him his freedom.

The sign or indication whereby the spectators shewed that they had granted the favour, was, to fall the thumb, or clench it between the other fingers; and when they would have the combat finished, and the vanquished slain, they raised the thumb, and directed it towards the combatants; which we learn from *Juvenal*, *sat.* iii. 36.

The *gladiators* challenged or defied each other by shewing the little-finger; and by extending this, or some other during the combat, they owned themselves vanquished, and begged mercy from the people.

There were divers kinds of *gladiators*, distinguished by their weapons, manner of fighting, *&c.* as the *Catervati*, who fought in troops or companies, number against number. —— *Cubicularii*, who fought in private houses during feasts. —— The *Dimachæ*, who fought armed with two poniards or swords, or with sword and dagger. —— The *Essedarii*, who fought in cars; called also in an inscription, lately discovered at *Lyons*, *Assedarii*. —— The *Fiscales* or *Cæsariani*, who belonged to the emperor's company, and who being more robust and dexterous than the rest, were frequently called for; and therefore named *Postulatitii*. —— The other kinds were, the *Hoplomachi*, *Meridiani*, *Mirmillones*, *Ordinarii provocatores*, *Retiarii*, *Rudiarii*, *Secutores*, *Spectatores* and *Thraces*.

There was another kind of building, in Antiquity, for the exhibiting shews to the people, called CIRCUS, from the *Latin*, *circuitus*, or from *Circe*, to whom *Tertullian* attributes the invention.

The *Roman circus* was a large oblong edifice, arched at one end, encompassed with portico's, and furnished with rows of seats, placed ascending over each other. —— In the middle was a kind of foot-bank or eminence, with obelisks, statues, and posts at each end. This served them for the courses of their *bigæ* and *quadrigæ*. — *Bigæ* were chariots drawn by two horses a-breast; *trigæ*, by three; *quadrigæ*, by four, *&c.*

There were no less than ten *circus's* at *Rome*; the largest was that built by the elder *Tarquin*, called *circus maximus*, between the *Avantine* and *Palatine* mounts. *Pliny* says it was enlarged by *Julius Cæsar*, so as to take in no less than three *stadia* in length, and one in width.

The most magnificent *circus's* were those of *Augustus* and *Nero*. —— There are still some remains of the *circus's*, both at *Rome*, at *Nismes*, and other places; but as they used to encompass a too large spot of ground, and were not built for so long duration, time has defaced them.

The *games* of the *circus*, which some call Circensean Games, were combats celebrated in the *circus*, in honour of *Consus* the god of councils and thence also called *Consualia*. — They were also called *Roman games*, either on account of their antiquity, as being coeval with the *Roman* people, or because established by the *Romans*.

These games were instituted by *Evander*, and re-established by *Romulus*; the pomp or procession, called *pompa circensis*, was only part of the games, making the prelude thereof, and consisting of a simple cavalcade of chariots. —— Till the time of the elder *Tarquin*, they were held in an island of the *Tiber*; and were called *Roman games:* After that prince had built the *circus*, they took their name therefrom, as being constantly held there.

There were six kinds of exercises in the *circus*; the first wrestling, fighting with swords, staves, and pikes; the second was racing; the third *saltatio* dancing; the fourth discs, or quoits, arrows, and *cestus:* all which were on foot; the fifth was horse coursing; the sixth courses of chariots, whether with two horses or with four; each bearing the names of the colours they wore. —— At first there was only white and red; then green was added, and blue. *Domitian* added two more colours, but they did not hold. —— It was *OEnomaus* who first invented this method of distinguishing the quadrils by colours. The green was for those who represented the earth; the blue for the sea, &c.

The great games, called *ludi magni*, were held in honour of the god *Neptune*, who was the *Roman consus*, and not of the *sun*.

Other antient edifices were the Agora's or squares of the *Greeks*, and the *forums* of the *Romans*. — The *Roman forums* differed from the *Grecian agora's*, and were of a square form, surrounded with spacious and double porticoes and thick columns. — These porticoes or piazza's were as broad as the columns were long; so that by their being double, the place for walking was as spacious, as twice the length of a column, which made it very commodious. —— Over the first columns, were others a fourth part less than the first; these had under them a *corridor* of such height, as was most convenient; because these upper porticoes were appointed likewise for walking and discoursing, and for persons to stand commodiously therein, to be spectators of any shews that might be exhibited in the square, either out of pleasure or devotion. —— All these porticoes must of course have been embellished with niches and statues, since the *Greeks* used to be highly delighted with such sort of ornaments. —— Near to these squares were the *basilica*, the senate-house, the prisons, &c.

But the *Roman forums*, or squares, were somewhat longer than they were broad; so that dividing the length into three parts, two made the breadth; because the *gladiators* exerting their skill publickly in these places, this form was more commodious for their purpose than a perfect square; for which reason likewise the intercolumnation of the porticoes, that went round the square, was made of two diameters and quarter of a column, or even of two diameters, that the sight of the people might not be intercepted by the thickness of the columns. —— The porticoes were as broad as the columns were high, and under them were the bankers and goldsmiths shops. —— The upper columns were a fourth part less than the under ones; because all pieces below should be stronger than those above, considering the weight they bear. —— In the part fronting the warmest region of heaven were the *basilicas*. —— On that side which fronted the north, stood the senate-house, a square and a half in length. This *curia*, or senate-house, was the place where the senate assembled to consult about state affairs.

Of these *forums* there were several at *Rome*; at first only three, *viz. Romanum Julianum*, and *Augustum*; but that number was afterwards encreased to six, by the addition of the *transitorium*, called also *palladium*; the *Trajanum* and *Sallustii forum*. —— The first and most eminent of these was the *forum Romanum*, called also *forum vetus*, the old square; and absolutely *forum* or the *forum*. —— In this was an apartment called the *rostra*, where the lawyers pleaded; the officers harangued; funeral orations were delivered, &c. —This *rostra* was adorned with the beaks of ships taken from the people of *Antium*, in a naval engagement: whence comes the name.

The ancient *funeral monuments*, are to be collected from the customs of the several nations. The *Romans* were not so extravagant in building places for their interment, as they were in all their other edifices; though besides the usual *sepulchres* for the interment of the whole body, or of the ashes of the body burnt, they had a particular kind, called *cenotaphia*, which were empty *sepulchres*, made in honour of some person, who perhaps had no burial at all; from a superstitious opinion, that the souls of those who wanted burial, wandered a hundred years, ere they were admitted to pass into the *Elysian Fields*.

Among the *Romans*, none but the Emperors, vestals, and persons signalized by great actions, were allowed to have *sepulchres* in the cities; the rest were all in the country, near the high roads; whence

whence come those common words, *Siste, & abi, viator*, which are still improperly retained in the inscriptions of monuments in churches, *&c.*

Strabo informs us, *Georg. l.* 14. that at *Anchiale*, was antiently seen the tomb of *Sardanapalus*, with this inscription in verse; *Sardanapalus built* Anchiale *and* Tarsus *in one day*; *go passenger, eat, drink, and be merry*; *the rest is nothing.*

The CATACOMBS, are a vast assemblage of subterraneous *sepulchres* chiefly about three miles from *Rome*, in the *Via Appia*, supposed by Mr. *Monro*, in the *philosophical transactions*, to have been originally the common sepulchres of the first *Romans*; and dug in consequence of these two opinions, that shades hate the light; and that they love to hover about the places where the bodies are laid. But most of the *Roman* catholicks suppose them to be the sepulchres of the martyrs, and visit them accordingly out of devotion; and relicks thence taken, are dispersed throughout the catholick countries after they have been baptized by the Pope, *i.e.* After those relicks being brought to him, and he calls them by the name of what saint he pleases.

Each *catacomb* is three foot broad, and eight or ten high; running in form of an alley or gallery, and communicating with others: in many places they extend within a league of *Rome*.——There is no masonry or vaulting therein, but each supports itself: the two sides, which we may look on as walls, were the places where the dead were deposited; which were laid lengthwise, three or four rows over one another, in the same *catacomb*, parallel to the alley. — They were commonly closed with large thick tiles, and sometimes pieces of marble, cemented in a manner inimitable by the moderns. —— Sometimes, though very rarely, the name of the deceased is found on the tile: frequently a palm is seen, painted or engraven, or the cypher Xp. which is commonly read, *pro Christo*, *i. e.* dead for Christ, or for the Christian religion.

Antiently, the word *catacomb* was only understood of the tombs of St. *Peter* and St. *Paul*.

The greatest pieces of *antiquity* we have of the sepulchre-kind in being, are the famous PYRAMIDS, erected for *sepulchres* of the *Egyptian* Kings and Queens, which time, the seasons, and the different revolutions, that have happened in so long a course of centuries, have till now left untouched.

This manner of erecting stately monuments for the dead, was invented by *Artemisia*, who first had a most sumptuous one erected to MAUSOLEUS her husband, King of *Caria*; from whence monuments of the same kind, are called MAUSOLEUMS.

England surpasses all other nations in funeral edifices; as witness the monuments in *Westminster-Abbey*.

Almost all the public edifices of the antients, were adorned with inscriptions, which have always very much tickled the curiosity of *antiquaries*.—— *Sanchoniathon*, *Gideon*'s contemporary, drew most of the memoirs, whereof his history is composed, from inscriptions, which he found in temples, and on columns, both among the *Heathens* and the *Hebrews*.

Pliny assures us, that the first publick monuments were made of plates of lead; and the treaties of confederacy, concluded between the *Romans* and the *Jews*, were written upon plates of brass; that, says he, the *Jews* might have something to put them in mind of the peace and confederacy concluded with the *Romans*. — The *Greeks*, and the *Romans* were great admirers of inscriptions, and extremely fond of being mentioned in them: and hence it is that we find so many, in those countries of antient learning, that large volumes have been composed of them; as the collection of *Grater*, &c.

The *Egyptian* inscriptions were all in *Hieroglyphicks*, which were symbols, or mystick figures used among them, to cover or conceal the secrets of their theology. — *Hermes Trismegistus*, is commonly esteemed the inventor of those symbols, which according to *Clemens Alexandrinus*, are a kind of real characters, which do not only denote, but in some measure express the things. — Thus a lion is the hieroglyphick of strength and fortitude; a bullock of agriculture; a horse of liberty; a Sphinx of subtilty, *&c.* — The religious rites of the *Egyptians*, are mostly involved in such figures of animals, to be seen still on the pyramids of *Egypt*, and on the mummies brought from thence.

The *sepulchres* or *tombs* have always had a sort of *inscription*, different from the rest, called EPITAPH, which is an inscription engraven or cut on a *tomb*, to mark out the time of a person's decease, his name, family, and usually some eulogy of his virtues, or good qualities.

The style of *epitaphs*, especially those composed in *Latin*, is singular. *Cicero* has prescribed the rules of it; *Accedat, oportet oratio varia, vehemens, plena spiritus, omnium sententiarum gravitate, omnium verborum ponderibus est utendum.* The discourse must be diversified with incidents, strong and full of spirit; all the thoughts must be noble and grave; and all the expressions weighty. — An *epitaph* is commonly neither prose nor verse; but a *medium* between both.

At *Sparta*, *epitaphs* were only allowed to people, who died in battle.——*Boxhornius* has made a collection of *epitaphs*, not very ample, but exceedingly well chosen. Father *L'Abbé* has likewise given a collection of the like kind in *French*, entitled

titled *Tresor des Epitaphes*.——*Camden* and *Weaver* have done something in the same way in our *English* epitaphs.

The *antient* Statues are divided by *Antiquaries* into *Greek* and *Roman Statues*, and these again subdivided into *Divine*, *Heroes*, and *August*.

The *Greek statues* were naked figures; being in this manner they represented their *Deities*, *Athletæ* of the Olympic games, and heroes; the reason of this nudity was, that those who exercised wrestling, wherein the *Grecian* youth placed their chief glory, always performed naked.——The *Greeks* succeeded in their statues beyond the *Romans*; both the workmanship and the fancy of the *Roman* statues were inferior to the *Grecian*: indeed we have very few remaining that have escaped the injuries of time.

The *Roman statues* differed in this from the *Grecians*, that they were cloathed; those of the Emperors, with long gowns over their armour, and hence were called *Statuæ Paludatæ*; those of captains and cavaliers, with coats of arms, *Thoracatæ*; those of soldiers with cuirasses, *Loricatæ*; those of senators and augurs, *Trabeatæ*; those of magistrates with long robes, *Togatæ*; those of the people with a plain *Tunica*, *Tunicatæ*; and, lastly, those of women with long trains, *Stolatæ*.— Their other division of statues is that I have already mentioned into *divine*, which were those consecrated to the *Gods*, as *Jupiter*, *Mars*, *Apollo*, &c. *Heroes*, which were those of the *demi-gods*; as *Hercules*, &c. and *Augusti*, which were those of the Emperors; as those two of *Cæsar* and *Augustus*, under the portico of the capitol.

The other kinds of edifices, which the antients used to adorn or embellish their cities or towns with, were *triumphal arches*, *baths* and *bridges*.

The Triumphal Arches were gates or passages into a city, built of stone or marble, sculpture, inscriptions, &c. serving not only to adorn a triumph, at the return from a victorious expedition, but also to preserve the memory of the triumph to posterity.— The most celebrated triumphal arches now remaining of antiquity are that of *Titus*, of *Septimus Severus*, and of *Constantine* at *Rome*.— One of the gates of *Orange* (the chief city of that principality belonging antiently to the illustrious house of *Nassau*, but at present in the King of *France*'s possession) is a triumphal arch of *Caius Marius*.——The gate, *Peyre*, at *Montpelier*, is also a triumphal arch; and the gates of St. *Denis*, St. *Martin*, and St. *Antoine* at *Paris*, though modern pieces, deserve that name.

Baths were large and pompous buildings, which made part of the antient *Gymnasia*, and which, though erected for the sake of bathing, were frequented more for the sake of pleasure, than health.

The most magnificent *baths* were those of *Titus*, *Paulus Æmilius*, and *Dioclesian*; of which there are some ruins still remaining.——It is said that at *Rome* there were 856 public *baths*. *Fabricius* adds, that the excessive luxury of the *Romans* appeared in nothing more visible than in their *baths*. *Seneca* complains that the *baths* of *plebeians* were filled from silver pumps; and that the freed-men trod on gems. *Macrobius* tells us of one *Sergius Oratus*, a voluptuary, who had pendant *baths* hanging in the air.

Since I have hinted here at Gymnasium I am obliged to inform the reader, that it was a publick edifice of the antients, erected for performing exercises of the body, where people were taught, and regularly disciplined therein.

The *Romans* borrowed the *Gymnasia* from the *Athenians*, and the *Athenians* from the *Lacedæmonians*; since *Solon*, in *Lucian*'s *Anacharsis*, and *Cicero de orat. l.* 2. are both of opinion, that the *Greeks* were the first that had *Gymnasia*.

There were three principal *Gymnasia* at *Athens*; the *Academy*, where *Plato* taught; the *Lyceum*, noted for *Aristotle*'s lectures; and the *Cynosarges*, allotted for the populace.

Mr. *Burette*, after *Vitruvius*, asserts, that the *Gymnasia* consisted of twelve members or apartments, *viz.* 1. The exterior portico's, where the philosophers, physicians, mathematicians, rhetoricians, and other virtuoso's read publick lectures, disputed, and recited their performances. 2. The *Ephebeum*, where the youth assembled very early, to learn their exercises in private, without any spectators. 3. The *Coryceum*, *Apoditerion*, or *Gymnasterion*, a kind of wardrobe where they stript, either to bathe or exercise. 4. The *Elæothesium*, *Alipterion*, or *Unctuarium*, appointed for the unctions, which either preceded or followed the use of the bath, wrestling, *Pancrasia*, &c. 5. The *Conisterium*, or *Conistra*, in which they covered themselves with sand or dust, to dry up the oil or sweat. 6. The *Palæstra*, properly so called, where they practised wrestling, the pugilate, *Pancrasia*, and divers other exercises. 7. The *Sphæristerium* or tennis-court, reserved for exercises, wherein they used balls. 8. Large unpaved alleys, which comprehended the space between the portico's and the walls, wherewith the edifice was surrounded. 9. The *Xysti*, which were portico's for the wrestlers

lers in winter or bad weather. 10. Other *Xisti's* or open alleys, allotted for summer and fine wea ther; some of which were quite open, and others planted with trees. 11. The *baths*, consisting of several different apartments. 12. The *Stadium*, a large place of a semicircular form, covered with sand, and surrounded with seats for the spectators.

There were several officers for the administration of the *Gymnasia*. 1. A director and superintendant of the whole, called the *Gymnasiarcha*. 2. The *Xistarcha*, who presided in the *Xistus* or *Stadium*. 3. The *Gymnasta* or master of the exercises, who understood their different effects, and would accommodate them to the different complexions of the *Athletæ*. 4. The *Pedotriba*, whose business was mechanically to teach the exercises, without understanding their theory or use. —— Under these four officers were a number of subalterns, whose names distinguish their different functions.

The exercises learned under those different masters, were either for defence, health, or diversion. —— Those for defence were called military, as the exercise of the javelin, gladiators, wrestling, boxing, running, leaping, throwing the *discus*, drawing the bow, *&c.* in all which exercises, there were prizes proposed for the conqueror, thereby to animate youths, to combats of divers kinds, that they might be capable, when occasion required, to repel the insults of their neighbours. — Those for health, were walking, vociferation, shouting, holding one's breath, *&c.* Though this kind of exercise is not co-eval with the rest; since it is *Plato*'s sentiment, that they were first introduced into the *Gymnasium*, by one *Herodicus*, prior a little to *Hippocrates*, and not before luxury and idleness had reduced men to the absolute necessity of applying to physicians, who discovered then, that nothing contributed more to the preservation and re-establishment of health, than exercises proportioned to the different complexions, ages and sexes; and being convinced by experience, of their usefulness, they applied themselves to it.—*Hippocrates* was the first, who treated of the utility of exercise, in his book of *regimen*; but as he, nor the other physicians, did not adopt all the exercises of the gymnastick art into their practice, they left the most violent and laborious, to the masters of the military and athletick exercises.

The exercises for diversion were dancing; all the exercises with *pilæ* or balls; mounting the horse; riding in chaise, litter, or other wheeled vehicle; rocking in beds or cradles; and sometimes swinging; swimming, *&c.*

The hope of being proclaimed and crowned conquerors in the publick games, which they thought was the highest honour a mortal could arrive at, had rendred the *Grecian* youths over diligent in those kinds of exercises, and caused such emulation among them, that what was originally only amusement, became at length, a matter of such importance, as to interest famous cities, and entire nations in the practice.——Nay, in process of time, all *Greece* went so far as to imagine, that even *gods* and *demi gods* were not insensible, of what men were so captivated withal; and in consequence hereof to introduce the greatest part of these exercises into their religious ceremonies, the worship of their gods, and the funeral honours done the *manes* of the dead.

We have no earlier monument now extant, of the *Grecian Gymnasticks*, (which is the name they gave to these exercises) than the description of them in the 23d book of the *Iliad* of *Homer*, where he describes the games celebrated at the funeral of *Patroclus*, which was at the time of the *Trojan war*, and whereby we learn that they had chariot-races, foot-races, boxing, wrestling, gladiators, throwing the *discus*, drawing the bow, hurling the javelin, *&c.*

We have not the least trace remaining of *Grecian Gymnasia*, which the *Romans* improved and advanced to the utmost pitch of magnificence; but the declension of the empire having involved the arts in its ruin, the *Gymnasia* were deserted, and those sumptuous edifices entirely ruinated; so that all that's seen of them at present, are only the places where they were erected.

The Bridges, the next piece of *antiquity*, which falls under our consideration, are commonly defined an edifice, either of stone or timber, consisting of one or more arches, erected over a river, canal, or the like, for the conveniency of crossing or passing over from one side to the other.

Abundance of *bridges* were erected by the antients in several places, but particularly in *Italy*, and on the *Tyber*; whereof some are this day entire, and others have some small remains only left, to preserve their memory.——Those, which are, at present, entire on the *Tyber*, are that of the castle of St. *Angelo*, called antiently the *Elian Bridge*, from the Emperor *Elius Adrianus*, who erected in this place his own monument. —— The *Fabrician Bridge*, erected by *Fabricius*, now called the four-headed bridge, or *ponte quattro capi*, from the four heads of *Janus*, or four *Termini*, placed on the left hand of this bridge, whereby the island of *Tyber* is joined to the city. —The *Cestian Bridge*, now called St. *Bartholomew's* bridge, which from the other side of the island passes to *Trans-Tyberim*, or over the *Tyber*. — The *bridge* called *Senatorius* from the Senators, and *Palatino*, from the adjacent hill,

hill, made of rustick work, and now called St. *Mary's Bridge.*

But the *Bridges*, whereof the antient remains are only to be seen in the *Tyber*, are the *Sublician Bridge*, called likewise the *Lepidan Bridge*, from *Emilius Lepidus*, who made it of stone, though it was first made of wood, and was built near *Ripa*. — The *Triumphal Bridge*, whose pilasters are still to be seen over against the church of the *Holy Ghost*. — The *Janiculan Bridge*, so named from its being adjacent to Mount *Janiculus*; which because Pope *Sixtus* IV. repaired it, is now called *Ponte Sisto*.— And the *Milvian Bridge*, now called *Ponte Molle*, in the *Flaminian* way, not two miles distant from *Rome*, and retaining only the foundations of its antient form. It is reported to have been erected in the time of *Sylla*, by *Marcus Scaurus* the Censor.

There are likewise the remains of a *Bridge*, to be seen, erected by *Augustus*, of rustick work, upon the *Vera*, a most rapid river near *Narmi*; and another of the same work upon the *Metaurus*, at *Calgi*, in *Umbria*, with particular counter-work at each end of it upon the banks; which makes it exceeding strong, and supports the road. ——— But among all the celebrated *bridges*, that is recorded as a miracle, which *Caligula* built from *Puteoli* to *Baiæ*, in the midst of the sea, almost three miles in length; and on which it is said, he expended the whole revenue of the Empire.

There was a *bridge* built over the *Danube* in *Transilvania*, which was extraordinary great, and deserving admiration, on which were inscribed these words. Providentia Augusti vere Pontificis, virtus Romana quis non Domet? Subjugor ecce rapidus Danubius, *i.e.* Can any thing be above the *Roman* strength, assisted with *Augustus*, truly pontiff's, special care; after it has stopt the rapidity of the *Danube*? —— This *Bridge* was afterwards broke down and demolished by *Adrian*, to prevent the *Barbarians* from coming over to plunder the *Roman* provinces; and its pilasters are still to be seen in the middle of the river.

But none of the antient *bridges* appear more beautiful, and more worthy of observation, than that erected by *Augustus Cæsar*, at *Ariminum*, a city of the *Flaminian* tribe. It is divided into five arches, the three middlemost whereof are equal, consisting of 25 feet in breadth; and the two next the banks are less, consisting only of twenty feet. All these arches consist of a semicircle, and the depth of their *Archivolte* is a tenth part of the light, or void of the greater, and an eighth part of the light of the lesser ones. The pilasters, as to their thickness, are a little more than the half of the light of the greater arches. The angle of the spurs, which cut the water, is a right angle, (this the ancients followed in building all their *bridges*, as being stronger than the acute angle; and for that reason, the acute angle is less exposed to be thrown down and destroyed by trees, or any other matter, which rolls down with the stream) on the sides of the *bridge*, there are some niches, wherein there must formerly have been some statues directly over the pilasters. Over these niches there is a cornice, the length of the whole *bridge*, which, although it is plain, adds nevertheless a most agreeable decoration to the work.

Over the *Bacchiglione*, and the *Bezone*, two rivers, which run through *Vicenza*, (the *Bezone* losing its name at its entrance into the *Bacchiglione*, without the city) are two ancient *bridges* built. The pilasters and one arch of that built over *Bacchiglione*, are still entire, and to be seen near the church of St. *Mary of the Angels*; the rest is all modern work.

The other over the *Bezone*, and which is called by the common people, *Il Ponte belle Beccarie*, or the *Butcher's bridge*, because it is adjacent to the greatest shambles of the city, is still entire, and varies but little from that on the *Bacchiglione*, being divided into three arches, and the middlemost larger than either of the other two.——Both the one and the other of these *bridges* are composed of *Costoza* stone, which is a soft stone, and is sawed like wood.

The High-Ways, or *roads*, of the ancient *Romans*, are also pieces of antiquity worthy our notice; and though almost spoilt by time; yet some of them preserve still in some places the memory of their former beauty and convenience; and among them the *Flaminian* and *Appian* ways are the most famous.

The *Flaminian way* was made by the consul *Flaminius* after his conquest over the *Ligurians*, or *Genoese*: it took its beginning from the gate *Flomentana*, (now called *Porta del Populo*) and passing through *Tuscany* and *Umbria*, led to *Ariminum*; from whence it was afterwards continued by *Marcus Lepidus*, his collegue, to *Bononia* (now *Bologna*,) and winding round the marshes, near the foot of the *Alps*, ended at *Aquileia*.

The *Appian way* owed its name to *Appius Claudius*, who made it with great labour and expence; whence, on account of its great magnificence and art, it was called the *Queen of roads*.—This way began from the *Coliseo* (or *Pompey*'s amphitheatre,) and leading through the *Porta-Capena* (a gate of *Rome* so called) is extended as far as *Brundusium*.— It was carried no farther than *Capua* by *Appius*; and

and who was the author of it beyond, is uncertain, tho' by some it is imagined to be *Cæsar*, because *Plutarch* says, that the care of this way was committed to *Cæsar*, and he laid out a large sum of money upon it.—It was last of all repaired by the emperor *Trajan*, who, by draining of marshes, levelling of mountains, filling up of vallies, and making bridges where it was requisite, made it both expeditious and agreeable to passengers.

The *Aurelian way* is also very famous; so called from *Aurelius*, a citizen of *Rome*, who made it.—It took its beginning from the *Aurelian* gate, now called the gate of St. *Pancrace*, and extending itself along the maritime places of *Tuscany*, ended at *Pisa*.

The *Numentan*, the *Prenestin*, and the *Labican ways*, were all equally celebrated.—The first began from the gate *Viminalis*, now called the gate of St. *Agnes*, and extended to the city of *Numentum*.—The second, at the gate *Esquila*, now called that of St. *Laurence*.—The third, from the gate *Nevia* (which is now the *Porta Maggiore*, the great gate,) and both led to the city of *Prebest*, now called *Pellestrino*, and to the celebrated city of *Labicana*.

There were several other ways, such as the *Via Salaria*, the *Collatina*, the *Latina*, and others, which authors have mentioned, and made famous; every one of which took its name, either from the man who made it, or from the gate where it began, or from the place where it ended. But the *Portuensian way*, which reached from *Rome* to *Ostia*, surpassed them all, no doubt, for beauty and conveniency; because, as *Alberti* affirms, it was divided into two ways; between each of which there was a course of stones, a foot higher than the rest of the way, and which served for a division; so that people went one way, and returned the other, whereby they avoided all hindrances, or jostling of each other; and it was indeed a very commodious invention considering the vast concourse of people that flocked then to *Rome* from all parts of the world; and worthy of imitation near *London* at this time.

The ancients made two kinds of those roads, which they called *military roads*; that is, one was paved with stones, and the other covered all over with gravel and sand.——The *ways* of the former kind were divided into three spaces, as far as by some remains of them we are able to conjecture.—On the middlemost, which was higher than the other two, and which rose a little in the middle, that no water might rest upon it, but run off immediately, went the people who travelled on foot.—It was paved with irregular stones; that is, such as had unequal sides and angles.—The other two spaces on each side of this were made a little lower, and covered with sand and fine gravel, being appropriated for the passage of horses and other cattle.——Each of these spaces were but half as large as that in the middle, from which they were divided by a range of stones, pitched edge ways: and there were other stones, somewhat higher, at certain distances, on which they got up when they mounted on horseback, the ancients not having had the use of stirrups.—Besides the stones for this purpose there were others, a considerable deal higher, set an equal distance, on which were engraven the miles of the whole journey: these were set up, and the ways measured by *Cneius Gracchus*.

The *military ways* after the second manner; that is, those made of sand and gravel, were raised by the ancients a little in the middle; for which reason no water being able to rest upon them, and consisting of matter, very apt to become dry in a short time, they were always even and smooth, without either dust or dirt.—Of this sort there is one to be seen in *Friuli*, which leads into *Hungary*, which by the inhabitants is called the *posthumous way*. There is another of them in the country of *Padua*, which beginning from the said city, at the place called *Argere*, passes through the midst of *Cicogna*, the *Villa* of the two brothers, the count *Edward*, and *Theodore de Thieni*, and lead to those *Alps*, which divide *Italy* from *Germany*.

The ancients had also magnificent VILLAS, or country-houses, of which there is none extant at present, though they pretend to shew some ruins of that magnificent one of *Cicero* at *Tusculano*.—The ancient *Romans* took particular care to have the principal front of their country buildings turned to the south, which front had a gallery, from which there was a passage into the kitchen, which received its light above the places adjacent; the chimney being always in the middle.—The stalls for the oxen were on the left hand, the manger whereof was turned to the east.——The bagnios were likewise on the same side, and at an equal distance from the kitchen, and from the gallery, on account of the room they required.——The oil-presses, and other places for the oil, answered the places of the bagnios, and were turned to the east, south, and west, on the right-hand.—The cellars were backwards, far from all noise, and open to the north, that they might not be exposed to the sun.—The granaries were above, and received the same light the same way as the cellars did.—On the right and left sides of the court were stalls for the oxen, for the horses, conveniences for the sheep, and other animals.—Hay-lofts and barns to put the straw in, and bake-houses were as far from the fire as conveniently could be.—The master's apartments were backwards, with the principal front opposite to the farmer's house; so that the halls were always in the back part of these country buildings.

I had almost forgot to mention Aqueducts among pieces of *antiquity*, which is a construction of stone or timber, built on an uneven ground, to preserve the level of water, and convey it by a canal from one place to another; and in which the *Romans* were very magnificent.—They had some *aqueducts* that extended an hundred miles.—*Frontinus*, a man of consular dignity, and who had the direction of the *aqueducts* under the emperor *Nerva*, tells us of nine that emptied themselves thro' 13594 pipes of an inch diameter.—*Vigenere* has observed, that in the space of four and twenty hours, *Rome* received from these *aqueducts*, no less than 500,000 hogsheads of water.—There is still an *aqueduct* of a *Roman* fabrick, which brings the water from *Arcueille* to *Paris*.—The *aqueduct* built by *Lewis* XIV. king of *France*, near *Maintenon*, for carrying the river *Bure* to *Versailles*, is perhaps the greatest in the world.——It is 7000 fathoms long, and its elevation 2560 fathoms; containing 242 arcades.

The pieces of antiquity we have left to examine, as *busts*, or *bustos*, *medals*, *medallions*, *manuscripts*, &c are more properly called *antiques*.

Busts or *bustos* denote the figure or pourtrait of a person in *relievo*, shewing only the head, shoulders, and stomach; the arms being lopped off, ordinarily placed on a pedestal or consolе.

The *bust* is the same with what the *Latins* called *Herma*, from *Hermes*, *Mercury*; the image of that god being frequently represented in this manner among the *Athenians*.

The *antique bustos*, were commonly made with the head of marble, and the shoulders and stomach of porphyry, or bronze.—Of them there are none to be seen, except in *France* among the king's collection of *antiquities*; at *Rome* and *Florence*, among those of the pope, and of the Grand Duke; tho' some of the most curious of our *Antiquaries*, pretend to be possessed of those rare pieces of *antiquities*, as well as of,

Medals, which are small figures or pieces of metal, in the form of a coin, destined to preserve to posterity the pourtrait of some great man, or the memory of some glorious action.

Medals have two parts or sides, the one called the face or head, and the other, the reverse of the *medal*. Each side has three parts, *viz.* the *area*, or field; the rim or border; and the *exergum* or *exergue*, which is a word, motto, or the like, beneath the ground whereon the figures are represented, though oftner placed in the reverse of the *medal*. — What we find in the *exergum* is sometimes no more than some initial letters, whose meaning we are unacquainted withal; though sometimes too they contain *epochas*, or words, that may be accounted an inscription. — The *type* or *device* of the *medal* is the figure represented; and the *legend* is the writing, especially that around the *medal*; though in the *Greek medals* the inscription is frequently in the *area*. — The *legend* serves to explain the *figures* or *devices*.

Legends on *medals*, are either in *Latin* or *Greek*; and their ordinary subjects, the virtues of Princes, the honours they have received, consecrations, signal events, publick monuments, deities, publick vows, privileges, &c.——The *Greek* characters, consisting of capital letters, appear uniform on all *medals*; no change or alteration being found in confronting the several characters; though it is certain there was in the ordinary use and pronunciation.——All we observe on *medals*, is sometimes a mixture of *Greek* and *Latin* characters. — The character was preserved in all its beauty till the Time of *Gallienus*.

From the time of *Constantine*, and for the space of 500 years, the *Latin* tongue was alone used in the *legend* of *medals*, even in those struck at *Constantinople*. — *Michael* began the first, whose *legend* was in *Greek*; and from his time the language, as well as the characters, began to alter for the worse.

Every *medal* has two *legends*, that on the front, and that on the reverse. That on the front, for the generality, serves only to distinguish the person, by his name, titles, offices, &c. and that on the reverse is intended to express his noble and virtuous sentiments, his good deeds, and the advantages the publick has reaped by him. This however does not hold universally; for sometimes we find the titles shared between both sides, and sometimes also the *legend*.

In the *medals* of cities and provinces, as the *type* or *head* is usually the *genius* of the place, or at least some *deity* adored there; the *legend* is the name of the city, province, or deity, or of both together; and the reverse some symbol of the city, province, &c. frequently without a *legend*; sometimes with that of one of its magistrates.

It seems as if the antients had intended their *medals* should serve both as images, and as emblems; the one for the common people, and the other for persons of taste and parts: the images to represent the faces of Princes; and emblems to represent

represent their virtues and great actions; so that the *legend* is to be considered as the soul of the *medal*, and the figure as the body.

Mr. *Patin* and F. *Joubert* imagine, that the antient *medals* were used for money, and that they had all (even without excepting the *Medallions*) a fixed regular price in payments. But those of a contrary opinion maintain, that we have no real money of the antients; and that the *medals*, we now have, never had any currency as coins; though we may reasonably keep a medium between both, and very well suppose, that some of those antient *medals* we have, were real money, and some not; but how to distinguish the one from the other, is a very difficult matter; since we find none number'd by our *Antiquaries* among the *Roman* coins, and all that Mr. *Patin* alledges in defence of his opinion, is but mere supposition.

Antient *medals*, properly called *antiques*, are divided into those of the higher and lower antiquity; and those again are subdivided into *Greek* and *Roman medals*.

The *Greek medals* are such as have either the heads of *Greek* Emperors, or *Greek Legends*. — These are the most antient and the most beautiful; since the *Greeks* struck *medals* in all the three metals with such exquisite art, as the *Romans* could never come up to; the *Greek medals* having a design, accuracy, energy, and a delicacy, that expresses even the muscles and veins, and it must be owned goes infinitely beyond any thing of the *Romans*.

Medals of the higher antiquity of both nations, consist of such as were struck before the end of the third century; and those of the lower, of such as were struck between the third and ninth century.

The *Roman medals* are distinguished by consular and imperial.

The *Consular medals* are certainly the most antient medals of the *Romans*, since they were struck before the Emperors had usurped the sovereign authority, and when the republick was governed by Consuls; and yet those of copper and silver do not go beyond the 484th year of *Rome*; nor those of gold beyond the year 546. If any are produced of an older date, they are spurious.

Of the *Consular medals* Father *Joubert* reckons about 50 or 60 of gold; 250 of copper; and near 1000 of silver. — *Ursinus* and Mr. *Patin* have disposed them genealogically, according to the order of the *Roman* families, and computes 1037 *Consular medals*, which relate to one hundred seventy-eight *Roman* families. — The *medals*, whose edges are cut, or notched like teeth, which is a sign of their purity and antiquity, are common among the *Consular*; but we have none later than *Augustus*. There are several of them, however, among those of the Kings of *Syria*.

Among the *imperial medals* we distinguish between the upper and the lower empire. — The upper empire commenced under *Julius Cæsar*, and ended about the year of *Christ* 260. — The lower empire comprehends near 1200 years, *viz.* 'till the taking of *Constantinople*, by *Mahomet* I. emperor of the *Turks*. It is the custom however to account all the *imperial medals*, 'till the time of the *Palæologi*, among the *antique*, and yet we have no *imperial medals* of any considerable beauty, later than the time of *Heraclius*, who died in 641.

After the time of *Phocas* and *Heraclius*, *Italy* became a prey to the Barbarians; so that the monuments we have remaining of those two emperors finish the set or series of *imperial medals*. — To these are added the *medals* of the lower empire and the *Greek* emperors; whereof a series may be made as low as our time, taking in the modern ones. — Mr. *Patin* has made an ample collection of the *imperial medals* 'till the time of *Heraclius*.

The *Gothick medals* make part of the *imperial* ones: They are so called, as having been struck in the times of the *Goths*, and in the declension of the empire; and favouring of the ignorance and barbarity of the age.

Medals have been struck in three several kinds of metal, which make three several sets or series in the cabinet of the curious, we mean as to the arangement of the several *medals*. — The gold series, for example, of *imperial*, amounts to about 1000, or 1200; that of silver may amount to 3000; and that of copper, in all of three sizes, great, middle, and small, to 6 or 7000. —— Of these the series of middle copper is most compleat and easily formed, as it may be brought down to the fall of the empire in the west, and the time of the *palæologi* in the east.

The series of *medals* are usually formed from the side called the head. —— In the first class is disposed the series of kings. —— In the second, that of the *Greek* and *Latin* cities. —— In the third, the *Roman* consular families. —— In the fourth, the imperial. —— In the fifth, the deities: to which may be added a sixth series, consisting of *medals* of illustrious persons.

It is not either the metal or the size, which makes a *medal* valuable; but the scarcity of the head, or of the reverse, or the *legend* —— Some *medals* are common in gold, which, yet, are very rare in copper; and others very rare in silver, which in copper and gold are very common. —— The reverse is sometimes common, where the head is singular; and some heads are common, whose reverse is very scarce.

There are also *medals* very scarce in some sets, and yet very common in others. —— For instance, there is no *Antonia* in the sets of large copper, and the middle copper is forced to supply its place. — The *Otho*'s are very rare in all the copper sets, and yet common in the silver ones. — *Otho*'s of the large copper are held at an immense price. There were but five of them struck, and the dye broke at the fifth; and *Otho* survived that accident but a few days. Four of those are deposited in the cabinets of the king of *France*, the pope, the grand duke, &c. Those on the middle copper are sold at forty or fifty pistoles; and the *Gordian Affrick*, near as high. — Singular *medals* are invaluable.

We commonly understand by singular *medals*, such as are not found in the cabinets of the curious, and are only met with by chance; but in a stricter sense are such whereof there is not above one of a kind extant. — When a *medal* exceeds the value of ten or twelve pistoles, it is worth what the owner pleases. —— The *Pescennius Niger* and *Pertinax* are very rare in all metals. — The *Didius Julianus* is hardly found any where, but in large copper. — *Carteron* a *Dutchman*, and some others, have made mills on purpose to strike *medals* that never were, as those of *Cicero*, *Virgil*, *Priam*, &c.

There are no true *Hebrew medals*; those we see of the heads of *Moses* and *Jesus Christ*, are spurious and modern. — We have a few shekels of copper and silver, with *Hebrew* or *Samaritan legends*; but none of gold; though there is mention made of one in the king of *Denmark*'s cabinet. — Father *Souciet* has a dissertation on the *Hebrew medals*, commonly called *Samaritan medals*, where he distinguishes accurately between the genuine and the spurious, and shews that they are true *Hebrew* coins struck by the *Jews*, but on the model of the ancients, and that they were current before the *Babylonish* captivity.

These *Samaritan medals* have been infinitely canvassed by the criticks, both *Jew* and *Christian*; particularly Rabbi *Alascher*, Rabbi *Bartenora*, Rabbi *Azarias*, Rabbi *Moses*; father *Kircher*, *Vellalpandus*, *Waserus*, *Couzingius*, *Hottinger*, father *Morin*, *Walton*, *Hardouin*, *Spanheim*. — It is from the characters, not from being struck by the *Samaritans*, that they are called *Samaritan medals*: and none are genuine *Samaritan*, of which father *Souciet* distinguishes four kinds.

The first bears expresly the name of *Simon*, and the subject for which they were struck, *viz.* the deliverance of *Jerusalem*. — The second kind have not the name of *Simon*, but only the deliverance of *Sion* or *Jerusalem*. — The third kind have neither *Simon*, nor the deliverance of *Sion*; but only the *epocha*'s first year, second year, &c. —— The fourth class have neither any inscriptions, nor any thing whence one may judge of the time when they were struck.

The three first kinds were certainly struck after the return from the *Babylonish* captivity, and in the time of *Simon Maccabeus*, after *Jerusalem* had been freed from the yoke of the *Greeks*. But though struck after the captivity, father *Souciet* observes, their character shews itself to be that of the antient *Hebrew*, which was used before the captivity, and the use whereof was lost by the people, during their sojourn in *Babylon* and *Chaldea*; but restored after their return on the same footing as before. He adds, that the legends are pure *Hebrew*, such as was spoke before the captivity; that the character therefore is the true antient *Hebrew* character; that it was the custom to write each language in its proper character; that if they had departed from this rule, they had doubtless used the new character they had brought with them from *Babylon*; that there could be do other reason, but that on settling all things on the same foundation they were on before the destruction of *Jerusalem*, that could have induced them to use this character of their coins. And lastly that these *medals* were not struck by the *Samaritans*, but by the *Jews* and in *Jerusalem*.

Father *Souciet* is very full on all these points, and to the proofs drawn from *medals*, adds two others foreign thereto; the first drawn from the resemblance of the *Greek* letters, introduced by *Cadmus* the *Phœnician*, with the *Hebrew* character; which was the same with that of the *Phœnicians*, as the language of those people was the same with that of the *Hebrews*. — The second drawn from several various readings in the scriptures, which cannot be well accounted for otherwise, than by supposing that the books wrote before the captivity, were in the same character with those of the *medals*, and which shew, that it is the conformity which certain letters have in that character, that has deceived the copyist.

From the whole, he concludes, that this character of the *medal* is the true antient *Hebrew* character; and that to judge of the various readings of the *Hebrew* text, and the differences of the antient *Greek* and *Latin* translations, either from themselves, or from the *Hebrew* text, recourse must be had to this character.

The *medals*, which are defaced or not entire, are called *mutilated medals*. — And those wherein we find the letters *rest*, which shew that they have been restored by the emperors, *redintegrated medals*.

Spurious

Spurious medals are either dipt or plated. —— The dipt ones are ſtruck of pure copper, and afterwards ſilver'd (a contrivance the curious have frequent recourſe to, in order to compleat their ſets.) —— The plated or covered *medals*, are thoſe which have only a thin ſilver leaf over the copper, but which are ſtruck ſo artfully, that the cheat does not appear without cutting them: Theſe are the leaſt ſuſpected.

There are alſo modern *medals*, which are ſuch as have been ſtruck in *Europe*, ſince the uſurpation of the *Goths* has been extinct; and ſculpture and engraving have begun to reflouriſh. — The firſt was of *John Huſs*, in 1415. If any pretend to be more antient, they are ſpurious. —— In *France* there were none ſtruck with the king's effigy before the reign of *Charles* VII.

Theſe *medals* have alſo their ſeries; that of the pope commences only, according to proteſtant *antiquaries*, from *Martin* V. in 1430; from which time we have, as they pretend, a ſeries of papal *medals*, tolerably compleat, to the number of 5 or 600. One might likewiſe have a ſeries of emperor's from *Charlemaigne*, provided one took in the current coins; but in practice they commonly commence from *Frederick* II. in 1463. The ſeries of the kings of *France* is the moſt numerous and moſt conſiderable of all the modern kings.

The ſtudy of *modern* MEDALS is ſo much the more uſeful, as they afford more light than the antient; and mark the time and conſequences of events more preciſely; whereas the legends or inſcriptions of antient *medals* are very ſhort and ſimple, and generally without any date. Add to this, that the antient *medals* are extremely liable to be counterfeited, by reaſon of the exceſſive price they bear; but in the modern there is not near the danger of being impoſed upon.

Mr. *Vaillant* has collected all the *medals* ſtruck by the *Roman* colonies; father *Hardouin* thoſe of the *Greek* and *Latin* cities; father *Noris* thoſe of *Syria*. Mr. *Morel* has undertaken an univerſal hiſtory of medals, and promiſed cuts of 25000. He ranges them under four claſſes; the firſt contains the *medals* of kings, cities, and people, which have neither the name, nor image of the *Roman* emperors: The ſecond contains the conſular *medals*: The third the imperial *medals*; and the fourth the *Hebrew*, *Punick*, *Parthian*, *French*, *Spaniſh*, *Gothick*, and *Arabick*. He begins with the imperial and brings them down as low as *Heraclius*: He places the *Latin* in order before the *Greek*. *Ad. Occo*, a *German* phyſician, and count *Mezzabarba*, have endeavoured to range the *medals* in a chronological order; but that is impracticable, for in many of the imperial *medals* there is no mark, either of the conſulate, or of the year of the reign; and ſince *Gallienus*, there are few of the imperial *medals* that bear the leaſt trace of chronology.

The moſt noted *medaliſts*, or authors on *medals*, are *Antonius*, *Auguſtinus*, *Wolf. Lazius*, *Fill. Urſinus* a learned antiquary, *Æneaſvicus*, *Hubert*, *Goltrius* a famous engraver, *Oiſelius*, *Sequin*, *Occo*, *Triſlan*, *Sermond*, *Vaillant*, *Patin*, *Noris*, *Spanheim*, *Hardouin*, *Morel*, *Joubert*, *Mezzabarba*, *Beger*, &c. We have had alſo, lately, in *England*, perſons of the firſt rank, who were very good medaliſts; as the late duke of *Devonſhire*, Sir *Andrew Fountaine*, Sir *Hans Sloane*, &c. as alſo Mr. *Cox* and Mr. *Goſſet*.

As for *medallions* they are nothing elſe but *medals* of an extraordinary ſize, which princes uſe to preſent as a token of honour or eſteem, for which reaſon the *Romans* called them *Miſſilia*.

Medallions are diſtinguiſhed from *medals* by the volume, that is, by the thickneſs and compaſs; as well as by the largeneſs and *relievo* of the head. — They were never current coins, as *medals* probably were; they were ſtruck purely to ſerve as publick monuments, or to make preſents of. — There cannot be any ſet made of them, even though the metals and ſizes ſhould be joined promiſcuouſly; the beſt cabinets do not contain above four or five hundred; though Mr. *Morel* promiſes us figures of above a thouſand.

Authors vary about the time when they firſt began to be ſtruck; ſome *antiquaries* will have it under the empire of *Theodoſius*: But this muſt be a miſtake; for there were ſome ſtruck even in the time of the upper empire; witneſs a *Nero*, a *Trajan*, and an *Alexander Severus*, ſtill extant. —— *Medallions* of gold are very rare, as alſo thoſe of a large copper.

Medals and *medallions* are almoſt coined in the ſame manner with money; with only this difference, that money having but a ſmall *relievo*, receives its impreſſion at a ſingle ſtroke of the engine; whereas for *medals* or *medallions*, the height of their *relievo* makes it neceſſary that the ſtroke be repeated ſeveral times; to this end the piece is taken out from between the dyes, heated, and returned again; which proceſs in *medallions*, and large *medals*, is ſometimes repeated fifteen or twenty times, ere the full impreſſion be given; care being taken every time the planchet is removed to take off the ſuperfluous metal, ſtretched beyond the circumference, with a file. — Add to this, that *medallions* and *medals* of high *relievo*, by reaſon of the difficulty of ſtamping them in the balancier, or preſs, are uſually firſt caſt or moulded in ſand, like other work of that kind, and are only put in the preſs to perfect them; by reaſon the ſand does not leave them

them clean, smooth, and accurate enough.—*Medals* therefore receive their form and impression by degrees; money at once.

The rule whereby they judge the *medal* to be sufficiently stamped is, when feeling it with the hand, it is found firm, and not to be shaken, as filling the dye equally every where.

Antient MANUSCRIPTS, are also pieces of *antiquity* very much esteemed by *antiquaries*, and other curious persons, the great number of rare and uncommon ones rendering always a library valuable.

There are antient *manuscripts*, which like *medals* of the first class, have no price: such as all originals of any consequence, either history, sacred or profane, divinity, especially the books of the New Testament; those of the old given for such, being nothing else but simple copies, though even some of those copies are very valuable. The antient fathers of the church, as St. *Athanasius*, *Origen*, *Justin the martyr*, St. *Basil*, St. *Jerome*, St. *Augustin*, St. *Cyprian*, St. *Ambrose*, &c. The history of both the *Greek* and *Roman* empires. That of the different monarchies which have risen from the ruins of those two empires, &c. &c. But among those originals and scarce copies, there are many spurious ones, though so well counterfeited, that the best Antiquary is often deceived in them. There are even some manuscripts written, since the invention of printing, which are imposed upon us, as having preceded that ingenious and useful art.

It is not very easy to distinguish an antient *manuscript* from a counterfeited one, especially those in the oriental language, whose originals being all lost, by the different revolutions happening in those countries where they were first written; and those languages, as they are spoken at present, very different from what they were at first, we cannot compare them with the copies, and therefore are obliged to trust to those copies, often but too imperfect, as if they were originals.

I know very well that all *originals* in those languages have not undergone the same fate; especially as to the books of the New Testament, and the works of some of the antient fathers of the *Grecian* church: of which there are still some few originals extant, which have been saved from the ruin of the eastern empire; and those are but in a very small number, and to be seen but in the most celebrated libraries, as those of the *Vatican*, of the king of *France*, of the *Grand Duke*, the *Bodleian* and *Cottonian* libraries, the *British Musæum*, &c.

The best *manuscript* bibles are those copied by the *Jews* of *Spain*. Those copied by the *Jews* of *Germany* are less exact but more common. —— The two kinds are easily distinguished from each other; the former being in beautiful characters like the *Hebrew bibles* of *Bomberg*, *Stephens*, and *Plantin*; the other in characters like those of *Munster* and *Gryphius*. —— *F. Simon* observes, that the oldest *manuscript Hebrew bibles* are not above 6 or 700 years old; nor does *Rabbi Menaham*, who quotes a vast number of them, pretend any of them exceed 600 years.

There are several different *manuscripts* of the bible in all the oriental languages, *viz. Hebrew*, *Samaritan*, *Chaldee*, *Syriac*, *Arabic*, *Æthiopic*, *Coptic*, (of which there's one in the king of *France's* library) and *Greek*.

The great difference found between the different *manuscript* copies of the antient fathers, and the faults and imperfections they are crouded with, proceed sometimes from the ignorance, sometimes from the unfaithfulness, and sometimes from the partiality of the copyists; which the better to understand, we must know that most of those copies were written by monks, who often for want of very well understanding the true sense of those fathers, whose works they were employed to copy or transcribe, or perhaps divided in their sentiments, as to religious matters, each of them gave to the original what sense they thought most favourable to the sect they were most inclined to.

I do not believe it necessary to take any great notice here of *Mummies*, which are also considered as pieces of Antiquity; since we have but very few, perhaps none at all, genuine ones; and as ever since our Antiquaries have dealt that way, we have no less than twenty *Ptolomies*, besides as many *Cleopatra's* brought over to us, besides those left under the *Egyptian* pyramids, and reserved, as I suppose, to divert our posterity, as these have diverted us, though at the same time they have very much puzzled our Antiquaries in the explanation of the *hieroglyphicks*, those *mummies* are powdered with.

ARCHI-

ARCHITECTURE.

ARCHITECTURE is the art of erecting *edifices* or *buildings*, whether for habitation or defence.

In this view, it has three objects, or branches, which are called *civil*, *military* and *naval*, of which this we ſhall diſcourſe ſeparately in their proper places. And, firſt,

Of Civil Architecture.

Civil Architecture, which is commonly by way of eminence called abſolutely Architecture, is the art of contriving and executing commodious buildings for the uſe of ſociety and the convenience of *civil life*.

In this art our chief regard is to be paid to *conveniency*, *ſtrength* and *beauty*.

The *conveniency* is a matter principally to be conſidered in the *plan* of a building; ſo to order the parts thereof, that they may anſwer the intention of the work; and not embarraſs one another.

The *ſtrength* depends on the choice and goodneſs of the *materials*, and upon the ſolidity of the foundation, the *ſquaring*, *levelling*, and *plumbing* of the walls, &c. and a due attention to the bearings of every part.

The *beauty* conſiſts in an exact order or ſymmetry, which ſhould be obſerved in every part; ſo that one member of the building does not exceed its proportion in regard to another member; and that, when compleat, they ſhould all together yield an agreeable form and pleaſing appearance.

Therefore to give a juſt idea of this ſubject, we muſt firſt conſider it in a *general* view, and then deſcend to *particulars*.

In a *general* view: Architecture is to be treated of in regard to its different ſtages or periods, *viz.* either as *antique*, or *ancient*, *Gothic*, *modern*, &c. or as it is divided into its ſeveral *orders*, viz. *Tuſcan*, *Doric*, *Ionic*, *Corinthian* and *Compoſite*.

But before we proceed, it will not be improper to obſerve, that the ſtudy of *Architecture* is profitable to *Gentlemen*, as well as to *Artiſts*: and to give a ſhort account of the origin and progreſs of Architecture.

Though we borrow the aſſiſtance of the Architect and the Mason, when we have a houſe to build, or an apartment to be repaired; yet *we*, at the ſame time, act a wiſe part in preſiding over the whole; and acquire a right to it, by early taking a proper notice of their works. This we have daily opportunities of doing: and having converſed with, and taken advice of an honeſt tradeſman, who though he builds his houſe without any oſtentation and magnificence; yet does it in taſte, and ſhews as much judgment in the diſpoſal of every part, as in the management of his expences, is as ſure a means of improving our minds, as it is of ſucceeding in what we undertake.

Human abodes have varied from time to time, according to local conveniencies, and with relation to the different genius and character of every nation. The *firſt* manner of building houſes ſince the *deluge* (for we are perfect ſtrangers to all events before it) was the architecture of the children of *Noah* in *Gorduena* or *Curdiſtan*, where the Ark ſtopt.

The appendices of rocks, the caves and hollow places dug under ground, were the firſt retreats of their families, at this time much encreaſed in number in that mountainous land. There they ſheltered themſelves from rains and ſharp winds, but not from damps and obſcurity. The melancholy ſituation, and the barrenneſs of thoſe regions, which were hardly habitable on account of the ſands, chaſms and broken rocks, of which they were full, drove them over the river *Tigris* into the plains of *Meſopotamia*.

The want of *ſtone*, or any other hard matters fit for making themſelves ſhelters, taught them how to mould bricks, or ſquare pieces of clay, and bake them hard, wherewith to lay ſtrata of Masonry perfectly even. They bound them together with a viſcous bitumen, which the ſame country ſtill affords, and which they thickened with reeds and ſtraw cut ſmall.

That country, ſo delightful in itſelf, became more ſo by the conveniencies, which the art of building began to procure them, when providence obliged them to deſperſe themſelves in colonies from one end of the earth to the other, leaving them for their guides the inſtructions of their fathers, their own wants, and a few natural talents.

When inſuperable obſtacles obliged them to fly from one country into another, the *woods*, which were eaſily found in almoſt every place, and equally fit to make pieces of ſupport and to procure them roofs and linings, were the moſt ſolid as well as the moſt pliant matters, that procured to the new colo-

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nies a well ſituated, wholeſome, commodious habitation, inſtead of the lurking holes and obſcure dens, which had often ſheltered them in their peregrinations; and though they were at firſt, and for want of ſkill, obliged to content themſelves with green arbours void of proportion and ſymmetry, or with twiſted willows cemented with clay; they nevertheleſs had there the benefit of the day light, and breathed a very pure air.

Wood took whatever form they were pleaſed to give it. The tools they had invented, turned it by degrees into *hurdles*, *poles*, *beams*, *joyſts*, *boards*, *laths*, and pieces of *all* ſhapes, and ſizes. The pliantneſs and perpetual reproduction of wood, and the ſkill of the *hurdler* and *carpenter*, are then the cauſes to which we are really indebted for the manner of building, which was moſt univerſal in the beginning, and which has rendred the earth truly habitable.

It is the uſe of *wood* that firſt diſtinguiſhed the habitations of men from thoſe of wild-beaſts, all over the earth.

But then, the decay of wood after a few years time, obliged men to add, or even as much as poſſible, to ſubſtitute to it *clay*, *loam*, *ſtone*, *ſlate*, and moſt commonly baked earth or *brick*; where *ſtone* was wanting.

This ſparing diſpoſition has often introduced and perpetuated among whole nations the faſhion of *rotundo's*, or circular buildings of hurdles, covered with thatch and ruſhes, and ending in a cone like ice-houſes.

The *hurdler*'s work was ſometimes ſtrengthened with a plaiſtering made of chopped ſtraw and loam. A hole, opened at the point of this ruſtick dome, gave vent to the ſmoak. The fire-place, ſomewhat ſunk in the middle of the room, and garniſhed ſimply with wood-coals, comforted the whole family diſperſed around it. The fabrick of ſuch buildings and the common exigencies of life, required only the cutting down of coppices or underwood.

It was this ſimplicity that did for ſo many ages together preſerve the immenſe foreſts with which *Germany* and *Gaul* were covered. Such was the ARCHITECTURE of our forefathers; and the remains of their way of building, as well as the form of their habitations, are ſtill to be ſeen in the villages of *Lorrain*, *Germany*, *Poland*, and alſo in ſome parts of *Britain*.

Other nations built their houſes in a quite different manner.

The EGYPTIANS, after having run over and cloſely examined the two ſides of their river *Nile*, took a reſolution to fix their abode in the plains it moſt fertilized, and to bring thither by the help of navigation the *ſtone*, *marble*, and all other matters fit to build, which they could no where find but at the farther end of *Africa*. The plenty of every thing determined them to fix there, and a national taſte occaſioned partly by the beauty of theſe matters, and partly by the ſituation and diſpoſition of the country, accuſtomed them to introduce ſublimity in *their* ARCHITECTURE.

Hence, thoſe magnificent habitations in form of terraſſes, and all thoſe lofty monuments, which muſt have been rendered ſuperior to the inundations, and indeſtructible to all the efforts of water. *Wood* had hardly any ſhare at all in their buildings. The country afforded but very little of it; nor would it have been laſting, being ſucceſſively and yearly preyed upon by water and air.

The elegance, that ſhines throughout the writings of the *Greeks*, is again found in their ARCHITECTURE, and in all their inventions. We had from them the fineſt operations of *Geometry*, the correctneſs of *Drawing*, the ſeveral ORDERS of ARCHITECTURE, the beautiful *proportions* in every thing, the *principles* of all the LIBERAL ARTS.

The ROMANS, leſs civilized and poorer in the beginning, built their houſes at firſt with *wood*, *earth*, and *ſtubble*. We nevertheleſs find a character of nobleneſs, in their primitive ſimplicity: nay, they arrived perhaps at once at the true grandeur, ſince they never ſpared any thing to perfect the edifices they built for common utility.

In the time of *Tarquin* the elder, that is, 600 years before our SAVIOUR, the whole ſoil of their town was channeled and inwardly traverſed by ſeveral large canals of MASONRY, which, like ſo many branches of one trunk, terminated in a *common conduit*, that was arched and acceſſible to the carts of their ſcavengers, that the foul water of all their houſes might at any time be diſcharged into the *Tyber*. This love of magnificence and cleanlineſs, in point of works deſigned for the public utility, was perpetuated through every age of the republic, and was ſtill regarded by the firſt Emperors.

The greateſt emulation of the moſt wealthy citizens was to convey from far wholeſome water into *Rome*, for the ſervice of the people: to procure them very ſpacious buildings, where the young *Romans* might ſtrengthen their conſtitution by bodily exerciſe: to build and adorn with ſtatues large portico's, where the people might at any time ſtand under ſhelter, when they were to make their purchaſes, or to the end that they might ſtudy the monuments and the hiſtory of their country there.

The greateſt enterpriſe, that ever was attempted by the *Romans*, was not only that of paving, but

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alſo of *maſoning* upon ſolid foundations all the high roads that traverſed the whole empire. *Agrippa*, the ſon-in-law of *Auguſtus*, who took the execution of it upon himſelf, with ſo much zeal and ſucceſs, was a true hero; ſince he thereby did a piece of ſervice to all mankind in general.

The inconveniences and decay of *wooden-buildings* brought MASONRY more and more in requeſt, both for public and private uſe. Society was a double gainer by it. Its habitations became more commodious: the matter of wood, ſo neceſſary to navigation, for the dreſſing of victuals, and for many other uſes, was conſiderably ſpared.

It nevertheleſs, ſtill came in for a great ſhare in the conſtruction of moſt edifices. It now and then ſupplies the whole carcaſs, or what they call the frame of them; which is afterwards filled up with a ſlight MASONRY. There is no doing without wood, when the diviſion of *ſtair-caſes* is to be made; and it is indiſpenſably neceſſary to *tye* in the walls, and to preſerve the whole by the ſhelter of the *roof*.

When we are either unable or unwilling to lay deep foundations, we are contented in that caſe with the ſolidity, which we find in a *wooden-building* from the ſeveral faſtenings and tyes, that out of a great many different pieces form a compleat whole; and the ground being leſs charged with it, yields leſs to its weight, than it would do to that of a *ſtone-maſonry* not founded on a firm bottom.

When, on the contrary, we would have a ſolid foundation upon *quickſands*, or in a place where the firmeſt ground cannot eaſily be attained; it is wood that comes in to our aſſiſtance, and inſures an unſhaken ſolidity to the MASONRY. The *piles*, which are driven into theſe ſoft ſoils by repeated blows of the rammer, have their foot perpendicularly reſting upon turf, and with their level heads they ſupport the weight of an immenſe edifice.

Thus did the MASON and the CARPENTER ſettle their reſpective provinces: they were then of mutual help one to another, and never parted afterwards.

The SMITH came next to faſten and perfect the work of both by ſtrong ties and by ſeveral inſtruments fit to prevent the inſults of the elements, or the violence of uſurpers. Workmen and profeſſions were multiplied with the ſeveral helps we might deſire to have. Many of them owed their birth barely to a taſte for new conveniencies. How many precautions, machines, and fabricks altogether different in *iron-work* alone? How many other proceſſes in the ſeveral uſes of *copper* and *lead?* How many more for the conveyance of waters and the preſervation of drinks? What a world of other contrivances have they not imagined for the bare diſtribution of light? The *hurdler* and *baſket-maker* had at firſt barred the windows of every habitation with thin wrought *lattices*, which admitted the day, but did not ſtop out the paſſage of the winds, or inclement air. The *weaver* improved the ſervice of theſe blinds by that of thin cloths; and the *glaſs-maker*, at laſt, ſubſtituted to the lattices of cloth, of alabaſter, or of any other thin ſtone, the fine white glaſs.

Theſe noble inventions, and a great many others had their birth in *ages*, which we are pleaſed to term the *times of ignorance*. Let us do them juſtice. Sound philoſophy is the product of all ages. True *philoſophers* are like true *Chriſtians*, whom we at any time diſcern by their fruits. Theſe are the men that do real honour to the human mind. Thoſe, who did not ſcruple to *aſſume* the titles of *maſters* and *ſages* to themſelves, have generally taught us nothing but words and the art of diſputing upon *poſſibilities:* but *artiſts* have inſtructed diſciples, who, like their maſters, go on from age to age with multiplying conveniencies, and producing new beings for our ſervice.

All is rough and in a battered condition in the places where the *architect*, the *carpenter*, the *maſon*, the *joiner*, and the *ſmith* are but juſt come: and we find at their going from thence, *ſymmetry*, *harmony*, *proportions*, *cleanlineſs*, and *eaſe*, on all ſides united with ſolidity.

Vitruvius contends for the origin of *architecture*, being almoſt as ancient as human ſociety, and that the rigour of the ſeaſons firſt led men to make little cabins to retire into; at firſt half under ground, and then half above covered with ſtubble; at length, growing more expert, they planted trunks of trees an-end, laying others a-croſs, to ſuſtain the covering.

But, however, as I don't ſuppoſe thoſe firſt *Architecture* to have been very curious in the ſymmetry of their edifices, or obſerved any regular order, I will rather believe, with ſome of the ancient writers, that *Architecture* firſt began to be reduced to any tolerable order among the *Tyrians*; that, as *Villalpandus* aſſerts, *Solomon* was the firſt, who brought it under thoſe rules, which he had received from GOD himſelf (whence he ſuppoſes *architecture* of divine invention) and that the *Tyrians*, employed by that prince, had learned that art from him, and carried it afterward into their country. To what a pitch of magnificence and grandeur the *Tyrians* carried it ere it came to the *Greeks*, may be learned from *Iſaiah* xxiii. 8. Yet in the common account, *Architecture* ſhould be almoſt wholly of *Grecian* original: three of the regular orders, or manners of building, are denominated from them, *viz*. *Corinthian*, *Dorick*, and *Ionick*, and ſcarce a part, a ſingle member or moulding, but comes to us with a *Greek* name.

Be that as it will; it is certain the *Romans*, from whom we derive it, borrowed what they had entirely from the *Greeks*; nor ſeem, till then, to have had any other notion of the grandeur and beauty of buildings, beſides what ariſes from their magnitude, ſtrength, &c. Thus far they were unacquainted with any order but the *Tuſcan*. Under *Auguſtus*, *Architecture* arrived at its glory: *Tiberius* neglected it as well as the other polite arts. *Nero*, amongſt a heap of horrible vices, ſtill retained an uncommon paſſion for buildings; but luxury and diſſoluteneſs had a greater ſhare in it than true magnificence. *Apollodorus* excelled in *architecture* under the emperor *Trajan*, by which he merited the favour of that prince: and it was he who raiſed the famous *Trajan*'s column, ſubſiſting to this day. After this, *architecture* began to dwindle, and though the care and magnificence of *Alexander Severus* ſupported it for ſome time, yet it fell with the *Weſtern* empire, and ſunk into a corruption, from whence it was not recovered for the ſpace of twelve centuries.

The ravages of the *Viſigoths* in the fifth century deſtroyed all the moſt beautiful monuments of antiquity; and *architecture* thence forwards became ſo coarſe and artleſs, that their profeſſed Architects underſtood nothing at all of their deſign, wherein its whole beauty conſiſts: hence a new manner of building took its riſe, called the *Gothick*.

Charlemagne did his utmoſt to reſtore *architecture*; and the *French* applied themſelves to it with ſucceſs, under the encouragement of *H. Capet*, the firſt of the line of the *Capetians*, from whom the preſent king of *France* is lineally deſcended. His ſon *Robert* ſucceeded him in this deſign, till by degrees the modern *architecture* was run into as great an exceſs of delicacy, as the *Gothick* had before done into maſſiveneſs. To this may be added the *Arabeſk*, *Moriſh*, or *Moriſk architecture*, which were moſt of a piece with the *Gothick*, only brought in from the ſouth by the *Moors* and *Saracens*; as the former was from the north by the *Goths* and *Vandals*.

The Architects of the thirteenth, fourteenth, and fifteenth century, who had ſome knowledge of ſculpture, ſeem to make perfection conſiſt altogether in the delicacy and multitude of ornaments, which they beſtowed on their buildings, with a world of care and ſolicitude, though frequently without any conduct or taſte.

In the two laſt centuries, the Architects of *Italy* and *France* were wholly bent upon retrieving the primitive ſimplicity and beauty of ancient *architecture*, in which they did not fail of ſucceſs; inſomuch that our churches, palaces, &c. are now wholly built after the *antique*.

The moſt celebrated *Architects* are, *Vitruvius*, *Palladio*, *Scamozzi*, *Serlio*, *Vignola*, *Barbaro*, *Cataneo*, *Alberti*, *Viola*, *Inigo Jones*, *Manſard*, *Bullant*, Sir *Chriſtopher Wren*, and *De Lorme*.

We have no *Greek* authors extant on *architecture*. The firſt who wrote of it was *Agatharus* the *Athenian*, who was ſeconded by *Democritus* and *Theophraſtus*. Among the *Latins*, *Fuſſitius*, *Terentius Varro*, *Publius Septimius*, *Rufus*, and *Epaphroditus* wrote *De Re Architectonica*. But of all the ancients, *Vitruvius* is the only entire author; though *Vegetius* relates that there were 700 Architects at *Rome* in his time. He lived under *Auguſtus*, and compoſed a compleat ſyſtem of *architecture* in ten books, which he dedicated to that prince. There are two things cenſured by the moderns in this excellent work, *viz.* want of method, and obſcurity. The mixture of *Latin* and *Greek* in *Vitruvius* is ſuch, that *Leon Baptiſta Alberti* has obſerved, he wrote *Latin* to the *Greeks*, and *Greek* to the *Latins*: he adds, that the work contains abundance of things ſuperfluous and foreign to the purpoſe. For this reaſon M. *Perrault* has extracted all the rules out of *Vitruvius's* prolix work, methodiſed, and publiſhed them in a little abridgment. Several authors have alſo endeavoured to explain the text of *Vitruvius*, particularly *Philander*, *Barbaro*, and *Salmaſius*, in notes added to their ſeveral editions; *Rivius* and *Perrault* in the notes to their *German* and *French* verſions; and *Baldus* in his *Lexicon Vitruvianum*, enlarged by *De Laet*. The ſame M. *Perrault*, has alſo compoſed an excellent *Treatiſe of the five Orders*, which may be eſteemed a Supplement to *Vitruvius*, who left the doctrine of the five orders defective.

The authors upon *architecture* ſince *Vitruvius* are, *Leon Baptiſta Alberti*, who in 1512, publiſhed ten books of the art of building, in *Latin*, deſigned to outvie *Vitruvius*; in which however he has not ſucceeded; his work has abundance of good things, but is deficient in the doctrine of orders. *Seb. Serlio*, who wrote ſeven books of *architecture*, five of which, concerning the *five orders*, were made publick in 1602; throughout all which, he religiouſly keeps to *Vitruvius*'s rules: the ſeventh was ſince publiſhed in 1675; but the ſixth, concerning private buildings, has not yet appeared. And *Palladio*, who wrote four books of *architecture*, containing the fundamental rules of the art, with various inſtances of all the kinds of works, publiſhed in *Italian*, in 1575: the two firſt books are rendered into *High Dutch*, and enlarged with annotations by *Boeckler*; and the four publiſhed in *Engliſh*, in 1735, embelliſhed with a large variety of chimney-pieces, collected from the works of *Inigo Jones* and others. *Phil. De Lorme*, who published nine books of *Architecture* in *French*. *J. Barozzi De Vignola*, who in 1631, made publick his rules of the five orders in *Italian*, since traslated with large additions by *Daviler*, under the title of *Cours d'Architecture*, &c. and since also into *High Dutch*, with notes.

To these are to be added *Vincent Scamozzi*, his idea of Universal *Architecture*, published in 1615, in *Italian*; *Car. Phil. Dieussart*, in his *Theatre of Civil Architecture*, published in *High Dutch*, in 1697; wherein he not only delivers the rules of *architecture*, but explains and compares the five orders, as laid down by *Palladio*, *Vignola*, *Scamozzi*, &c. which same design was also executed in *French* by *R. Freart De Cambray*, in a *Parallel of the ancient Architecture with the modern*, published in *French*, in 1650, and since translated into *English*, with additions by Mr. *Evelyn*. *Fr. Blondel*, director of the royal academy of painting, *&c.* in 1698, gave a *Course of Architecture* in *French*, being a collection from all the celebrated writers upon the subject of the *orders*, &c. *Nic. Goldman*, in a treatise *De Stylometris*, published in *Latin* and *High Dutch*, in the year 1661, has done good service by reducing the rules and orders of *architecture* to a further degree of perfection, and shewing how they may be easily delineated, by means of certain instruments invented by him.

Lastly, the *Elements of Architecture* are very ingeniously laid down by Sir *H. Wotton*. The same are reduced by *Starmius* and *Wolfius*, to certain rules and demonstrations; and thus is *architecture* brought into the form of a *mathematical art*; by the first, in his *Mathesis Juvenil*, and the second in his *Elementa Matheseos*, *Tom.* 2. *An.* 1715.

These particulars premised, let us now proceed with the division of ARCHITECTURE.

ANTIQUE ARCHITECTURE is the name given to buildings erected from the days of *Alexander the Great* to the reign of the emperor *Phocas*; which happened about the year of CHRIST 600. From this *epocha* the artists call the buildings or edifices only *ancient*; because they were erected in a more barbarous stile by the *Goths* and *Vadals*.

The difference between *antique* and *ancient* buildings appears particularly in the joining of the stones together; in which the *antique* Architects were so very curious and exact, that it is very difficult to discern the joints in a great many places, and which contributed much to the beauty, strength, and solidity of the building.

This, in my opinion, could not be done, without having those sides of the stones squared and wrought first, which were to be laid one above another, leaving the other side rough, after which they were made use of in the building; so that the angles or edges of the stones not being so sharp, they could move them up and down better, till they joined well, and were in no more danger of breaking, than if all the sides had been squared; for the angles being then too thin, are apter to break.

In this manner they made all their stone buildings rough and rustic, as it were; and when these were compleated, they continued to polish those sides of the stones that were exposed to view.—— It must be acknowledged, that as the roses between the modilion or other decorations of the cornice, could not be commodiously worked after the stones were fixed, they made them while they lay on the ground.—This is evident by many ancient buildings, in which several stones are found that were left unwrought and unpolished. The arch near the old castle in *Verona*, and all the other arches, and ancient edifices in that place, were made after the same manner: this we easily discover by the marks of the tools, which shew in what manner the stones were wrought.

The columns of *Trajan* and *Antoninus* at *Rome*, were thus wrought; for it would have been impossible, otherwise, to have fixed the stones, so as that the joints should meet so close together, cross the heads, and other parts of the figures.——The same may be said of those triumphal arches that are found there, for when they had any large edifice to erect, as the amphitheatre of *Verona*, that of *Pola*, and the like, to save time and charge, they only wrought the imposts of the arches, the capitals and cornices, leaving the rest rustick, regarding only the beauty of the whole fabrick.—But in temples and other magnificent edifices, that require great delicacy, they spared no labour in working them, but glazed and polished them, even to the very flutes of the columns, with the utmost accuracy and application.

GOTHICK ARCHITECTURE, is that which deviates from the proportions, characters, *&c.* of the *antique*.

The *Gothick architecture* is frequently very heavy, solid, and massive; and sometimes, on the contrary, exceedingly light, delicate and rich.—The abundance of little whimsical, impertinent ornaments, are its most usual character.

Authors distinguish two kinds of *Gothick architecture*; the one *ancient*, the other *modern*.—The ancient is that which the *Goths* brought with them from the north, in the fifth century: the edifices built in this manner were exceedingly massive, heavy and coarse.

Those of the *modern Gothick* run into the other extreme, being light, delicate, and rich to a fault; witneſs *Weſtminſter-Abbey*, the cathedral of *Litchfield*, the *croſs* of *Coventry*, &c.

The laſt kind continued long in uſe, eſpecially in *Italy*, viz. from the thirteenth to the reſtauration of the *antique* building in the ſixteenth century. All the ancient cathedrals are in this ſtile.

Modern Architecture is that which partakes partly of the *antique*, retaining ſomewhat of its delicacy and ſolidity; and partly of the *Gothick*, whence it borrows members and ornaments, without proportion or judgment.

Before I give an exact deſcription of the five different Orders of *architecture*, which all public and private edifices muſt be compoſed of, it will not be improper to obſerve here, that the *columns*, in each of the five Orders, are to be made ſo, as the diameter of the upper part of the column, may be leſs than at the baſe, and have a little ſwelling in the middle.

In the diminution of the *columns*, we muſt take care that the longer they are, the leſs they muſt diminiſh; becauſe the height, by reaſon of the diſtance, has the effect of diminution.

Vitruvius, l. iii. c. 2. gives us directions to that purpoſe; for he ſays, that if the column be fifteen feet high, the diameter at the bottom muſt be divided into ſix parts and a half; and five and a half muſt be the thickneſs at top; if from fifteen to twenty feet, the diameter at the bottom muſt be divided into ſeven parts, and ſix and a half will be the diameter at top.—The ſame obſervation muſt be made in thoſe that are from twenty to thirty feet high; where the diameter, at the bottom, muſt be divided into eight parts, ſeven of which will be the diameter at top; and thus ſuch columns as are of a greater height, will diminiſh in the manner above mentioned.

As to the ſwelling, which is to be in the middle of the column this excellent author has left us in the dark; but *Palladio* has ſupply'd his defect, and left us a method for the profile of ſuch ſwelling.—He divides the *fuſt* of the column into three equal parts, and leaves the lower part exactly perpendicular; to the extremity whereof he applies a thin rule of the exact length, or ſometimes a little longer than the column, and bends that part of the rule which comes forwards, till the point thereof touches the point of diminution of the upper part of the column, under the *collarino*; then he marks as that curve directs; thus he has the column ſwelling a little in the middle, and projecting forward, which ſtrikes the eye very agreeably.

The diameter muſt always be taken at the loweſt part of the column, and the intercolumnations, which are the diſtances between the columns, are to be one diameter and a half, or of two diameters, of two and a quarter, of three, and ſometimes more of the column, though the ancients never exceeded three, except in the *Tuſcan order*, where the architraves being of timber, they made the intercolumnations very large. But then they never made them leſs than a diameter and a half, which diſtance they particularly obſerved when the columns were very lofty.—But they principally approved of thoſe intercolumnations, which were of two diameters and a quarter, and eſteemed them as moſt elegant and beautiful.

The beauty and elegance of the columns are very much heightened by the proportion and harmony between them and the intercolumnations; for if ſmall columns are made with large diſtances, or intercolumnations, the too great quantity of air in the void ſpaces will very much leſſen their thickneſs, and conſequently diminiſh their beauty; and if, on the contrary, there are but ſmall intercolumnations between large columns, the two little vacuity will make them appear heavy, thick, and diſagreeable. Therefore, if the diſtance be more than three diameters, the thickneſs of the column muſt be a ſeventh part of its height, as I ſhall obſerve hereafter in the *Tuſcan order*.—But if the diſtances are three diameters, then the length of the column muſt be ſeven diameters and a half, or eight, as they are in the *Dorick order*.——If two and a quarter, the columns muſt be nine diameters and half in length; as in the *Corinthian*.——And if a diameter and a half only, the length of the columns muſt be then ten, as in the *Compoſite*.

In the front of any edifice, the columns muſt be of an even number, that there may be an opening in the middle, larger than the other diſtances and intercolumnations, for the doors and entries; that is to ſay, for ſingle pillars and columns.——But if galleries are to be made with pilaſters, they muſt be diſpoſed ſo, that the thickneſs of pilaſters or piers be not leſs than the third of the void from pier to pier, and to thoſe in the angles two thirds, which will make the angle in the building more ſolid and ſubſtantial.——When theſe piers are to ſupport a cumbrous load, as in large ſtructures, then they muſt have half the thickneſs of the vacancy, or otherwiſe two thirds in public edifices; but in private ones they muſt be as thick at leaſt, as the third part of the opening, but no thicker than two thirds, and ought to be ſquare.—But to ſave charges, and make it more commodious, and the paſſage more open, they need not be ſo thick in flank as in front, and, for its embelliſhment, half columns or pilaſters may be placed in the middle, to ſupport the cornices over the arches of the gallery, whoſe

thickneſs

thickneſs muſt be in proportion to their height, according to each order, as I ſhall demonſtrate in the courſe of this treatiſe.

For the diviſion and menſuration of the abovementioned orders, we'll make uſe of the ſame meaſure or *module*, which *Vitruvius* uſed to divide the *Dorick order* with, which *module* is taken from the diameter of the column, and which may be uſed in all the *orders*.

This *module* is the diameter of the column at bottom, and is divided into ſixty minutes, except in the *Dorick*, in which the *module* is half the diameter of the column, and is divided into thirty minutes, this being more commodious in the diviſions of that order.—One may therefore divide the *module* into more or leſs parts, according to the quality of the edifice, and uſe the deſigns of the proportions and profiles ſuitable to each order.

A COLUMN in *architecture* is a round pillar, made to ſupport or adorn a building.

The entire *column* in each order is compoſed of three principal parts, the *baſe*, the *ſhaft*, and the *capital*. See Plate IV.

(A) The BASE of a *column* is that part between the ſhaft and the pedeſtal, if there be any pedeſtal; or if there be none, between the ſhaft and the plinth, or ſocle.

The *baſe* is ſuppoſed to be the foot of the *column*, or as ſome will have it, it is that to a *column*, which a ſhoe is to a man.

The *baſe* is different in the different *orders*, as we ſhall ſee when we come to treat of thoſe *orders*.

(B) The SHAFT of a *column* is the body thereof; thus called from its ſtraitneſs; though moſt commonly called *fuſt*.

(C) The CAPITAL is the uppermoſt part of a *column*, ſerving as the head or crowning thereof, placed immediately over the *ſhaft* or *fuſt*, and under the *entablature*. The *capital* is a principal and eſſential part of a *column*, is made different in the different *orders*, and is that, which chiefly diſtinguiſhes the *orders* themſelves.

Each of theſe parts is again ſubdivided into a great number of leſſer, called *members* or *mouldings*, ſome whereof are eſſential, and found in all *columns*; others are only accidental, and found in particular *orders*.

MEMBERS or MOULDINGS are Jettings or Projectures beyond the naked part of a *column*, of a wall, wainſcot, &c. the aſſemblage whereof forms cornices, door caſes, and other decorations of *architecture*.

Some *mouldings* are ſquare, others round, ſome ſtrait, others carved, &c.—Some are plain, others carved, or adorned with Sculpture, either hollowed, or in *relievo*.

Some *mouldings*, again, are crowned with a *fillet*, others are without, as the *doucine*, *talon*, *ovolo*, *torus*, *plinth*, *ſcotia*, *aſtragal*, *gula*, *corona*, and *cavetto*.

FILLET, in *architecture*, is a little ſquare member or ornament, uſed in divers places, and on divers occaſions; but generally as a ſort of *corona*, over a greater moulding; and on occaſion, ſerves to ſeparate the *flutings* of *columns*.

The *fillet* is the ſame with what the *Italians* call *liſta*, or *liſtella*; and the *French*, *bande*, *bandelette*, and *reglet*; though the *reglet*, according to *Daviler*, differs from the *fillet*, in that it projects equally like a ruler.

The DOUCINE is a *moulding* on the higheſt part of the cornice, in form of a wave half convex and half concave.—The *doucine* is the ſame with a *cymatium* or *gula*.

Vitruvius does not confine *cymatium* to the cornice, but uſes it indifferently for any ſimilar moulding, wherever he meets with it: in which he differs from the moſt accurate among the moderns.

Filibien makes two kinds of *cymatiums*; the one right, and the other inverted; in the firſt, that part, which projects the furtheſt, is concave; and is otherwiſe called *Gula recta* and *Doucine*.——In the other, that part, that projects fartheſt, is convex, called *Gula inverſa*, or *Talon*, i. e. *Ogee*.

Our *architects* do not uſe to give the name *cymatium* to theſe mouldings, except when found on the tops of *cornices*; but the workmen apply the name indifferently, wherever they find them.——*Palladio* diſtinguiſhes the *cymatium* of the cornice, by the name *intavolata*.

TALON (a *French* word which literally ſignifies *heel*) is a *moulding* concave at the bottom, and convex at the top; having an effect juſt oppoſite to the *doucine*.——When the concave part is a-top, it is called an *inverted talon*.

The *talon* is uſually called by our *Engliſh* workmen *ogee*, or *O. G.* and by authors an *upright*, or *inverted cymatium*.—The figure of the *ogee* bears ſome reſemblance to that of an S.

The OVOLO is a round *moulding*, whoſe profile or ſweep in the *Ionic* and *Compoſite* capitals, is uſually a quadrant of a circle; whence it is alſo popularly called the *quarter round*.——It is uſually enriched with ſculptures among the antients in form of cheſnut-ſhells; whence *Vitruvius*, and other of the ancients call it *Echinus*, cheſnut-ſhells.—Among us it is uſually cut with the repreſentation of eggs, and anchors, or arrows heads, placed alternately; whence its *Italian* name *ovolo*, *Latin*, *ovum*, q. d. *egg*.

(D) PLINTH is a flat ſquare member in form of a brick; ſometimes alſo called the *ſlipper*.——

The

The *Plinth* is uſed at the foot or foundation of *columns*; being that ſquare flat table under the mouldings of the *baſe* and *pedeſtal*, at the bottom of the whole *order*; ſeeming to have been originally intended to keep the bottom of the primitive wooden pillars from rotting.——The *plinth* is alſo called *orle* or *orlo*.—*Vitruvius* alſo calls the *Tuſcan abacus*, *plinth*, from its reſembling a ſquare brick.

The TORUS or TORE, is a large round *moulding* uſed in the baſes of *columns*.——The *tore* is alſo called *gros baton*, and *tondin*.—It is the bigneſs that diſtinguiſhes the *tore* from the *aſtragal*.—The baſes of the *Tuſcan* and *Dorick order*, have but one *tore*, which is between the *plinth* and the *liſtel*.——In the *Attick baſe* there are two; the upper, which is the ſmaller; and an under, or bigger.

SCOTIA is a ſemicircular cavity or channel between the *tores*, in the baſes of *columns*.——It is a concave, dark *moulding*; whence its name, *viz.* from σκοτος, obſcurity, darkneſs.—The *ſcotia* has an effect juſt oppoſite to that of the *quarter-round*.—Our workmen frequently call it the *caſement*.—It is alſo called *trochillus*, partly from its form.—In the *Ionick* and *Corinthian baſe*, there are two *ſcotia's*, the upper whereof is the ſmaller.—According to *Filibien*, the *cavetto* is a fourth part of the *ſcotia*.

The ASTRAGAL, in *architecture*, is a little round member, in form of a ring, or bracelet; ſerving as an ornament at the tops and bottoms of *columns*.——The *aſtragal* is ſometimes alſo uſed to ſeparate the *faſciæ* of the *architrave*; in which caſe it is carved chaplet-wiſe, with beads and berries.——It is alſo uſed both above and below the *liſtel*, adjoining immediately to the ſquare or dye of the *pedeſtal*.

The GULA, GUEULE, or GOLA, in *architecture*, is a wave member, whoſe contours reſemble the letter S.—This member is of two kinds, *recta* and *inverſa*.—The firſt and principal has its cavity above, and convexity below. This always makes the top of the *corona* of the cornice, jetting over, the drip of the cornice like a wave ready to fall.—It is called *gula recta*, by the *French*, *doucine*.—The ſecond is juſt the reverſe of the former, its cavity being at the bottom; ſo that it appears inverted, with regard to the former.——This is uſed in the architrave, and ſometimes in the cornice, along with the former, only ſeparated by a reglet.

Some derive the word from the reſemblance theſe members bear to the *gula*, or throat of a man: others from the herald's terms, *gules*; as ſuppoſing the *moulding* form'd from the ancient manner of wearing their garments, which conſiſted of ſlips of ſwaths, alternately fur and ſtuff of various colours; the intervals between which were called *gules*, or *gueles*.

†

The CORONA, *crown*, or *crowning*, is a large, flat, maſſive member of the cornice; ſo called becauſe it crowns not only the cornice, but the entablature, and the whole order.—The workmen call it the *drip*, as ſerving, by its great projecture, to ſcreen the reſt of the building from the rain.——Some *Latin* authors call it *ſupercilium*; and, as it ſhould ſeem, by miſtake *ſtilicidium*.——Certain *Latin* authors *mentum*, chin; from its keeping the weather from the parts underneath, as the *chin* does the ſweat, &c. out of the neck.

Some call it abſolutely the *cornice*, as being the principal member thereof.——*Vitruvius* frequently uſes the word *corona* for the whole *cornice*.——The *corona* is itſelf crowned or finiſhed with a *reglet* or *fillet*.——There are ſometimes two *corona's* in a *cornice*, as in the *Corinthian* of the *Rotunda*.

The CAVETTO is a hollow member or moulding, containing a quadrant of a circle, and having an effect juſt contrary to that of a *quarter-round*: it is uſed as an ornament in *cornices*.—Mr. *Filibien* obſerves, that the workmen confound the *cavetto* with a *ſcotia*, but to ill purpoſe; the *cavetto* being, in effect, only half a *ſcotia*: yet he himſelf is chargeable with the ſame overſight.—When in its natural ſituation, the workmen frequently call it *gula*, or *gucula*; and when inverted *gorge*; which *gorge* is a ſort of concave moulding, concave in the upper part, and convex at bottom, more properly called *gula* and *cymatium*.

The ABACUS is the uppermoſt member of a *capital* of a *column*, ſerving as a kind of crowning, both to the capital, and the whole *column*.

Vitruvius, and others after him, who give the hiſtory of the orders tell us, the *abacus* was originally intended to repreſent a ſquare tile laid over an *urn*, or over a baſket. An *Athenian* woman happening to place a baſket thus covered, over the root of an *acanthus*; that plant ſhooting up the following ſpring, encompaſſed the baſket all around, till meeting with the tile, it curled back into a kind of ſcrolls. An ingenious ſculptor paſſing by, took the hint, and immediately executed a capital on this plan; repreſenting the brick by the *abacus*, the leaves by the *volutes*, and the baſket by the *vaſa*, or body of the *capital*. Such was the riſe of the firſt regular order.

There is ſome difference in the form of an *abacus* in different *orders*. In the *Tuſcan*, *Dorick*, and ancient *Ionick*, it is a flat ſquare member, well enough repreſenting its original tile, whence the *French* call it *tailloir*, trencher. In the richer *orders* it loſes its native form; its four ſides or faces

being

being arched, or cut inwards, with some ornament, as a rose, or other flower, or fishes tail, in the middle of each arch. But some *architects* take other liberties in the *abacus*, both in respect of its name, place and office. Thus in the *Tuscan order*, where it is the larger and more massive, as taking up one third of the height of the whole *capital*, it is sometimes called the dye of the *capital*. In the *Dorick*, it is not always the uppermost member of the *capital*; a *cymatium* being frequently placed over it. In the *Ionick*, some make it a perfect *ogee*, and crown it with a *fillet*.

The proportion of the *abacus*, as prescribed by *Vitruvius* (4. 1.) is short, is diagonal (from corner to corner) being twice its height, a rule which the moderns make no difficulty of dispensing withal.

Volute is a kind of spiral scroul, used in the *Ionick* and *Composite capitals*, whereof it makes the principal characteristick and ornament. Some call it the *ram's-horn*, from its figure, which bears a near resemblance thereto. Most *architects* suppose that the ancients intended the *volute* to represent the bark, or rind of a tree, laid under the *abacus*, and twisted thus at each extreme where it is at liberty; others will have it a sort of pillow, or bolster, laid between the *abacus* and *echinus*, to prevent the latter being broke by the weight of the former, and the *entablature* over it, and accordingly call it *pulvinus*. Others after *Vitruvius*, will have it to represent the curls or tresses of a woman's hair. The number of *volutes* in the *Ionick order*, is four; in the *Composite*, eight. There are also eight angular *volutes* in the *Corinthian* capital, accompanied with eight other small ones, called *helices*.

The Achantus is only an ornament in the *Corinthian* and *Composite orders*; being the representation of the leaves of an *achantus* plant, in *English*, *bear's-foot*, in the capital thereof.

Over the *capital* is the Entablature; comprehending the *architrave*, *freeze*, and *cornice*. The *entablature* is also called the *trabeation*, and by *Vitruvius* and *Vignola*, *ornament*: It is different in the different orders: Indeed it consists of the three grand parts or divisions above-mentioned in all; but those parts consist of a greater or less number of particular members or sub-divisions, as the orders are more or less rich. *Vignola* makes the *Entablature* a quarter of the height of the whole column, in all the orders. In the *Tuscan* and *Dorick*, the *architrave*, *freeze*, and *cornice*, are all of the same height. In the *Ionick*, *Corinthian*, and *Composite*, the whole *entablature* being fifteen parts; five of them are allowed for the *architrave*, four for the *freeze*, and six for the *cornice*.

(E) The Architrave is that part of a *column*, which lies immediately upon the *capital*; the *Greeks* call it *epistyle*. The *architrave* is the lowest member of the *entablature*. The *architrave* is supposed to represent the principal beam in timber buildings, whence the name which is formed of the *Greek*, αρχὸς, Chief, and the *Latin*, *Trabs*, Beam.—The *architrave* is different in different orders.—In the *Tuscan* it only consists of a plain face, crowned with a *fillet*; and is half a *module* in height.—In the *Dorick* and *Composite*, it has two faces, or *fascia*; and three in the *Ionick* and *Composite*, in which last order, it is $\frac{1}{1}\frac{0}{2}$ of a *module* high.—*Architects* however take a deal of latitude in this part; some using more members than others; and many of them having two or three forms of *architraves*.—*Architrave* is also called the *reason-piece*, or *master-beam*, in timber buildings, as portico's, cloisters, &c.—In chimnies, it is called the *mantle-piece*; and over the jaumbs of doors or lintels of windows, *hyperthyron*.

(F) The Freeze or Frize, is that part of the entablature of *columns* between the *architrave* and *cornice*; and is properly a large flat face, or member, separating the architrave from the *cornice*.—The antients called it *Zophoros*, Ζωφορος, by reason it was usually enriched with figures of animals; and our denomination *freeze*, has a like origin, being formed of the *Latin*, *phrygio*, an embroiderer, because it is commonly adorned with sculptures in *basso relievo*, imitating embroidery.

The *freeze* is supposed to be intended to represent the heads of the transverse beams that sustain the roof or covering. In the *Tuscan order* it is quite plain. In the *Dorick*, enriched with *triglyphs*. In the *Ionic* it is sometimes made arched or swelling, in which case it is called by Vitruvius, *pulvinatus*, *q. d.* bolstered. In the *Corinthian* and *Composite*, it is frequently joined to the *architrave* by a little sweep; and sometimes to the *cornice*. And in these richer orders it is usually adorned with sculptures, figures, compartments, histories, foliages, festoons, &c.

As to the height of the *freeze*, it is, in general, much the same with that of the *architrave*. The *Tuscan freeze Vitruvius* makes 30 minutes: *Vignola*, 35; *Palladio*, who makes it swelling, gives it but 26; and *Scamozzi* 42. The *Doric*, in *Vitruvius* and *Vignola*, is 30 or 40 minutes; in *Palladio*, &c. 45. The *Ionick Vitruvius* makes flat, adorned with *achantus*'s leaves, lions, &c. and makes it 30 minutes high: *Vignola* also makes it flat, gives it 45 minutes; and *Palladio*, who makes it convex or swelling, 27 minutes; and *Scamozzi*, 28. The *Corinthian*, *Vitruvius* enriches with achantus's leaves, human figures, &c. and makes its height, 37 minutes; *Vignola*, 45; *Palladio*, 28; and *Scamozzi* $35\frac{1}{4}$. *Lastly*, The

Composite,

Compoſite, which in *Vitruvius* is ſet with cartoozes, and carved between them, is $34\frac{1}{2}$ minutes; *Vignola*, who makes it like *Vitruvius*'s only gives it 45 minutes; *Palladio*, who makes it ſwellling, only 30; and *Scamozzi* 32.

From the variety of the enrichments of the *freeze*, they become variouſly denominated, as

Convex or *pulvinated* FREEZES are thoſe whoſe *profile* is a curve, the beſt proportion whereof is when drawn on the baſe of an equilateral triangle.—In ſome, the ſwelling is only a top, as in a conſole: in others a bottom, as in a balluſter.

Flouriſhed freezes, are thoſe enriched with rinds of imaginary foliages; as the *Corinthian freeze* of the frontiſpiece of *Nero*; or with natural leaves, either in cluſters or garlands; or continued, as in the *Ionick* of the gallery of *Apollo* in the *Louvre*.

Hiſtorical *freezes* are thoſe adorned with *baſſo relievo*'s repreſenting hiſtories, ſacrifices, &c. as that of the arch of *Titus* of *Rome*.—*Marine freezes*, are thoſe repreſenting ſea-horſes, Tritons, and other attributes of the ſea; or ſhells, baths, grotto's, &c.—*Ruſtick freezes*, are thoſe whoſe courſes are ruſticated or imboſſed; as the *Tuſcan freeze* of *Palladio*.—Symbolical *freezes* are thoſe adorned with the attributes of religion; as the *Corinthian* of the temple, behind the capitol at *Rome*, whereon are repreſented the inſtruments and apparatus of ſacrifice.

The uppermoſt member of the entablature of a *column*, or that which crowns and finiſhes the *order*, is called CORNICHE (g) or CORNICE, from the *Latin coronis*, a crowning. The *cornice* is the third grand diviſion of the trabeation, commencing from the *freeze*, and ending with the *cymatium*.

The *cornice* is different in the different orders: In the *Tuſcan order* it is moſt plain. *Vignola* makes it conſiſt of an *ovum*, or quarter-round; an aſtragal, a fillet, a larmier, and a talon. In the *Dorick*, he uſes capitals to the *triglyphs* of the *freeze*, with their bandelettes, a *talon*, mutules or dentils, a larmier, with its guttæ underneath, a talon fillet, cavetto and reglet. In the *Ionick* the members are in moſt reſpects the ſame as in the *Dorick*, except that they are frequently enriched with carving, and there are always dentils. In the *Compoſite*, there are dentils; its mouldings are carved, and there are channels under the ſoffit. The *Corinthian cornice* is the richeſt; and is diſtinguiſhed by having both modillons and dentils; contrary to the opinion of *Vitruvius*, who locks on thoſe two ornaments as incompatible; and of Mr. *Le Clerc*, who regards the dentils as peculiar to the *Ionick*.

For the *heights* and projectures of the *cornices* in the ſeveral orders, *Goldman* makes the height of the *Tuſcan* $1\frac{1}{3}$, its projecture $2\frac{2}{3}$ modules: the height of the *Dorick* $1\frac{1}{3}$, its projecture $2\frac{2}{5}$; height of the *Ionick* $1\frac{3}{5}$, its projecture $2\frac{2}{3}$; height of the *compoſite* $1\frac{3}{5}$, projecture $2\frac{1}{3}\frac{3}{5}$; height of the *Corinthian* $1\frac{2}{5}$, projecture $2\frac{1}{3}\frac{3}{5}$.

There are different ſorts of *cornices*; *viz. architrave cornice*, which is that immediately contiguous to the *architrave*, the freeze being retrenched. *Mutilated cornices*, whoſe projecture is omitted, or elſe interrupted, right to the *larmier*, or reduced into a plat-band with a *cymatium*. *Cantaliver cornice*, a term uſed by the workmen for a *cornice* that has *cantalivers* underneath it. *Modillon cornice*, a *cornice* with *modillons* under it. *Coving cornice*, a *cornice* which has a great caſement or hollow in it; ordinarily lathed, and plaiſtered upon compaſs, ſprokets, or brackets.—*Cornice* is alſo uſed in general, for any little projecture, either of Maſonry or Joinery, even where there are no *columns*. Thus we ſay, the *cornice* of a chimney, a beauſet, &c.

Cornice is alſo applied to the crowning of *pedeſtals*. This *cornice* is different in the different *orders*: in the *Tuſcan*, according to Mr. *Perrault*, it has a platband which ſerves as a *corona*, and a *cavetto*, with its fillet. In the *Dorick* it has a *cavetto*, with a fillet, which bears a drip, crowned with a ſquare. In the *Ionick*, a *cavetto*, with its fillet above, and a drip or pendant ſquare, crowned with an *ogee* and its *fillet*. In the *Corinthian*, an *ogee* with its fillet, a *cymatium* under the *corona*, which it hollows to make a drip, a *corona*, and an *ogee* with its fillet. *Laſtly*, in the *Compoſite*, a fillet with a ſweep over the dye, and *aſtragal*, *cyma* with its *fillet*, *corona*, and *ogee*, with its fillet.

We have ſo often mentioned FASCIA's or FASCIÆ, that it is not improper to obſerve here, that *Faſcia*, in *architecture*, is a broad liſt, fillet, or band; particularly uſed in *architraves* and *pedeſtals*.

The *architrave* conſiſts of three *faſciæ* or bands; thus called by *Vitruvius*, as reſembling ſwaths, called in *Latin*, *faſciæ*.—That author admits no *faſciæ* in the *Tuſcan order*, and *Dorick architrave*, *i. e.* he makes all plain, without any diviſion, or cantoning into parts or *faſciæ*; but the modern *architects* take liberty to differ from him herein In brick buildings, the juttings out of the bricks, beyond the windows in the ſeveral ſtories, except the higheſt, are called *faſcia*'s or *faſchæ*.——Theſe are ſometimes plain and ſometimes moulded; but the moulding is only a *cyma reverſa*, or an O. G. at the bottom, with two plain courſes of bricks over it, then an *aſtragal*, and laſtly a *boultine*; which *boultine*, or *boltel*, is the workmen's term for a convex moulding, whoſe periphery is juſt $\frac{1}{4}$ of a circle; placed next below the *plinth*, in the *Tuſcan* and *Dorick* CAPITAL.

Thus we have carried the *column*, to its uppermoſt extremity, and crowned the whole order; but we have left it without a pedeſtal, which is the loweſt

owest part of an order of *columns*; being that which sustains the *column*, and serves it as a foot, or stand.

(H) The PEDESTAL (from the *Latin*, *pes*, a foot, and στυλος, column) consists of three principal parts; *viz.* a square trunk or dye, which makes the body; a *cornice* the head; and a base the foot of the *pedestal*. The *pedestal* is properly an appendage to a *column*, not an essential part thereof; though Mr. *Le Clerc* thinks it is essential to a compleat order.

The proportions and ornaments of the *pedestal* are different in the different orders: *Vignola*, indeed, and most of the moderns, makes the *pedestal*, and its ornaments in all the orders, one third of the height of the *column*, including the *base* and *capital*: but some deviate from this rule. Mr. *Perrault* makes the proportions of the three constituent parts of *pedestals*, the same in all the orders, *viz.* the base one fourth of the *pedestal*; the *cornice*, an eighth part; and the socle or *plinth* of the base two thirds of the base itself. The height of the dye is what remains of the whole heights of the *pedestal*.

(h 1) *Tuscan* PEDESTAL, is the simplest, and the lowest. *Palladio* and *Scamozzi*, make it three modules high; *Vignola* 5. Its member, in *Vignola*, is only a *plinth* for a base, the *dye* and a *talon* crowned, for a *cornice*. It has rarely any base. *Dorick pedestal*, (h 2) *Palladio* makes four modules, five minutes high; *Vignola* five modules four minutes. In the antique, we not only do not meet with any *pedestals*; but even not with any base in the *Dorick order*. The members in *Vignola*'s *Dorick pedestal*, are the same with those in the *Tuscan*, with the addition of a mouchette in its cornice. (h 3) *Ionick* PEDESTAL in *Vignola* and *Serlio*, is six modules high; in *Scamozzi*, five; in the temple of *Fortuna virilis*, it is seven modules, twelve minutes. Its members and ornaments are mostly the same with those of the *Dorick*, only a little richer. The *pedestal* now usually followed, is that of *Vitruvius*; though we do not find it in any work of the antique. Some in lieu hereof use the *Attick base*, in imitation of the antient.

The *Corinthian* PEDESTAL (h 4) is the richest and most delicate. In *Vignola*, it is seven modules high, in *Palladio*, five modules one minute; in *Serlio*, six modules, fifteen minutes; in the *Coliseum*, four modules, two minutes. Its members, in *Vignola*, are as follows: in the base, are a plinth for a socle, over that a tore carved; then a reglet, gula inverted and inriched, and an astragal. In the dye are a reglet, with a *conge* over it, and near the cornice a reglet with a *conge* underneath. In the cornice is an astragal, a freeze, fillet, astragal, gorge, talon, and a fillet.

In *Vignola* the *Composite* PEDESTAL is of the same height with the *Corinthian*, *viz.* seven modules; in *Scamozzi*, six modules, two minutes; in *Palladio*, six modules, seven minutes; in the goldsmiths arch, seven modules, eight minutes. Its members in *Vignola*, are the same with those of the *Corinthian*; with this difference, that whereas these are most of them enriched with crownings in the *Corinthian*, they are all plain in the *Composite*. Nor must it be omitted, that there is a difference in the profiles of the base and cornice in the two orders. *Daviler* observes, that the generality of *Architects* use tables or pannels, either in *relievo*, or creux, in the dyes of *pedestals*; without any regard to the character of the order. He observes farther, that those in *relievo*, only fit the *Tuscan* and *Dorick*; the three others must be indented; which, he adds, is a thing the antients never practised, as being contrary to the rules of solidity and strength.

There are besides, square, double, and continued *pedestals*. *Square pedestal*, is that whose height and width are equal. As that of the arch of the *Lions* at *Verona*, of the *Corinthian order*; and such, some followers of *Vitruvius*, as *Serlio*, *Philander*, &c. have given to the *Tuscan order*. *Double pedestal*, is that which supports two columns, and is more in width than height. *Continued pedestal*, is that which supports a row of columns, without any break or interruption; such is that which sustains the fluted *Ionick* columns of the *Tuilleries*, on the side of the garden.

The DYE, is the trunk of the *pedestal*, or that part between the *base* and the *cornice*; being so called, because it is frequently made in the form of a *cube*.

There are two ways of determining the measures or proportions of buildings.

The first by a fixed standard measure, which is usually the diameter of the lower part of the column, called a *module*, subdivided into 60 parts called *minutes*.

A *minute* denoting a 60th, and sometimes only a 30th part of a division of a *module*.

Vignola divides his *module*, which is a semi diameter, into twelve parts, in the *Tuscan* and *Dorick*; and into eighteen for the other orders. The *module* of *Palladio*, *Scamozzi*, *M. Cambray*, *Des Godetz*, *Le Clerc*, &c. which is also the semi-diameter, is divided into thirty parts or minutes, in all the orders.

In the second there are no minutes, nor any certain and stated division of the *module*; but it is divided occasionally into as many parts as are judged necessary. —— Thus the height of the *Attick base* which is half the *module*, is divided, either into three,

three, to have the height of the *plinth*; or into four, for that of the greater *torus*; or into ſix for that of the leſſer. —

Both theſe manners have been practiſed by the antient as well as the *modern Architects*; but the *ſecond*, which was that chiefly uſed among the *antients*, is, in Mr. *Perault*'s opinion, preferable to all others.

As *Vitruvius*, in the *Dorick* order, has leſſened his *module*, which in the other orders, is the diameter of the lower part of the column; and has reduced that *module* to a mean one, which is a *Semi-diameter*: Mr. *Perault* reduces the *module* to a third part for the ſame reaſon, *viz.* to determine the ſeveral meaſures without a fraction.——For in the *Dorick order*, beſides that the height of the baſe, as in the other orders, is determined by one of theſe mean *modules*; the ſame *modules* give, likewiſe, the heights of the capital, architrave, triglyps, and metopes. ——— But our little *module* taken from the third of the diameter of the lower part of the *column*, has uſes much more extenſive; for by this the heights of *pedeſtals*, of columns, and entablatures, in all the orders, are determined without a fraction.———As then the great *module* or diameter of the column has 60 minutes; and the mean *module*, or half the diameter 30 minutes; our little *module* has 20.

There are a few ornaments, which we had almoſt forgot mentioning, as the *trygliphs*, and *metopes*, both repeated, only in the *Dorick freeze*; the *triglyphs* at equal intervals. — Each *triglyph* conſiſts of two entire gutters or channels, cut to a right angle, called *glyphes*, and ſeparated by three interſtices, called by *Vitruvius*, *femora*, from each other, as well as from two other half channels, which are at the ſides.

The ordinary proportion of *triglyphs*, is to be a *module* broad, and one and a half high. — But this proportion Mr. *Le Clerc* obſerves, ſometimes occaſions ill-proportioned intercolumnations in portico's; for which reaſon he chuſes to accommodate the proportion of his *triplyphs*, to that of the intercolumns.

The intervals between the *triglyphs* are called *metopes*, which the antients uſed to adorn with carved works or paintings, repreſenting the heads of oxen, veſſels, baſons, and other utenſils of the heathen ſacrifices.

As there is found ſome difficulty in diſpoſing the *triglyphs* and *metopes* in that juſt ſymmetry which the *Dorick order* requires; ſome Architects make it a rule never to uſe this order but in temples. *Semi-metope*, is a ſpace ſomewhat leſs than half a *metope*, in the corner of a *Dorick freeze*.

The *triglyphs* make the moſt diſtinguiſhing character of the *Dorick order*. Some imagine them originally intended for the conveyance of the *guttæ* that are underneath them: Others fancy they bear ſome reſemblance to a lyre, and thence conjecture the ornament to have been originally invented for ſome temple dedicated to *Apollo*.

We'll now proceed to the FIVE different ORDERS of *Architecture*, viz. *Tuſcan*, *Dorick*, *Ionick*, *Corinthian*, and *Compoſite*.

The TUSCAN *order* is the firſt, ſimpleſt, and moſt maſſive of the *five orders*. It is called by *Vitruvius*, the *ruſtick order*, to be uſed, properly, in country houſes and palaces; in *Vignola*'s manner of compoſition, it is a beauty, even in its ſimplicity, and as ſuch ſhould find place, not only in private edifices; but likewiſe in publick ones, as in the *piazza's* of ſquares and markets; in the magazines and granaries of cities, and even in the offices and lower apartments in palaces.

Of all the orders the *Tuſcan* is the moſt eaſily executed, as having neither *triglyphs*, nor *dentils*, nor *modillons* to cramp its inter-columns. On this account, the columns of this order may be ranged in any of the five manners of *Vitruvius*, *viz.* the *Pycnoſtyle*, *Syſtyle*, *Euſtyle*, *Diaſtyle*, or *Aræoſtyle*.

The *Tuſcan order* takes its name from an antient people of *Lydia*, who coming out of *Aſia* to people *Tuſcany*, firſt executed it in ſome temples which they built in their new plantations.

Palladio gives us theſe inſtructions for the *Tuſcan order*; that the *column* (See *Plate* iv. 1) together with its baſe, (a 1) and capital (c 1) muſt be ſeven *modules* in length, and its diminution a fourth part of its bigneſs. That if a work is to be compoſed of this plain order, the intercolumnations ſhould be very wide, becauſe the architraves are made of timber, which, therefore, will be very commodious for country buildings, on account for the eaſy paſſage for carts and other country conveniencies.

The ſame author obſerves that the *pedeſtals*, (h 1) which are under this *order*, muſt be very plain and ſimple, and the height of a *module*; and that of the baſe of the column, half its diameter. That this height muſt be divided into two proportional parts, one whereof is to go to the *plinth*, which is round; and the other ſubdivided into four parts, one whereof is appropriated to the *liſtella* or fillet, which is ſometimes made a little leſs. That in this order only the *liſtella* makes a part of the *baſe*; and a part of the column in all the others; the other three parts being appropriated to the *torus*. That this baſe ought always to project a ſixth part of the diameter of the column. That the height of the capital is half the diameter of the lower part of the column,

column, and is divided into three proportional parts; the first applied to the *abacus*, which, from its form, is generally called *dado*, or a *dye*; the second to the *ovolo*; and the third subdivided into seven parts, the *listella* under the *ovolo*, being one of them, and the other remaining six are applied to the *collorino*, or neck of the column. The *astragal* (says he) is twice the height of that of the *listella*, under the *ovolo*; and its centre is made on the line, which falls perpendicular from the *listella*, the projecture of the *cincture*, which is as thick as the *listella*, falls directly upon it. The projecture of this *capital* corresponds with the shaft of the column below: Its *architrave* (e 1) is composed of timber, the height whereof must be equal to its breadth, and its breadth must never be greater than the shaft of the column at top. The joists, which are instead of the *guttæ* or *drip*, project a fourth part of the length of the column. The profiles on the side of the plan of the base and capital are the impost of the arches.

But, continues he, if the architraves are composed of stones, you must observe what I have already mentioned, with respect to the intercolumnations; and which is the same mentioned at the beginning of this treatise.

Mauclerc will have the height of the *Tuscan column*, divided into nine parts; two whereof are for the *stilobate*, or *pedestal*; and those two subdivided into six parts; one to be applied to the inferior *cymatium*, one to the superior, and the four remaining to describe a square, intersected by two diameters or diagonal lines. In that square he would have a circle made, and another square in that circle, which inward square will be the swelling of the lower part of the column, and the outward one the breadth of the plinth of the base. He will have the swelling at top to be the middle square, which is to be divided into eight parts, two whereof will be the diminution of the column. The projecture of the cymatium of the plinth he divides into six parts, one to project out, in which he places the square. He also divides the *base* of the column into two parts, one whereof to be the *plinth*, and the other to be subdivided into four, one for the *tailloir* over the *listel*, and one of the remaining three to be divided into two, one whereof for the reglet, or fillet, under the *cornice*, which is to project out square-like. Thereby, says he, the whole projecture will be the seventh part of the breadth of the *pedestal*.

In his opinion, the upper *cymatium*, otherwise called the cornice of the pedestal, is to be divided into four parts; one to be applied to the listel, or *talcar*, two to the *plinth*, and the fourth to the *astragal*, or *fillet*; so that the *astragal* might be twice larger than the *fillet*. The *base* of the column is to be divided into two parts; one for the *plinth*, (D 1) and the other subdivided into three; two whereof to be applied to the *torus*, and the third to the *fillet*; so that its whole projecture is the interval from the exterior square to the interior. The projecture of the *fillet* must be a square from the column, and the rest is given to the *torus*. The height of the *fust* of the column must be six parts of its breadth, with its *cymatium* and capital. The height of the capital must be half the breadth of the lower part of the *shaft* or *fust* of the column, and is to be divided into three parts, one whereof to be given to the *abacus*, the second to the *tore*, and the third to the *freeze*. The *tore* being divided into four parts; one is given to the *fillet*, and the rest makes up the *torus*. The *freeze* (f 1) is divided into two, one for the breadth of the *astragal*, and this to be subdivided into three, one for the *fillet*, and the two others for the *astragal*. The eighth part of the breadth of the *fust* of the column below will be the projecture of the *capital*. He gives the following directions for the diminution of the column.

The length of the column between its two *cymatiums*, is to be divided into six parts, two thereof for the lower part of the column, and make a third of its height. Having made the division from the bottom to the top, transversal lines are to be drawn on each side, and the compass applied from one end to the other of the line of the third part; the compass placed on the side, the circle is to be divided from one of the sides of its semicircle to that part, where the line falls perpendicularly for the higher scope of the column, to the six parts of the *ichnography* on the pedestal, where they cut the *semiround* on the left, into four parts. Likewise, from each part must be drawn a line upwards, beginning outwards, and proceeding to the sixth part of the *fust*; from the second and third of these lines thus conducted, must be drawn those for the diminution of the column. But to render the diminution more just, and agreeable to the eye, he advises, that instead of dividing the circle into four parts, it is better to divide that same space, together with the column, into 5, 6, 7, or 8, since the great number of divisions renders always the diminution more agreeable and perfect.

Vitruvius, *lib.* 3. *c.* 12. gives other instructions for the diminution of these columns, and will have the lower diameter of a *Tuscan* one, in which is 16 feet in height from the *base* to the *capital*, divided into six parts, allowing five for the top. Those from 15 to 20 feet, their lower diameter is to be divided into six parts and a half, five and a half

half for the top. From 20 to 30, the diameter is divided into ſeven parts and a half, ſix and a half whereof are to be given to the top. But from 40 to 50, the diameter muſt be divided into eight parts, allowing ſeven to the top, from whence will iſſue a handſome *diminution.*

The ſame author divides the *architrave*, which he makes half the breadth of the lower part of the column, into ſix parts, one he gives to what he calls the ſuperior cornice, and ſubdivides that alſo into three, one for the fillet, and the two others for the left *talon*; but the other five remaining parts of the *architrave*, he ſubdivides into nine, five whereof he gives to the ſuperior *faſcia*, and the four remaining to the inferior, the whole with its projecture. He alſo makes the height of the freeze half the breadth of the lower part of the column. Over the freeze he places the cornice, of an equal altitude with the freeze, whoſe projecture on the left ſide, is equal to its height; and is to be divided into four parts, one for the *talon*, ſubdivided into three, one thereof for the *faſcia*, and the two others for the *talon*; but of the three parts remaining of the cornice, one he gives to the *echine*, and to the fillet, and this he ſubdivides into four, one for the fillet, and three for the *echine*, and the two parts remaining of the firſt three, are for the projecture, which is equal to the height.

Others divide the height given for this whole order, into ten ſeveral parts, take two for that of the *pedeſtal*, and divide the remaining eight parts into five, one whereof for the altitude of the *entablature*, and the other four for the length of the column, the *baſe*, and the *capital* included; ſo that the entablature is by that means, made one fourth of the length of the column.

Having divided the entablature into ſeven parts, they apply two to the *architrave*, two to the *freeze*, and two to the *cornice:* making of four of theſe parts, the diameter of the column.

They divide the altitude of the *pedeſtal* (h 1) into ſix parts; two for the *baſe* and *plinth*; three for the altitude of the *dye*; and one for that of the *cap*.

In order to find out the breadth of the *dye*, the diameter of the column is divided into five parts, and ſeven ſuch parts is the breadth, and is likewiſe, the projecture of the baſe of the column.

The *baſe* of the *pedeſtal* is found by the diviſion of the two parts allotted for the *baſe* and *plinth*, into three, allowing one to the *baſe* and two to the *plinth*. The projecture of the *cap* and *baſe* of the *pedeſtal* is equal to the altitude of the ſaid baſe.

In order to diminiſh the ſhafts of the column, they will have its diameter taken with compaſſes, and find it ſix times contained between the *baſe* and the *capital*; at two of which from the *baſe*, they make a ſemi-circle; then let fall a perpendicular from the diameter at top, and cut the ſemi-circle at four; after that divide the part of the ſemi-circle, ſo cut off into four parts (becauſe four parts of the *ſhaft* remain above) and raiſe perpendiculars from the ſaid points, to the correſpondent diviſion, which will form a regular curve for the ſwelling.

The *altitude* of the *baſe* of the column, is half a diameter, and is divided into two, allowing one to the *plinth*, the other part is divided into four, giving one to the *fillet*, and three to the *torus*. The whole projection is one fifth of the diameter of the column, and the fillet projects equal to its altitude.

For the ſeveral and reſpective members of the *pedeſtal*, *baſe*, *plinth*, and *cap*, they divide the baſe into three, allowing one to the *fillet* and three to the *hollow*.

They divide the altitude of the *cap* into four, allowing one to the *ogee*, two to the *corona*, and one to the *band* at top. For the projections, they make them both equal to the altitude of the *baſe*, and both being divided into three parts, they conceive, by inſpection, the projecture of the ſeveral members.

Having ſhewn the whole altitude of the *entablature* to be one diameter, and three fourths, and ſet off the principal height of the *architrave*, *freeze*, and *cornice*; as for the particular members, they divide the *architrave* into ſix parts, allowing two to the firſt *faſcia*, three to the ſecond, and one to the band at top. They make the projection equal to the altitude of the firſt band, and give one third to the ſecond *faſcia*.

They divide the altitude of the *cornice* into nine parts (*i. e.* each principal third into three) allowing one and a half to the *hollow*, half to the *fillet*, one and a half to the *ovolo*, two to the *corona*, half to a *fillet*, two to the *ſcima recta*, and one to the upper *fillet*. They make again the projection equal to its altitude, and to contain the ſame diviſions, pretending the ſeveral diviſions to be obvious by the inſpection of the ſcales only.

They make the *capital* half a diameter in height, and divide it into three parts, allowing one to the freeze of the *capital*, another to the *ovolo* and *fillet*, which is one fourth, and the other part to the *abacus*. Thereby the projection is one eighth of the diameter, which gives likewiſe the diameter of the column at top. The fillet is equal to the height.

The *aſtragal*, or *collorino*, is one third of the ſaid freeze of the capital in height, and the fillet the

the height thereof, and is equal to the height in its projection.

In the *Tuscan cornice*, (g 1) as well as in all others, they preserve the principal divisions, both with respect to the height and projection, and introduce them again, with no other intent but to corroborate the rules, and to shew the method of forming the several and respective mouldings, and which they suppose discernable by inspection.

The DORICK is the second of the FIVE ORDERS, being that between the *Tuscan* and *Ionick*.

As for the invention of the *Dorick order*, the tradition is, that *Dorus*, king of *Achaia*, having first built a temple of this order at *Argos*, which he dedicated to *Juno*, occasioned it to be called *Dorick*; though others derive its name, we know not how, from its being invented or used by the *Dorians*.

'Tis the most natural and the best proportioned of all the orders; all its parts being founded on the natural position of solid bodies.——At its first invention it was more simple than at present; and when in process of time they came to adorn and enrich it more, the appellation *Dorick* was restrained to its richer manner, and the primitive simple manner, they called by a new name, *Tuscan Order*.

Some time after its invention they reduced it to the proportion, strength and beauty of the body of a man. Hence, as the foot of a man was judged the sixth part of its height, they made the *Dorick* column, including the *capital*, six diameters high, *i. e.* six times as high as thick.—Afterwards they added another diameter to the height, and made it seven diameters; with which augmentation, it might be said to be near the proportion of a man: the human foot, at least in our days, not being a sixth, but nearly a seventh part of the body.

The characters of the *Dorick order*, as now managed, are the height of its column, which is eight diameters; its freeze, which is enriched with *triglyphs*, *drops*, and *metopes*; its *capital*, which is without *volutes*, and its admitting of *cymatiums*.

Vitruvius complains of the *Dorick*, as very troublesome and perplexing, on account of the *triglyphs* and *metopes*, so as scarce to be capable of being used, except in the *pycnostyle*, by putting a *triglyph* between two columns; or in the *aræostyle*, by putting three *triglyphs* between each two columns.

The moderns, on account of its solidity, use it in large, strong buildings; as in the gates of cities and citadels, the outsides of churches, and other massy work, where delicacy of ornament would be unsuitable.

Vignola adjusts the proportions of the *Dorick* ORDER, thus: the whole height of the order, without *pedestal*, he divides into twenty parts or modules; one of which he allows the *base*, fourteen to the *shaft* or fust, one to the *capital*, and four to the *entablature*.

Palladio will have the *module* of this *order* to be but half the diameter of the column, divided into thirty minutes, whereof in the other orders, he makes it the whole diameter, divided into sixty.

The same author will have the *Dorick column*, if insular without piers, to be eight diameters in length, or seven and a half at least; and seventeen *modules*, and a third (including the *base* and *capital*) when joined to piers.

He observes, that when a *pedestal* (h 2) is to be joined to this *order* (which he says was not the custom of the ancients) the *dado* or *dye*, must be square, from whence the measure of its decorations must be taken; therefore he divides it first, into three proportional parts, allowing two for the *base* and its *plinth*, and the third for the *cymatium*, whereto the *plinth* of the *base* of the column must be joined.

He supposes no peculiar *base* (a 2) to this order, which is the reason he gives for these columns being found without bases in several buildings, as the theatre of *Marcellus* at *Rome*; the temple *de la Picta*, adjacent to it, the theatre of *Vicenza*, &c. but pretends the *Attick base* to be a great ornament to it.——He then proceeds to give us the exact measures thereof.—He will have its height half the diameter of the column, and divided into three proportional parts; one for the *plinth*, and the other two subdivided into four proportional parts; one for the upper *torus*, the other three subdivided again, into two proportional parts; one whereof is the lower *torus*, and the other the *cavetto*, with is *listella's*.——He also gives these their particular measure, and divides them into six parts; the first for the upper *listella*, the second for the lower, and the four others for the *cavetto*.——He makes the whole projecture, the sixth part of the diameter of the column, and the *cincture* half the upper *torus*.——In case he divides it from the *base*, he makes its projecture a third of that of the *base*; but in case the *base* and part of the column make one perfect piece, he will then have its *cincture* small.

The capital, (b 2) says he, must be half the diameter of the column, and divided into three parts. the first whereof subdivided into five parts, of which three are for the *abacus*, and the other two for the *cymatium*; which being subdivided into three parts, the first goes to the *listella*, and the two last to the *cymatium*.——The second principal part he subdivides into three proportional parts; one for the annulets or squares, which are all proportional; the other two for the *ovolo*, the projecture whereof he makes two thirds of its height; allowing the third principal part for the *collorino*, so that the entire projecture must be the fifth part of the diameter of the column.

He makes the height of the *astragal* proportional to the three *listella's*, and to project to the lower part of the shaft of the column; and the *cincture* half the height of the *astragal*, and its projecture direct with its center.—The architrave (e 2) raised upon the capital, and whose height must be half the diameter of the column, (b 2) he divides into seven parts, one for the *tenia* or *fillet*, whose projecture is proportional to its height, and afterwards subdivides the whole into six parts, one for the *guttæ*, of which there must be six, and the *listel* under the *tenia*, which he makes a third part of the *guttæ*.—The remainder from the *tenia* downwards, he subdivides into seven parts; three of them for the first *fascia*, and the other four for the second.—He makes the freeze (f 2) a *module* and a half high, the breadth of the *triglyph* a *module*, and its *capital* the sixth part. The *triglyph* he divides into six parts; two whereof are for the two channels in the middle, one for the two half channels at the ends, and three for the spaces between the said channels. He'll have the *metope*, which is the space between the *triglyphs*, a perfect square. —He'll have also the *cornice* (g 2) a *module*, and a sixth in height, and divided into five parts and a half, two for the *cavetto* and *ovolo*, (the *cavetto* to be less than the *ovolo*, and exactly as much as its *listella*) the other three and a half for the *corona*, and both the *cimas*, the *recta*, and the *reversa*.

He makes the projecture of the *corona*, two thirds of a *module*, and in the face thereof, which looks downwards, and projects along the *triglyphs*, places six *guttæ* in length, and three in breadth, with their *listella's*, and some *roses* over the *metope*. The *guttæ* are round in the form of bells, and answer to those under the *tenia*. The body of the *cymatium* is one eighth larger than the *corona*, and is divided into eight parts, two for the *plinth*, and six for the *cymatium*, the projecture whereof is seven and a half: so that the altitude of the *architrave*, the *freeze* and *cornice*, are a fourth part of the height of the column.

Most of the *Architects* divide the altitude given for this whole order, first into ten parts, allowing two to the *pedestal*, and dividing the remaining eight parts into five; then give four to the length of the column, including the *base* and *capital*, and reserve the other one for the entablature, which they divide into four parts, two whereof they make the diameter of the column: thus the column will be eight diameters high, and the *entablature* one fourth of the length of the column. Having divided the architrave into four, they give one to the architrave, one and a half to the *freeze*, and one and a half to the *cornice*. They make the *architrave* to project one sixth of its height, and the cornice a diameter of the column; that is to say, four such parts as it is three in height. The height of the *pedestal* they divide into seven parts, allowing two to the *base* and *plinth*, four to the *dado*, or *dye*, and one to the *cap*.

They diminish the column one sixth of the diameter, from one third of the length of the *shaft* or fust; and say, that if the diameter at bottom be divided into five, the *base* of the column will project, on each side, one of these parts, which will give the breadth of the *dado* of the *pedestal*, and by that means make it a square. They make the *base* of the *pedestal* one third of the two parts for the *base* and *plinth*, and its projection equal to the height, and the *cap* to project four fifths of the height.

They make the height of the base of the column half the diameter, and the projection to give the breadth of the *pedestal*, which is a diameter, and two fifths.

For the particular members of the *pedestal* they divide the height of the *base* into six, giving three to the *torus*, one to the *fillet*, and two to the *hollow*, pretending that the projection being the same parts, each member is easy to set off by inspection. They divide the *cap* into five parts, giving one to the hollow, half a part to the fillet, one and a half to the *ovolo*, one and a half to the *corona*, and half a part to the *fillet* at top; therefore the projection must have four of these parts.

The height of the *base* of the column they divide into three parts, one for the *plinth*, the half of another for the upper *torus*, and the half of the remainder for the lower *torus*; then the remaining three fourths are divided into six, one for each *fillet*, and four for the *scotia*. They make the whole projection one fifth of the diameter, and dividing it into three, they give one to the upper fillet, which is part of the column, and is double the height of the others, and another to the upper *torus*.

They make a *Dorick fluted column* (b 2) with twenty in number, fluted to an edge, some making their form or depth by the center, being in the middle of a square; others by the joint of an equilateral triangle.

Having made the whole height of the *entablature* two diameters, they divide it into four, one for the *architrave*, one and a half for the *freeze*, and one and a half for the *cornice*. As for the particular members they divide the *architrave* into six; two for the first face, three for the second, and one for the band at top. They allow one of these parts to the *guttæ* or bells, and a third thereof to their *fillet*;

as

as well as to the projection. They adorn the *freeze* with *triglyphs*, which are half a diameter in breadth, one whereof they place in the middle of the column, and make the *metope*, or place beween, equal to the height of the said *freeze*. They, afterwards, divide the *triglyphs* into twelve parts, allowing one to each half channel, two to each whole channel, and two to each of the space between the channels. They make the projection of the *triglyph* one and a half of these parts.

They divide the height of the *cornice* into three, and divide again the lower part into three; one gives the *cap* of the *triglyph*, one the *hollow* and *fillet*, (which is one fourth) and the other the *ovolo*. The other two parts they divide into seven, allowing two to the *mutule* and *cap*, two to the *corona*, one to the *scima reversa* and *fillet*, and two to the *scima recta* and *fillet*, and discover the smaller divisions by inspection.

As to the *projections*, the whole being four such parts as the three in height, they divide again the first of them into three, allowing one to the cap of the *triglyph*, another to the *cavetto*, and the other to the *ovolo*. The outer part they subdivide likewise into seven, which regulate the *scima* and *corona*.

The height of the *capital* they divide into three, one gives the *freeze* of the *capital*, another the *fillets* and *ovolo*, and the third the *abacus*, *scima reversa* and *fillet*; but to be more particular, the middle part is divided into three, allowing one to the fillets, which are three, and equal, or (as on the other side) one to a *fillet*, and two to an *astragal*; the upper third part they divide into five, allowing three to the *abacus*, and two to the *scima reversa* and *fillet*, which is one third. They make the projection equal to the height of the *freeze*, and fillets together, and from its being divided into four, expect the rest to be seen at once.

To regulate the *intercolumnations* in the *Dorick order*, it must be done according to the number of *triglyphs* intended between, allowing for one *triglyph* between, one diameter and a half; for two *triglyphs* two and three fourths, and for three *triglyphs* four diameters.

The Ionic Column (b 3) is the third in order, and is distinguished from the *Composite*, in that it has none of the leaves of the *acanthus* in it *capital*; from the *Tuscan*, *Dorick* and *Corinthian*, by the *volutes* or rams-horns, which adorn its *capital*; and from the *Tuscan* too by the channels, or flutings in its *shaft*.

The Ionic Order owes its origin to *Ionia*, a province of *Asia*, and it is said the temple of *Diana* at *Ephesus*, the molt celebrated edifice of all antiquity was of this order. The *Ionic* has an advantage above any of the rest; and it consists in this, that the fore and hind parts of its capital are different from its sides. But this is attended with an inconvenience, when the ordonnance is to turn from the front of the building to the sides; to obviate which, the *capital* may be made angular, as is done in the temple of *Fortuna Virilis*.

This *column* is a medium between the massive and delicate orders, the simple and the rich. Its height is eighteen *modules*, or nine diameters of the column taken at the bottom. When it was first invented its height was but sixteen *modules*; but the ancients, to render it still more beautiful than the *Dorick*, augmented its height by adding a *base* to it, which was unknown in the *Dorick*.

M. *Le Clerk* makes its *entablature* four *modules* and ten minutes, and its *pedestal* (h 3) six entire *modules*; so that the whole *order* makes twenty-eight *modules* and minutes.

Palladio will have this column with its *capital* (c 3) and *base* (a 3) nine *modules* high, (making the *module* a diameter of the column below.) Its *architrave*, (e 3) *freeze*, (f 3) and *cornice*, (g 3) are a fifth part of the height of the column, and the intercolumnations two diameters and a quarter, which he believes the most commodious, and the most fit to strike the eye agreeably.

In the *arches* where the *Ionic columns* are to have *pedestals*, he makes their height equal to half the breadth of the opening of the arch, and divides it into seven parts and a half, two for the *base*, one for the *cymatium*, and the other four and a half for the *dado*. He makes the *base* of the *Ionic order* half a *module* thick, and divides it into three parts, one for the *plinth*, the projecture whereof is the fourth, and an eighth part of the *module*, dividing the other two into seven parts, three whereof he gives to the *torus*, subdividing the other four into two parts, one for the upper *cavetto*, and the other for the lower *cavetto*, which ought to have the greatest projecture. He has the *astragals*, the eighth of the *cavetto*, the *cincture* of the column the third part of the *torus* of the *base*, provided the cincture be not joined to the base of the column; for in that case he makes it smaller, making its projecture half of that above mentioned.

To make the *capital*, he divides the diameter at the *base* of the column into eighteen parts, and nineteen of such parts make the length and breadth of the *abacus*, one half whereof is the height of the *capital*, with its *volutes*, whence its height must be nine parts and a half; one and a half whereof is for the *abacus* with its *cymatium*, and the other eight for the *volutes*, which he makes after this manner.

He takes one of the nineteen parts from the end

of

of the *cymatium*, inward, and from the point made, he lets down a plum-line to divide the *volute* in the middle. Where the point falls upon this line, which ſeparates the four parts and a half above, from the three and a half below, the centre of the *volute* is made, whoſe diameter is one of the eight parts; and from the aforeſaid point he draws a line, which as it cuts the *catheto* at right angles, divides the *volute* into four parts. Then he makes a ſquare in the eye of the *volute*, about the ſame bigneſs as the ſemi-diameter of the ſame eye; and drawing diagonal lines, he marks the points upon them, where the fixed foot of the compaſs muſt ſtand to make the *volute*; which points or centers are thirteen in number, the eye incluſive. He places the *aſtragal* of the column in a direct line with the eye of the *volute*. He makes the thickneſs of the *volutes*, in the middle, in proportion to the projecture of the *ovolo*, which muſt project beyond the *abacus*, juſt as much as the eye of the *volute*. The channel of the *volute* is even with the *ſhaft* of the column. The *aſtragal* of the column goes under the *volute*, and is always ſeen.

Palladio uſually makes *capitals* in the angles of colonades or portico's of the *Ionic order*, with *volutes*, not only in the front, but alſo in that part which would have been the flank, in caſe the *capital* was to be made as generally it is; by which means they have the front on two ſides, and are called by him *Angular Capitals*.

The ſame author makes the *architrave*, *freeze*, and *cornice*, a fifth part of the altitude of the *column*, and divides it into twelve parts; ſome whereof are for the *architrave*, three for the *freeze*, and five for the *cornice*. The *architrave* he ſubdivides into five parts, one for the *cymatium*, and the remainder is again ſubdivided into twelve parts; three whereof are for the firſt *faſcia* and its *aſtragal*, four for the ſecond, and five for the third. He divides the *cornice* into ſeven parts and three-fourths, two for the *cavetto* and the *ovolo*, two for the *modillon*, and three and three-fourths for the *corona* and the *cymatium*. The projecture or jetting out of the whole cornice, he renders proportional to its altitude.

Others divide whatever height be given for the whole order, into ten parts, and allowing two to the *pedeſtal*, divide the remaining eight into ſix, giving one to the *entablature*, and five to the length of the column, incluſive of the *capital* and *baſe*. The ſaid length being divided into nine parts, they find it to be the diameter of the column, which, like moſt of the other *Architects*, they make uſe of to regulate ſome of the ſmalleſt members.

The height of the *entablature* they divide into ſix, allowing two to the *architrave*, one and a half to the *freeze*, and two and a half to the *cornice*, making the projecture of the *architrave* one fourth of its height, and that of the *cornice* equal to its height. They divide the height of the *pedeſtal* into ſeven parts, allowing two to the *baſe* and *plinth*, four to the *dado*, and one to the *cap*.

They diminiſh the column one ſixth of the diameter, from one third of the length of the *ſhaft*, in the ſame manner as the laſt order, and the baſe of the column projects the ſame, which gives them likewiſe the breadth of the *dado* of the *pedeſtal*. They make the *baſe* of the *pedeſtal*, one third of the two parts given for the *baſe* and *plinth*, and the projection thereof equal to the height, and the *cap* to project three fourths of its height.

They make the height of the *baſe* of the column half the diameter, and the projection one fifth part of the whole diameter, which gives the breadth of the *pedeſtal*; for the principal members thereof they divide the height of the *baſe* into four parts, allowing half a part to the *fillet*, two to the *cymate*, one half part to the *fillet*, and one to the hollow. The projection being equal to the height, and divided into the ſame number of parts, the members, ſay they, appear by inſpection. They likewiſe divide the *cap* into four parts, allowing one to the *hollow* and *fillet*, which is one fourth, another to the *ovolo*, another to the *corona*, and one to the *ogee* and *fillet*, which is one third. They make the whole projection three of the four parts of the height, and dividing each third into three, they ſet off as to appear by inſpection.

The *baſe* of the column they divide into three parts, one for the *plinth*, and the other two as they are divided in the *Dorick order*. They make the *bead* above the upper *torus*, part of the column, and double the height of the *fillets*; and the *fillet* above the ſaid *bead* equal to the others, and the projection the ſame as in the *Dorick*.

They make twenty-four flutes in the fluted columns of the *Ionic*, each of a ſemicircle in depth, and the *liſt* or *fillet*, between each one third of the ſaid flutes.

The whole height of the *Ionic capital*, (c 3) which they conceive to be more difficult than the former, is made half a diameter, which being firſt divided into three parts, the upper part is for the *abacus*, which is divided again into three, one for the upper part, half a part for the *fillet*, and one and a half for the lower part. From the middle of the ſaid *abacus* downwards, it is divided into eight parts, allowing two and an half from the bottom of the *volute* to the *fillet*, half a part to the *fillet*, one to the *aſtragal*, and two to the *ovolo*.

The whole height of the *entablature*, they divide into ſix parts (as before mentioned) allowing two

two to the *architrave*, one and an half to the *freeze*, and two and an half to the *cornice*; as for the particular members, the *architrave* (e 3) being divided into two parts, each is fubdivided into eight, in all fixteen, allowing three to the firft face, four to the fecond, five to the third, one to the *bead*, two to the *ogee*, and one to the *fillet*. They make the projection one fourth of the height, and the upper face one third thereof. They form the *freeze* (f 3) by making a triangle on the middle part of three in its height, whofe oppofite angle is the center for the curve or fwelling.

They divide the height of the *cornice* (g 3) into eight parts, allowing one to the *hollow* and *fillet*, (which is one fourth) another to the *ovolo*, and two more to the *modillon* and *cap* (which is half a part) the upper four parts they fubdivide into five, giving two to the *corona*, one to the *fcima reverfa* and *fillet* (which is one fourth,) one and an half to the *fcima recta*, and half a part to the *fillet*. They make the whole projection equal to the height, and divide it into nine parts (each being one twelfth of the diameter) and as to the feveral members, they refer to a due infpection.

Scamozzi, and fome other modern *Architects*, have introduced the upper part of the *Compofite capital* in lieu of the *Ionic*, imitating that of the temple of *Concord*, whofe four fides are alike; to render it more beautiful, the *volute* may be made a little oval and inclining.

At prefent the *Ionic order* is properly ufed in churches and religious houfes, in courts of juftice and other places of fuppofed tranquility, and devotion.

The CORINTHIAN ORDER, the fourth, or as *Scamozzi* and M. *Le Clerk* make it, the fifth, and laft of the ORDERS of ARCHITECTURE is the nobleft, richeft, and moft delicate of them all. This is faid by the ancients to be invented as remarked on page 142. But *Callimachus*, a *Corinthian* Sculptor, is thought by moft of the modern writers to have been the inventor of this *order* of *Architecture*, and that paffing by the tomb of a young lady, over which her nurfe had placed a bafket with fome of her play-things, and covered it up from the weather with a tile; the whole having been placed on a root of *achantus*; as it fprung up, the branches encompaffed the bafket, and bending down a-top under the corner of the tile, formed a kind of *volutes*; hence *Callimachus* took his hint: the bafket he imitated in the *vafe* of his column; the leaves in the *volutes*, and the tile in the *abacus* of his order. *Villalpandus* treats this ftory of *Callimachus*, as a fable; and will have the *Corinthian capital* to have taken its origin from an order in *Solomon*'s temple, the leaves whereof were thofe of the palm tree.

The *Corinthian* has feveral characters, whereby it is diftinguifhed from the reft. Its *capital* (c 4) is adorned with two rows of leaves, between which rife little ftalks or caulicoles, whereof the *volutes* are formed, which fupport the *abacus*, and are fixteen in number. It has no *ovolo*, nor even *abacus*, properly fpeaking; for the member that goes by that name is quite different from the *abacus* in the other *orders*; being cut with a fweep, in the middle, on which is carved a rofe, or other ornament.

Vitruvius obferves, that the *Corinthian* order has no particular ordonnance for its *cornice*, or any of the other ornaments of its entablature; nor does he give it any other proportions than thofe of the *Ionick order*; fo that if it appears higher than the *Ionick*, it is purely owing to the excefs of the height of its *capital*. He alfo makes the reft of the *entablature* the fame; and the *Attick bafe* he ufes indifferently for the one and the other.

But we have feveral examples now remaining of antiquity, which contradict *Vitruvius*'s opinion; the moft beautiful whereof have a particular *bafe* (a 4) and the whole order twenty *modules* in height; whereas the *Ionick* has but eighteen. Again, its *capital* is higher than that of *Vitruvius* by one third of a *module*; and its *entablature*, which has *modillons*, and fometimes *dentils*, together with *modillons*, is very different from the *Ionic entablature*.

Moft of the modern *Architects* fet afide *Vitruvius*'s *Corinthian* ordonnance, and follow that of the ancient buildings, felecting from them according to their feveral taftes: fo that modern *Corinthian* is a kind of *Compofite*; differing from any of the ancient buildings, and much more from *Vitruvius*'s rules.

Vignola and Mr. *le Clerc* make the *Corinthian* order twenty modules high: yet *Serlio* makes it only eighteen; and Mr. *Perrault* eighteen and two-thirds, retrenching fomething from the nineteen of *Vitruvius*. The height of the fhaft, Mr *Perrault* makes lefs than that of the *Ionic*, by reafon of the excefs of its *capital*.

Palladio makes the *Corinthian* columns nine *modules* and an half in height, including both their *bafe* and *capital* (and in cafe they are to be fluted) with twenty-four *flutes* or hollows, whofe depth is in proportion to half their breadth. The plan, or interval between two *flutes*, he makes one third part of the breadth of thofe *flutes*. The *architrave*, (e 4) *freeze*, (f 4) and *cornice*, (g 4) are a fifth part of the height of the column. He will have the altitude of the *pedeftal* one fourth part of the height of the column, and divides it into eight parts; one for the *cymatium*, two for the *bafe*, (a 4) and the other five for the *die*.——when he has divided the *bafe* into three parts, two of them go to the *plinth*, (D 4)

(D 4) and one to the *mouldings*. Like *Vitruvius* he ſets the *Attic baſe* under this order, but different from that which is placed under the *Dorick*, the projecture thereof being one fifth part of the diameter of the column.

He makes the height of the *Corinthian capital*, the diameter of the column below, and a ſixth which he allows to the *abacus*, the reſidue he divides into three proportional parts; the firſt is for the firſt row of leaves, the ſecond for the middle row, and the third he ſubdivides into two parts; the caulicules, or ſtalks, together with their leaves, which are, as it were, ſupported by them, and out of which they grow, he makes of the part which is neareſt the *abacus*: the ſtalk thereof, or *fuſt*, from whence they ſpring, he will have thick, and to decreaſe gradually in their foldings, like plants which are thicker at the bottom, than at the end of their branches. He makes the *campana*, or bell, which is the ſtalk of the column under the leaves, perpendicular to the bottom of the *flutes* of the column.

In order to give the *abacus* a proper projecture, he forms a perfect ſquare, the ſide whereof is a *module* and a half; in which ſquare he draws diagonal lines, the point of the interſection thereof, is in the center, on which he places the foot of the compaſs, and makes a *module* towards each angle; drawing lines, which cut the ſaid diagonals at right angles, where theſe points meet, ſo as to touch the ſides of the ſquare; and theſe are his limits of the projecture, whoſe length gives the breadth of the horns of the *abacus*. To make its curvature, or dimunition, he draws a circular line from one horn to the other, and makes the point; whereby an equilateral triangle is made, the baſe whereof is the diminution.

Afterwards he draws a right line from the ends of the before-mentioned horns to the end of the *aſtragal* of the column; which he makes ſo as to be touched by the tips or ends of the leaves; and this he gives for their projecture. He makes the *roſe* a fourth part, as broad as the diameter of the column at the foot. Having made the *architrave*, *freeze*, and *cornice*, a fifth part of the altitude of the column; he divides the whole into twelve parts, as in the *Ionic*, but varies in this, that he divides the cornice of the *Corinthian* into eight parts and a half, giving the firſt to the *ſcima reverſa*, the ſecond to the *dentils*, the third to the *ovolo*, and the fourth and fifth to the *modillons*, and the other three and a half to the *corona* and the *cymatium*. The projecture of the cornice is in proportion to its height. He has the pannels of the *roſes* between the *modillons* ſquare, and the *modillons* half as broad as the plan of the ſaid *roſes*.

The height given for the *Corinthian order*, is alſo often divided into ten parts, giving two to the *pedeſtal*, (h 4) and dividing the other eight parts into ſix, five for the length of the column, with the *baſe* and capital, and the other for the height of the *entablature*. They afterwards divide the length of the column into nineteen parts, and make two of them the diameter of the ſaid column; from whence they form ſeveral of the minuter parts.

They divide the height of the *entablature* into ſix parts, giving two to the *architrave*, one and a half to the *freeze*, and two and a half to the *cornice*; making the projection of the *architrave* one fourth of its height, and that of the *cornice* equal to its height.

The height of the *pedeſtal* is divided into ſeven parts; two for the *baſe* and *plinth*, four for the *dado*, and one for the *cap*.

They diminiſh the column in the ſame manner as in the laſt order, and by taking the height of the *pedeſtal*, they give the projection of the baſe of the column, and the breadth of the *dye* of the *pedeſtal*. They make the *baſe* of the *pedeſtal* of one third of the two parts allotted for the *baſe* and *plinth*, and the projection thereof equal to the height, and the *cap* three-fourths of the height.

They make the height of the baſe of the column, half a diameter, and find its projection by taking half the height of the *pedeſtal*, which, alſo, is the breadth of the *dye*.

For the particular members of the *pedeſtal*, they divide the height of the *baſe* into three parts, giving one to the *torus* and *fillet*, which is one fourth, another to the *cymaſe*, and the third to the *ogee* and *fillet*, which is one fourth alſo. The whole projection they make equal to the height, and dividing it into five parts, give two to the *ogee*, two to the *cymaſe*, and the other to the *torus*. The *cap* is divided into four parts; half a part for the *hollow*, one fourth to the *fillet*, one to the *cymaſe*, one fourth to the *fillet*, one entire part to the *corona*, and one to the *ogee* and *fillet*, which is one third part thereof. They make the whole projection three parts of thoſe four in height, which dividing into four, they ſet off by inſpection.

They divide the height of the *baſe* of the column into three, one for the *plinth*, ſubdividing the upper two into five, giving one and a half to the lower *torus*, one to the upper *torus*, one to the *ſcotia*, and the other one and a half to the *fillets* and *beads*, viz. half a part to each *bead*, and one fourth to each *fillet*, the *bead* above the upper *torus* (being part of the column) is as large as the *fillet* and *bead* together, and its *fillet* the half thereof.

To find the height of the *Corinthian capital*, they divide

divide the diameter of the column into fix parts, and make one whole diameter, and one of thefe parts the height. Thofe fix parts they allow for the *abacus*, which dividing into two, they give one to the hollow, and the other to the *ovolo* and *fillet*. To each height of leaves they give two of the fix parts, the remaining diameter is divided into, and make the heads of thofe leaves to turn down half a part. They divide again the under one, of the upper two parts into two, the heads of the leaves turning down one part, and the upper one into three, giving one to the *fillet*, and two to the fmall *volutes*; the large *volutes* having the entire part. The *rofe* they make as high as the *abacus* and the *fillet* together.

They make no other difference between the projections of this order, and thofe of the foregoing one, but by obferving in the circumference of the column, that there are eight leaves in each height, and that each leaf has four plants carved with olive, parfley, &c. according to fancy; limiting the projection of their heads, by a right line drawn from the projecture of the *abacus* to the *collorino*, or *aftragal* of the column.

Having divided the whole height of the *entablature* into fix, they give two to the *architrave*, one and a half to the *freeze*, and one and a half to the *cornice*; and to make up the particular members, they halve each of the two principal parts the *architrave* is divided into, and then divide the lower part into three, giving two to the lower face, and half a part to the *bead*; dividing alfo a fecond part of the four into three, allowing one to the *ogee*; alfo dividing the upper fourth part into three, giving half a part to the *bead*, one and a half to the *ogee*, and one to the upper *fillet*, making the projection one of thofe fourths in height, of which they give half to the middle face.

For the *cornice*; they divide its height into eight parts, one for the *ogee* and *fillet*, another for the *dentils*, another for the *ovolo* and *fillet*, and the other is divided into fix, one fourth whereof they give to the *fillet* under the *modillons*, one and one fourth to the *modillon*, half a part to the *ogee* and *fillet*, one and a half to the *corona*, half a part to the *ogee*, one fourth to the *fillet*, one and one fourth to the *fcima recta*, and half a part to the *fillet*, making the whole projecture equal to the height, and dividing it into the fame number of parts.

The COMPOSITE (fo called from its *capital* (c 5) being compofed out of thofe of the other orders) is the laft of the five orders of *architecture*. It borrows a quarter round from the *Tufcan*, and *Dorick*; a double row of leaves from the *Corinthian*, and *volutes* from the *Ionick*.—Its *cornice* has fimple *modillons* or *dentils*. *Scamozzi*, and M. *Le Clerc*, place this order between the *Ionick* and *Corinthian*, in regard to its delicacy and richnefs, which they efteem inferior to the *Corinthian*, and therefore make no fcruple to ufe it under the *Corinthian*, tho' moft authors rank it after the *Corinthian*.

The proportions of this *order* are not fixed by *Vitruvius*; he only marks its general character, by obferving that its *capital* is compofed of feveral parts taken from the *Dorick*, *Ionick*, and *Corinthian*: He does not feem to regard it as a particular order; nor does he vary it at all from the *Corinthian*, except in its *capital*.—In effect it was *Serlio* who firft added the *Compofite order* to the four of *Vetruvius*, forming it from the remains of the temple of *Bacchus*, the arches of *Titus*, *Septimus*, and the Goldfmiths: Till then this *order* was efteemed a fpecies of the *Corinthian*, only differing in its *capital*.

This *order* being thus left undetermined by the antients, the moderns have a fort of right to differ about its proportions, &c. *Scamozzi*, and after him Mr. *Le Clerc*, make its column (b 5) 19 *modules* and a half, which is lefs by half a *module*, than that of the *Corinthian*; as in effect the order is lefs delicate than the *Corinthian*.—*Vignola* makes it 20, which is the fame with that of its *Corinthian*; but *Serlio*, who firft formed it into an *order*, by giving it a proper *entablature* and *bafe* (a 5) and after him M. *Perrault*, raife it ftill higher than the *Corinthian*.—This laft does not think different ornaments and characters fufficient to conftitute a different order, unlefs it have a different height too; agreeably to his rule of augmenting the height of the feveral columns by a feries of two *modules* in each; he makes the *compofite* twenty *modules*, and the *Corinthian* eighteen; which it feems is a medium between the porch of *Titus*, and the temple of *Bacchus*.

Palladio makes the columns of the *compofite* ten *modules* long; and the intercolumnation in the defigns of colonades, one diameter and a half.—He makes this order flenderer than the *Corinthian*, and its *pedeftal* (c 5) one third of the altitude of the column, and which he divides into eight parts and a half, the firft for the *cymatium*, and five and a half remaining for the *dado*. He fubdivides the *bafe* of the *pedeftal*, into three parts, two he allows for the *plinth*, and one for the *torus*, with its *cymatium*. He makes indifferently the *bafe* of this column, *attick*, or a compound of the *Attick* and *Ionick*.

He gives to the *Compofite capital* (c. 5.) the fame meafures with the *Corinthian*, but varies from it in the *volutes*, the *ovolo* and *aftragal*, which he cuts into beads, which members he borrows from the

Ionick, and which he makes thus.——He divides the capital from the *abacus* downwards into three parts; the firſt he allows to the firſt row of leaves, the ſecond to the middle row, and the third to the *volutes*, which takes up ſo much of the *abacus*, that it ſeems to go out of the *ovolo*, near the flower which is placed in the middle of the curvature of the *abacus*, and is as thick in front as the breadth of its *horns*, or little more.—The thickneſs of the *ovolo* he makes three fifths of the *abacus*, and its lower part to begin parallel to the eye of the *volute*; giving to its projecture, three fourths of its altitude.—He makes the *aſtragal* one third part of the altitude of the *ovolo*, and its projecture a little more than half its thickneſs, and to wind about the *capital* under the *volute*, ſo as to be always viſible.—To the *liſtella*, which is under the *aſtragal* and forms the *plinth* of the *bell* of the *capital*, he gives half the *aſtragal*, making the body of the *bell* perpendicular to the bottom of the flutes of the column.

A great number of modern *Architects* divide the height given for this order into ten parts, two thereof for the *pedeſtal*, and dividing the eight remaining parts into ſix, one for the height of the *entablature*, and five for the length of the column, with *baſe* and *capital*.—That length they divide into ten parts, which is no more than halving each of the five parts, and that is the diameter of the column below. So will the *pedeſtal* (h 5) be three diameters, the column ten, and the *entablature* two in height. Having divided the *entablature* into ſix, they give two the *architrave* (E 5), one and a half to the *freeze* (F 5), and two and a half to the *cornice*, (g 5), making the projection of the *architrave* two ſevenths of its height, and that of the *cornice* equal to its height. The height of the *pedeſtal* being divided into ſeven parts, they give two to the *baſe* and *plinth*, four to the *dye*, and one to the *cap*.

They diminiſh the column as in the laſt order, and dividing the diameter at bottom, into five, they make the *baſe* of the column project on each ſide, one of theſe parts, which gives the breadth of the dye of the *pedeſtal*. To the *baſe* of the *pedeſtal* they give one third of the two parts for the *baſe* and *plinth*, and make the projection thereof equal to the height, and that of the *cap* four fifths of the height.

They make the height of the *baſe* of the column, half a diameter, and its projection one fifth of the whole diameter. For the particular members of the *pedeſtal*, they divide the height of the *baſe* into four parts, one for the *torus*, one third of a part for the *fillet*, one and two thirds for the *cymatium*, and the other part, which is one third, to the *aſtragal* and *fillet*; the whole projection being equal to the height. The height of the *cap* they divide into five parts, one for the *aſtragal* and *fillet*; which is one third, two more to the *cymatium* and *fillet*, which is half a part; one to the *corona*, and one to the *ogee* and *fillet*, which is one third; making the whole projection four of the ſaid parts.

The height of the *baſe* of the column being divided into ſix, they give one and three-fourths to the *plinth*, one to the lower *torus*, one fourth to the *fillet*, half a part to the *ſcotia*, one to the *aſtragal* and *fillet*, (which are ſubdivided into ſix, each *fillet* having one, and each *aſtragal* two) then give half a part to the other *ſcotia*, one fourth to the *fillet*, and the remaining three fourths to the upper *torus*; as to the *fillet* above, which is part of the column, it is half a part, or double the bigneſs of the under one.

They make the height of the *Compoſite capital* a diameter and one ſixth, which they divide into ſeven, giving two to each height of *leaves*, the *head* thereof turning down half a part; two thirds of a part to the ſpace between the *leaves* and *fillet*, one third to the *aſtragal* and *fillet*, (which is one third of that) two thirds more to the *ovolo*, one third to the ſpace between the *ovolo* and *abacus*, half a part to the *hollow*, and half a part to the *ovolo* and *fillet*, which is one third thereof. They make no other difference between the projection of this, and that of the *Corinthian*, but in the *volutes*, which they make after the ſame manner of the *Ionick*; making beſides, this *capital* equal in height to the *architrave* and *freeze* taken together.

For to form the *entablature*, they divide its height into ſix parts, two for the *architrave*, one and a half for the *freeze*, and two and a half for the *cornice*.—For the particular members, the *architrave* is divided into ſeven parts, giving two to the firſt *faſciæ*, half a part to the *ogee*, two and a half to the ſecond *faſciæ*, dividing again the upper two parts into five, half a part for the *bead*, one and a half for the *ovolo*, two for the *hollow*, and one for the *fillet*; making the projection two of thoſe ſeven parts in height.

They obſerve no other order in the *freeze*, than that followed in the *Ionick*; but they divide the height of the *cornice*, into two and a half principal parts, ſubdividing each of them into four, and the half into two, which makes ten in the whole; giving one fourth to the *fillet*, one fourth to the *bead*, and one to the *ogee*; one more to the firſt *faſcia* of the *modillons*, half a part to the *ogee*, one and one fourth to the ſecond *faſcia*, one fourth to the *fillet*, half a part to the *ovolo*, two to the *corona*, one to the *ſcima reverſa* and *fillet*, which is one

one fourth, and one and a half to the *scima recta*, and half a part to the *fillet*; making its whole projection equal to its height.

The COMPOSITE is also called the ROMAN and ITALICK ORDER; as having been invented by the *Romans*, conformably to the rest, which are denominated from the people among whom they had their rise. Mr. *Perrault*, in his *Vitruvius*, distinguishes between *Composite* and *composed* order. The latter, he says, denotes any composition whose parts and ornaments are extraordinary and unusual; but have withal somewhat of beauty; both on account of their novelty, and in respect of the manner or *genius* of the *Architect*; so that a *composed order* is an arbitrary humorous composition, whether regular or irregular.

The same author adds, that the *Corinthian order* is the first *Composite order*, as being composed of the *Dorick* and *Ionick*, which is the observation of *Vitruvius* himself, *lib.* 4. *c.* 1.

GENERAL RULES given by PALLADIO, for avoiding several errors, which were first introduced by the *Barbarians*, and which are still in practice among us in *Architecture*.

1. He would have us admit of nothing in the several ORDERS repugnant to that symmetry, which nature observes in all her works: thus, as trees are bigger at the trunks and near the roots than at the top; he would have it laid down, that columns should be thicker at bottom than at top.

2. He rejects all columns without *bases*; since *bases* with their *torus's* and *cavetto's* represent so naturally the swellings occasioned by the weight they sustain; therefore condemns those, who, deviating from whatever is good, just and beautiful in *Architecture*, instead of pilasters or columns, which are to sustain any weight, place *cartouches*, which he calls *scrolls*, and supposes should strike the eyes of judges very disagreeably; and are so far, says he, from being satisfactory and pleasant to those, who are not, that they give them only an imperfect idea of *Architecture*, and only put builders to an unnecessary expence; for which reason he would have none of those cartouches come out of the cornice.

3. He condemns all *frontispieces* of gates, windows, and galleries, divided, and open in the middle, since those *frontispieces* were first made to defend these parts of the edifice from rain, &c. Necessity having instructed the antient *Architects* to cover them, and to give them the shape of a roof. Therefore he thinks that nothing can be more ridiculous than to open that part, which was invented for no other purpose than to shelter the inhabitants, and such as go into it from rain, snow, hail, and other injuries of the weather. And, says he, though variety and novelty pleases all mankind, yet they are not to be introduced in direct opposition to the rules of art, and the dictates of reason; and it must be acknowledged, that the antients never departed from any general and necessary precepts of art in their various inventions.

4. He forbids the making the projecture of the *cornice*, and other decorations very large, because when they exceed reasonable and due proportion, especially in a close place, they make it still closer, and more disagreeable to the eye, and frighten those who stand under them, who imagine they are every moment to fall on their heads.

5. He will have the *cornice* made in a due proportion to the columns, for if great cornices are put over little columns, or little cornices upon great columns, the whole must needs be disagreeable to the eye.

5. He advises us to avoid the supposing the columns to be composed of various pieces, and jointed together by certain *annulets*, and garlands round them, which appear to keep them close together; because the more solid and whole the columns seem to the eye, the better they answer the end, for which they were raised, which is to make the whole building more strong and secure.

6. And he forewarns us against making some *members* in the *cornice* unequal to the rest: besides several other abuses, which he supposes an able Architect can caution himself again.

There are other sorts of ARCHITECTURE; as

ARCHITECTURE *in* PERSPECTIVE, which is a sort of building, wherein the members are of different measures and modules, and diminish in proportion to their distance, to make the work appear larger, and longer, to the view, than really it is. Such is the celebrated pontifical stair-case of the *Vatican*, built under Pope *Alexander* VII. by *Cavalier Bonino*.

COUNTERFEIT ARCHITECTURE, which is that which has its projectures painted, either in black or white, or coloured after the manner of marble, as is seen practised in frontispieces and palaces in *Italy*, and in the pavilions of *Marli*. This painting is done in *fresco* upon plaister'd walls, and in oil on walls of stone. Under the name of *counterfeit Architecture*, which we, otherwise, call *scene-work*, is likewise comprehended, that painted on slight boards, or planks of wood, whereon the columns, pilasters, and other parts of building seem to stand out, with a *relievo*; the whole being coloured in imitation of various marbles, metals, &c. and serving in the decorations of theatres, triumphal arches, publick entries, funeral pomps, &c. Such is the *catafalco*, used for a decoration of *Architecture*, Sculpture, and Painting; raised on a timber scaffold to shew a coffin or tomb in a funeral solemnity.

The MODERNS have also certain other orders, in their *Architecture*, which may be properly called *national*; and are known by the names of the *Rustick*, *Attick*, *Persian*, *Caryatick*, *Gothick*, *French*, and *Spanish* orders.

The RUSTICK ORDER, is that adorned with *Rustick* quoins, bossages, *&c.*

ATTICK ORDER, is a little order of low pilasters, with an *architrave cornice* for its *entablature*, as that of the castle of *Versailles*, over the *Ionick*, on the side of the garden. M. *Blondel* calls the little pilasters of *Atticks* and *Mezzanines*, *false orders*.

PERSIAN ORDER, is that which has figures of *Persian* slaves instead of columns to support the *entablature*. This order was first practised among the *Athenians*, on occasion of a victory their general *Pausanias* obtained over the *Persians*; as a trophy of this victory, the figures of men dressed in the *Persian* mode, with their hands bound before them, and other characters of slavery, were charged with the weight of *Dorick* entablatures; and made to do the office of *Dorick* columns. Though M. *Le Clerc* observes that *Persian* columns are not always made with the marks of slavery; but are frequently used as symbols of virtues, vices; of joy, strength, valour, *&c.* as when made in the figures of *Hercules*, to represent strength, of *Mars*, *Mercury*, *Faunus*, *Satyrs*, &c.

The CARYATICK ORDER, is that, whose entablature is supported with figures of women, instead of columns. *Vitruvius* observes, that the *Greeks* having taken the city *Carya*, led away their women captives; and to perpetuate their servitude, represented them in their buildings, as charged with burdens, such as those supported by columns. The *Caryatides*, says M. *Le Clerc*, are not now represented as among the antients, *viz.* as symbols of slavery, with hands tied before and behind; those characters being supposed injurious to the fair sex. Among us they are represented as images of justice, prudence, temperance, *&c.* Their legs are always to be close to each other, and even a-cross; their arms laid flat to the body or to the head, or at least as little spread as possible; that, as they do the office of columns, they may have, as near as possible, the figure thereof. Sometimes their arms are cut off for greater delicacy; as in the hall of the *Swiss* guards in the *Louvre*; but M. *Le Clerc* does not approve of such mutilations.

When insulated they should never have any great weight to support; and their *entablature* and *pedestal* are ordinarily to be *Ionick*. When they join to a wall, *&c.* it is adviseable to put a *console* over them, which may appear to support the weight of their *entablature*; otherwise as they represent women, they do not seem so proper to sustain great loads. When they are made in form of angels, the same author would have them support the *entablature*, which in that case, is to be *Corinthian*, with their hands. The Antients made the *Caryatides* frequently to support baskets, or *corbels* of flowers; and these they call *Canephoræ*, or *Cistiferæ*; which *Canephoræ*, are in allusion to the *Canephoræ* of the Antients, who were two virgins of *Athens*, kept in *Minerva*'s temple in the *Acropolis*, who at the feast of the *Panathenæa*, carried baskets on their heads, with something secret or mysterious therein, delivered to them by the priestess. The baskets were usually crowned with flowers, myrtles, *&c.* The *Canephoræ*, in these ceremonies, always marched first, the philosopher or priest next, and the choir of musick followed.

FRENCH ORDER, is a new contrived *order*, wherein the capital consists of attributes agreeing to that warlike nation; as *Cocks heads*, *Flower-de-Luces*, &c. Its proportions are *Corinthian*; such is that of M. *Le Brun*, in the grand gallery of *Versailles*; and that of M. *Le Clerc*. This last gives us a second *Tuscan order*, and a *Spanish order*, besides his *French order*. The *Tuscan* he ranks between the first *Tuscan* and *Dorick*. Its height he makes 23 semi-diameters, 22 minutes. The *column* to have 15, the *pedestal* 5, and the *entablature* 3, and 22 minutes; and he proposes its *freeze* to be adorned with turtles, which are the arms of *Tuscany*.

The SPANISH ORDER he places between the *Corinthian* and *Composite*. The whole *order* he makes 30 semi-diameters, 28 minutes, whereof the *column* has 9, and 25 minutes, the *pedestal* 16, and 18 minutes, and the *entablature* 4, and 15 minutes. The horns of the *Abacus* he sustains with little *volutes*; the middle, in lieu of a rose, has a lion's snout: that animal being the symbol of *Spain*, and expressing the strength, gravity and prudence of that nation.

Having been informed of the *origin*, *progress*, and *use* of the several ORDERS in CIVIL ARCHITECTURE; we shall shew how to compute the charge of a building, to chuse proper materials, lay foundations, and to raise superstructures.

Upon a due examination of the premisses in a model or draught, it may be ascertained how much the whole building shall amount unto: and the builder is directed to make provision of the *materials* requisite for the work intended.

The computation depends chiefly on a knowledge of the quantity or quality of the materials; and the quality or beauty of the work.

The

The MATERIALS are chiefly, *ſtones* and *wood*; *lead*, *tiles*, and *ſlates*; *lime*, *ſand*, *plaiſter*, *nails*, and *glaſs*.

STONES include *marble*, *free-ſtone*, and *bricks* for walls, &c.

WOOD includes all ſorts of *oak*, *fir*, &c. timber, planks and boards.

In the choice of theſe materials depend, in a great meaſure, both the decoration and ſtrength of the building: therefore obſerve,

MARBLE is a precious kind of ſtone, found in great maſſes, dug out of pits and quarries, being of a conſtitution ſo hard and compact, and again ſo fine, as readily to take a beautiful poliſh; much uſed in ornaments of buildings, as columns, chimney-pieces, tables, &c.

The goodneſs of *marble*, and its beauty, proceeds chiefly from the different quarries it is dug out of.

The beſt *marble* we have, at preſent, is imported from *Italy*; for the quarries of *Parian marble*, of which the greateſt part of the *Grecian* ſtatues were made, are loſt.

Thoſe from the ſtate of *Genoa* deſerve the preference; and of them, there are ſeveral ſorts, *viz.* *Marble of Carrara*, which is very white. *White veined marble*, which has large veins, with grey and blue ſtains on a white ground. *Blue Tarquin marble*, mixed with a dirty kind of white. *Modern green marble*, improperly called *Egyptian*, of a deep green, ſpotted with grey. Theſe three ſorts come from *Carrara*, on the coaſt of *Genoa*, and are very good.

The other *marbles* from *Italy* are, the *marble* of *Porta Santa*, called, at *Rome*, *Serna*; which is mingled with large clouds, and veins of red, yellow, and grey. *Marble* of *Breſs*, yellow with white ſpots. *Portor marble*, which has a black ground, with clouds, and veins of yellow. *Marble fior di Perſica*, which conſiſts of white and red ſtains, ſomewhat yellowiſh. *Marble ochio di pavone*, or *peacock's-eye*, mingled with red, white, and bluiſh clouds, ſomewhat reſembling the eyes at the end of the peacock's tail. *Marble* of *Sicily*, which is a browniſh red, ſtained with oblong ſquares of white, and *Iſabella* like ſtriped taffaty. *Marble* of *Savoy*, which is a deep red, mixed with other colours; each piece whereof ſeems cemented on the reſt. *Cypollino*, or *Cipollin marble*, of a ſea-green colour, mixed with large waves, or clouds of white or pale green.

Spain produces likewiſe ſome very good *marbles*, viz. the *Brocatella marble*, which is mingled with little ſhades of *Iſabella*, yellow, pale, and grey; and comes from *Tortoſa*, where it is dug out of an

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antient quarry. *Marble* of *Signam*, in the *Pyreneans*, of a greeniſh brown, with red ſtains; though this is ſomewhat various in its colours. *White marble*, that dug out of the *Pyreneans* on the ſide of *Bayonne*.

The *French* have alſo quarries of *marble* in ſeveral of their provinces, as in *Auvergne*, which produces a pale red marble, mingled with violet, green, and yellow. *Languedoc*, which produces *marble* of a vivid red, with large white veins, or ſtains; there is ſome borders pretty much on the blue, but this is of leſs value. The *marble* of *Barbançon*, in *Hainault*, is black, veined with white. That of *Dinant*, near *Liege*, is of a pure black, very beautiful, and very common. That of *Namur* is black, likewiſe, but leſs beautiful, as inclining a little to the blue, and traverſed with little ſtreaks of grey; this is very common, and frequently uſed in paving. The *marble* of *Guachenet*, near *Dinant*, is of a reddiſh brown, with white ſpots and veins. That of *Rance*, in *Hainault*, is of a dirty red, mixed with blue and white clouds and veins; this is pretty common, but is different in degree of beauty.

We have, in *England*, *Engliſh white marble*, veined with red. *Derbyſhire marble*, variouſly clouded, aad diverſified, with brown, red, yellow, &c.

MARBLES are divided into *rigid*, *fibrous*, *brittle*, and *terracy marbles*.

The *rigid marble* is that, which being too hard, works with difficulty, and is liable to ſplinter, as the black of *Namur*. The *fibrous* is that full of threads or filaments. The *brittle*, that which crumbles under the inſtrument; and the *terracy marble*, that with ſoft places in it, which muſt be filled up with cement. Theſe two laſt kinds are not to be choſen where others can be had, no more than thoſe *marbles* which have the grain too coarſe, nor thoſe full of nails, which anſwers to the knots in wood; or with *emeril*, which is a mixture of copper, or other metals, forming black ſtains in the *marble*, and rendering it diſagreeable to the eye, eſpecially white *marble*, to which the *emeril* is peculiar. The nails augment the difficulty in cutting and poliſhing the *marble*.

For STONE: here, in *England*, that dug in the *Peninſula* of *Portland*, and thence called *Portland-ſtone*, is much uſed, being ſofter, and whiter than *Purbeck-ſtone*, and is commonly raiſed out of the quarries in bigger blocks than that. The *Ryegate-ſtone*, called alſo *fire-ſtone*, is good, and much uſed for chimneys, hearths, ovens, and ſtoves. The *ſtone* uſed in the edifices from the *conqueſt* to the reign

reign of *Henry* VI. was chiefly brought from *Caen* in *Normandy*.

Bricks, among us, acquire various names, according to their form, dimenſions, uſes, method of making, *&c.* The principal are *compaſs bricks*, of a circular form. uſed in ſteening of walls. *Concave*, or *hollow bricks*, on one ſide flat, like a common *brick*, on the other hollowed; uſed for conveying water under-ground. *Cogging-bricks*, uſed for making the indented works under the coping of walls, built with great *bricks*. *Coping bricks*, formed on purpoſe, for coping of walls. *Dutch* or *Flemiſh bricks*, uſed to pave yards and ſtables, and for ſoap-boilers vats and ciſterns. *Clinkers*, ſuch *bricks* as are glazed by the heat of the fire in making. *Feather-edg'd bricks*, like the common ſtatute *bricks*, only thinner on one edge than on the other, and uſed to pen up the brick-pannels in timber-buildings. *Great bricks*, are thoſe which are twelve inches long, ſix broad, and three thick: The weight of one being about 15 pounds, ſo that 100 weigh 1500, and 1000 of them 15000 pounds: their uſe is to build fence-walls, together with *pilaſters*, or *buttreſs-bricks*, which are of the ſame dimenſions with the great *bricks*, only they have a notch at one end, half the breadth of the *brick*; their uſe is to bind the work at the *pilaſters* of fence-walls, which are built of great *bricks*. *Paving-bricks* or *Tiles*, are of ſeveral ſizes in ſeveral countries and places. *Place-bricks*, ſuch as are made in a place on purpoſe for them, near the *building* they are to be uſed in. *Statute* or *ſmall common bricks*, when burnt, ought to be nine inches long, four and a quarter broad, and two and a half thick. 100 of theſe uſually weigh about 550 pounds, and 1000, 5500 pounds; about 407 make a ton weight. Theſe are commonly uſed in paving cellars, hearths, ſinks, *&c.* 30, or 32, if true meaſure, will pave a yard ſquare, and 330 will pave a ſquare of 100 foot laid flat; but if laid edge-ways, there muſt be near double the number. *Stock-bricks* are to be of the ſame dimenſions, only $\frac{1}{8}$ of an inch thicker.

The Material, which comes next under the conſideration of our Architect, is *lime*, which is a white, ſoft, friable ſubſtance, prepared of *ſtone*, *marble*, *free-ſtone*, *chalk*, or other ſtony ſubſtance, by burning in a kiln. That which is ſuch as it comes from the kiln or furnace, is called *quick-lime*; and that diluted, or drenched in water, *ſlack'd lime*.

Palladio ſays, that the beſt *lime* is made of the hardeſt, ſoundeſt, and whiteſt ſtone, and which remains a third part lighter after it is burnt than the ſtones it was made of. He obſerves alſo, that ſtones collected up and down, and which have been expoſed a long time to the injuries of the weather, are not ſo proper to make lime with, as thoſe which are newly dug out of the quarry; nor thoſe taken from a dry pit, ſo good as thoſe from a moiſt and ſhady one. That ſuch pebbles as are found in rivers and rapid ſtreams are excellent for lime, and make very white, neat, and ſmooth work; on which account it is principally uſed in the rough-caſting of walls. That all ſtones, whether thoſe taken from the hills, or from the rivers, burn faſter or ſlower, in proportion to the fire, which is given them; but that for the generality, they are burnt in threeſcore hours.

Dieuſſant recommends *lime* made of ſea-ſhells as the beſt; but *Goldman* finds fault with it, as being impatient of moiſture, and therefore eaſily peeling off from the outſide of walls.

Good *lime* may alſo be made of mill-ſtone, not coarſe, and ſandy, but fine, and greaſy; and Sir *H. Wotton* finds fault with the *Engliſh* for making *lime* as they do, of refuſe and ſtuff without any choice; whereas the *Italians*, at this day, and much more the Antients, burnt the firmeſt ſtones, and even fragments of marble, where it was plentiful; which in time became marble again for its hardneſs; as appears in their ſtanding theatres, *&c.*

We have two kinds of *lime* in common uſe in *England*, the one made of hard ſtone; the other (of moſt uſe near *London*) of a ſoft, calcarious, or chalky ſtone; whereof the former is much the ſtrongeſt.

That made of ſoft ſtones, or chalk, is fitteſt for plaiſtering of cielings and walls within doors; and that made of hard ſtones, for buildings, and for plaiſtering without doors.

Before the *ſtones* be thrown into the kiln, they are to be broke in pieces, otherwiſe the air contained in their cavities, too much expanded by the heat, makes them fly with ſo much violence, as to damage the kiln. According to *Alberti*, and *Palladio*, *lime* will not be ſufficiently burnt in leſs than ſixty hours intenſe heat.

The marks of a well burnt *lime*, is, that its weight be to that of the ſtone, in a ſeſquialterate proportion; that it be white, light, and ſonorous; that when ſlacken it ſticks to the ſides of the veſſel; and ſends forth a copious thick ſmoak; and needs a great deal of water to ſlack it. It muſt not be wetted all at once; but only by ſlow degrees, to prevent its burning before it be duly temper'd.

When ſlacked, it may be kept ſeveral years, by letting it paſs through a hole open at the bottom of the veſſel, into a pit dug under ground, and as ſoon as it it full, covering it with ſand, to prevent its drying.

drying. *Boekler* gives another method. He will have a *ſtratum* of *lime* covered, two or three feet high, with another of ſand of the like height, and then water enough poured on to ſlack the *lime*, but not to reduce it to duſt after ſlacking. If the ſand cleave into chinks, as the ſmoak aſcends, they muſt be covered up, ſo as no vent may be given thereto. This *lime*, he adds, kept ten or twelve years, will be like glue, and will, further, be of particular uſe in painting walls, as being no ways prejudicial to the colours.

SAND, is a fine, hard, gravelly ſort of earth, or rather ſtones divided into ſmall grains; of great uſe in *building*.

There are three ſorts of *ſand* proper to be employed in *building*, *viz.* pit-ſand, river-ſand, and ſea-ſand.

The firſt is the beſt, and is either of a black, white, red, or aſh-colour; which laſt is a ſort of earth burnt by fire incloſed in the cavities of mountains. Among the various kinds of pit-ſand, the white is found by experience to be the worſt; and of river-ſand, the beſt is that which is found in rapid ſtreams, and under water-falls; becauſe it is moſt purged. Sea-ſand is the worſt; but if uſed, it muſt be that which is of a blackiſh colour, and ſhines like glaſs; but that, whoſe particles are biggeſt, and lies neareſt the ſhore, is better than any other ſort.

Pit-ſand, as it is of a fatter ſubſtance than the reſt, makes a more tenacious cement; and though it is apt to crack, is frequently made uſe of in *building* long vaults, or raiſing walls. *River-ſand* is proper enough for rough-caſting of walls. *Sea-ſand* being ſoon wet, and ſoon dry, and of a ſaline quality, which ſoon melts away, is very improper to ſuſtain any conſiderable weight.

That *ſand* is good in its kind, which, when ſqueezed and handled, crackles; and if being put on a white cloth, neither ſtains, nor makes it foul. That *ſand* is naught, which, mixed with water, makes it dirty and muddy, and which has been long in the air; for ſuch will retain much earth, and rotten humour. Hence ſome MASONS waſh their *ſand* before they uſe it.

Our TIMBER, which is one of the principal, and of the moſt expenſive articles, muſt conſiſt, 1. Of *oak*, for poſts, rails, boards, &c. 2. *Elm*, for dreſſers, &c. 3. *Beech*, which can ſupply the want of *oak*. 4. *Aſh*, which is of a general uſe in *building*, eſpecially where it may lie dry. 5 *Fir* commonly known by the name of *deal*; for floors, ſtairs, wainſcot, and moſt works of ornament. 6. *Walnut-tree*, is uſed within doors, being of a more curious brown colour than *beach*, and leſs ſubject to the worms. 7. *Service-tree*, as yielding beams of a conſiderable bigneſs. 8. *Cheſnut tree*, which is the moſt laſting, next to *oak*. And, 9. *Alder*, much uſed for ſewers, and pipes to convey water: when always wet, it grows hard like a ſtone; but where ſometimes wet, and ſometimes dry, it rots preſently.

The chief care in the choice of this kind of building materials, is to ſee that it is clear of ſap; that it is clean or free from knots, flaws and cracks; and that it be of a proper ſize for the purpoſes intended; ſo that there be as little waſte as may be in cutting it out for particular uſes.

When *Timber* is cut down, *Palladio* will have it ſtored up in ſome place where it may not be expoſed to the heat of the ſun, or to the injuries of the weather; particularly ſuch trees as riſe out of the ground without being planted; and bedaub'd over with cow-dung, to prevent its ſplitting. It is not to ſtand upright, but to lie all along, one piece over another, only kept apart by ſhort blocks interpos'd, to prevent a certain mouldineſs, which they are apt to contract in ſweating on one another; from which frequently ariſes a ſort of fungus, eſpecially if there be any ſappy parts remaining. Others adviſe boards, planks, &c. to be laid in ſome pool, or running ſtream, for a few days, to extract the ſap from them, and afterwards to dry them in the ſun or air. By this means it is ſaid, they will be prevented from either chapping, caſting, or cleaving; but againſt ſhrinking there is no remedy. Mr. *Evelyn* particularly recommends this method for *Fir*. Others, again, are for burying them in the earth; others in wet; and others for ſcorching and ſeaſoning them in fire; eſpecially piles, poſts, &c. that are to ſtand either in water, or earth. Sir *Hugh Plat* informs us, that the *Venetians* burn and ſcorch their *timber* in the flaming fire, continually turning it round with an engine, till it has got a hard, black, cruſty coal upon it.

Timber muſt not be work'd, if it is very wet, or very dry; for in one caſe it will be liable to rot, and in the other will make but very aukwark work: neither will it be dry enough to be worked into planks, doors, and windows, in leſs than three years. But as all Architects do not, or cannot take this laſt precaution, and conſequently *timber* is but too often liable to chops or clefts, by its having been work'd too green, which is a very great eye-ſore in many fine buildings; thoſe chops or clefts are cloſ'd by anointing, ſuppling, and ſoaking it with the fat of powder'd beef broth, twice or thrice repeated. Some carpenters uſe greaſe and ſaw-duſt mingled, for the ſame purpoſe; but the former method

method is excellent, only it is not to be us'd while the *timber* is green.

We muſt alſo provide IRON, for cramps, nails, hinges, bolts, gates, bars, and ſuch like work.

One diſtinguiſhing mark of the goodneſs of *iron* is, when its veins are found to run ſtrait, and unbroken, after it is work'd into bars, and when the two extremes of the bar are clean, and without foulneſs; for theſe veins are indication that the *iron* is free from knots and flaws; and by the extremes we may judge of the goodneſs of the middle. If its ſides are found to be ſtrait after it is wrought into plates, or into any other form whatever, we may pronounce it equally good in all its parts, as it has endured the hammer in equal proportion.

We may cover buildings either with LEAD, (which is alſo us'd for pipes and gutters to convey water, and in faſtening all ſorts of iron-work in ſtone) or with *copper*, *ſlate*, or *tiles*.

The white and aſh-colour'd *leads* are more perfect and valuable than the black, though not really black, but only has a few black ſpots in it. *Lead* for this uſe, is either caſt into *ſheets* in a mould, or *milled*.

COPPER is at preſent but ſeldom employed in covering any kind of edifices, not even publick ones; as being too expenſive, and too heavy, except in *Sweden*, where it is very common.

This metal was uſed in making *letters* for *inſcriptions*, that were placed in the frizes of buildings: hiſtorians aſſure us, that the hundred gates of *Babylon*, ſo much taken notice of, were all of *copper*; as alſo the two pillars of *Hercules*, which were eight cubits high, in the iſland of *Gades*.

The beſt *copper* is that, which, when drawn out of the mine, and purify'd by fire, is of a reddiſh colour, but ſomewhat inclining to a yellow, and full of pores. It may be heated like iron, and liquify'd, and therefore capable of being caſt; and though hard, may be render'd ſo ſoft and pliant, as to be wrought into very thin leaves. When mixed with tin, lead, or latten, which laſt is another ſort of *copper*, but colour'd with *lapis calaminaris*, it makes a metal called *braſs*, which is often made uſe of by *Architects* in making of baſes, columns, capitals, ſtatues, and ſuch like decorations.

SLATE is a blue fiſſel ſtone, very ſoft when dug out of the quarry, and on that account eaſily cut, or ſawed into thin long ſquares, or eſcallops, to ſerve in lieu of tiles for the covering of houſes.

The *blue ſlate* is a very light, laſting and beautiful covering, but chargeable withal, in regard the roof muſt be leafed over with thin laths, of about two inches broad, and two foot and a half long, plac'd cloſe to one another, and each *ſlate* requiring a peg, and a nail, at leaſt.

In *England*, beſides blue, we have likewiſe grey ſlates, called *Horſham ſtones*, from a town in *Suſſex*, of that name, where the greateſt quantities of it are found; and which is chiefly uſed in the covering of churches, chapels, chancels, *&c.*

The timber of the *roof* need be very ſtrong for the grey *ſlates*, it being almoſt double the weight of tiles.

Mr. *Colepreſs* informs us, in the *Philoſophical Tranſactions*, that to judge of the goodneſs of *ſlate*, it muſt be knocked againſt any hard body, to make it yield a ſound; for if the ſound be good and clear, the *ſlate* is firm and good, otherwiſe it is crazy. *Slates* which are ſcaly like fiſhes, are not good. Theſe two methods are the ſureſt to diſcover the goodneſs of *ſlate*, and all others propoſed by our Naturaliſts are too tedious, and very uncertain.

Our moſt common covering in *England* is made of TILES, which are a ſort of thin, fictitious, laminated ſtones; or, more properly, a fat clayey earth, knodden and moulded of a juſt thickneſs, dried, and burnt in a kiln; like a brick.

All ſorts of *tiles* are not employed in covering, nor proper for it, but only thoſe called *plain*, or *thack tiles*, ſqueezed flat, while yet ſoft, in a mould, of an *oblong* figure, and which, by Stat. 17 *Ed.* IV. *c.* 4. are to be 10½ inches long, 6¼ broad, and half an inch and half a quarter thick.

Among theſe may be rank'd, 1. *ridge*, *roof*, or *creaſe-tiles*, made circular, breadth-wiſe, like a half cylinder, and uſed to cover the ridges of *houſes*; by the *Statute* they are to be 13 inches long, and of the ſame thickneſs with the *plain tiles*. 2. *Hip*, or *corner tiles*, which lie on the hips or corners of *roofs*. They are flat, like *plain tiles*, but of a quadrangular figure, whoſe two ſides are right lines, and two ends arches of circles; one end being a little concave, and the other convex; the convex end to be about ſeven times as broad as the concave; ſo that they would be triangular, but that one corner is taken off: then, before they are burnt, they are bent on a mould breadth-wiſe, like *ridge-tiles*. They have a hole at their narrow end, to nail them on by; and are laid with their narrow end upward. By the *Statute* they are to be 10 inches long, and of a convenient breadth and thickneſs. 3. *Gutter tiles*, which lie in gutters, or valleys, in croſs buildings. They are made like *corner-tiles*, only the corner of the broad end are turned back again with two wings. They have no holes in them, but are laid with the

the broad end upwards, without any nailing. They are made in the same mould as *corner-tiles*, and have the same dimensions of the convex side. Their wings are each four inches broad, and eight inches long. 4. *Pan*, *crooked*, or *Flemish-tiles*, used in covering of sheds, lean-to's, and all kinds of *flat-roofed* buildings; they are, like *plain tiles*, in the form of an *oblong parallelogram*, but are bent breadth-wise, forwards and backwards, in form of an S, only one of the arches is, at least, three times as big as the other; which biggest arch is always laid uppermost, and the lesser arch of another *tile* lies over the edge of the great arch of the former. They have no *holes* for pins, but hang on the laths by a knot of their own earth; they are usually $14\frac{1}{2}$ inches long, and $10\frac{1}{2}$ broad. By 12 *Geo.* I. *c.* 25. they are to be, when burnt, no less than $13\frac{1}{2}$ inches long, $9\frac{1}{2}$ wide, and half an inch thick. 5. *Dormar*, or *Dorman-tiles*, which consist of a *plain tile*, and a triangular piece of a *plain tile*, and swept with an arch of a circle from the other end, which end terminates in a point. Of these *tiles* there are two kinds, the triangular piece, in some, standing on the right, in others on the left side of the *plain tile*; and of each of these, again, there are two kinds, some having a whole *plain tile*, others but half a *plain tile*: but in them all the *plain tile* has two holes for the pin, at the end where the broad end of the triangular piece stands. Their use is to be laid in the gutters, betwixt the *roof* and cheeks, or sides of the *dormars*, the plain part lying on the *roof*, and the triangular part standing perpendicularly by the cheek of the *dormar*. They are excellent to keep out the wet in those places, and yet are not known, perhaps, any where, but in *Sussex*. The dimensions of the *plain tile*'s parts, are the same as those of a *plain tile*; and the triangular part is of the same length, and its breadth at one end 7 inches, and at the other nothing. 6. *Scallop*, or *Astragal-tiles*, which are in all respects like *plain tiles*, only their lower ends are in form of an *astragal*, viz. a semicircle, with a square on each side. They are used in some places for *weather-tiling*. And, 7. *Traverse-tiles*, a kind of irregular *plain tiles*, having the *pin-holes* broke out, or one of the *lower corners* broke off. These are laid with the *broken end* upwards, upon rafters, where pinn'd *tiles* cannot hang.

All these kind of *tiles* are laid either dry, as they come from the kiln, without *mortar*, or any thing else; or in a kind of *mortar* made of *loam* and *horse-dung*. In some parts of *Kent* they lay them in *moss*.

According to *Stat.* 17 *Ed.* IV. the earth for *tiles* should be cast up before the first of *November*, stired, and turned before the first of *February*; and not made into *tiles* before the first of *March*; and should likewise be try'd, and sever'd from stones, marle, and chalk.

We must also provide ourselves with *Flemish*, or *Dutch tiles*, for jambs of chimneys, instead of chimney corner-stones; for they divert agreeably the sight by the variety of figures painted on them.

When the carcass of the building is finished, GLASS must be provided for the *windows*, of which there are *various sorts*. 1. *Crown glass*; of which, says *Neve*, there are two kinds, distinguished by the places where they are *work'd*, *viz.* *Ratcliff*, or *Cock-Hill crown-glass*, which is the best, and clearest. Of this there are twenty-four tables to the case, the tables being of a circular *form*, about three foot six inches in diameter. But this varies according to the goodness; it being divided or packed up in three different sorts or degrees; for though the metal shall be all of one goodness, the accidents the *glass* meets with in the pot, or in blowing, or in knealing, occasions an alteration in its price and package.

2. *Newcastle glass*, which is that most used in *England*, is of an ash *colour*, and subject to specks, streaks, and other blemishes; and, besides, is frequently warped. *Leybourn* says, there are forty-five tables to the case, each containing five superficial feet; some say there are but thirty five tables, and six foot in each table.

Having made the necessary provision of *materials* and *workmen*, we begin our *work* with making of MORTAR: which is a *composition* of *lime* and *sand*, mixed up with water; serving as a cement to bind the stones, &c. of a *building*.

De Lorme observes, that the best *mortar* is that made of *pazzalana*, for sand; adding, that it penetrates black flints, and turns them white. If we make our *mortar* with pit sand, we must take three parts of it, and mix it with one of lime; but if we make use of river, or sea sand, our proportion must be two parts of sand only, and one of lime. Abour *London*, the proportion of sand to quick lime is as 36 to 25; in some sort of work they use an equal quantity of each.

It is a maxim among old *Masons* to their labourers, that they should dilute *mortar* with the sweat of their *brow*, i. e. labour it a long time, instead of drowning it with water, to have done the *sooner*.

There are two other sorts of *mortar* employ'd in *building*, viz. *white mortar*, made of ox-hairs, mix'd with lime and water, without any sand, used in plaistering the walls and cielings; and a hard *mortar* made of lime and hogs grease, sometimes mixed with the juice of figs, and sometimes with liquid

 pitch,

pitch, employed in making water-courſes, ciſterns, *&c.* This, after application, is waſhed over with linſeed-oil.

The FOUNDATION is that part of a building which is *under ground*, and ſuſtains the whole edifice; or upon which the walls of the ſuperſtructure are raiſed. So that of all the *errors* in *building*, thoſe are the moſt fatal, that are committed in the *foundation*; becauſe they at once endanger the whole ſtructure: nor can it be rectify'd, but with the utmoſt difficulty. That therefore the *Architect* muſt take great care to make choice of a *good foundation.*

Let him firſt examine the bed of earth upon which he is to build.

If the earth be *ſolid*, the *Architect* muſt adjuſt the depth of the *foundation* by the height, weight, *&c.* of the *building*; a ſixth part of the whole height, where there are to be no cellars, nor other offices, *under ground*, is looked on as a medium; and as to thickneſs, double that of the width of the wall, is a good rate.

But if it be a *gravelly*, or *ſandy ſpot*, not to be truſted, particular care is to be taken, whether it be on land, or in the water; for if it be on land, the *obſervation* of what has been already mentioned, concerning *firm ground*, will be ſufficient; if we build in the water, we muſt therefore dig till we find a *ſolid bottom*; or, if this can't be effected with eaſe, we muſt then dig a little into the ſand and gravel, and driving in piles of oak, till the ends reach the *good ground*, and on theſe we may build. This operation is called *pallification*. But if we are obliged to build upon *moſſy* and *looſe earth*, we muſt then dig till we find *ſolid ground*, and that in *proportion* to the thickneſs of the walls, and the bulk of the ſtructure.

An *old foundation* muſt never be built upon before we know its depth, and are well aſſured that it is able to ſuſtain the fabrick.

If the earth we *build* upon be *marſhy*, we muſt ſtrengthen it with piles, whoſe length muſt be the eighth part of the height of the walls, and their diameter the twelfth part of their length. Theſe piles muſt be drove in ſo *contiguous* to one another, that no others can be ſet between them; and particular care muſt be taken to ram them in, with gentle blows often repeated, rather than with violence; for the earth will *conſolidate* better the one way, than the other. Piles muſt be drove, not only under the walls, but alſo under the inner, or partition-walls; and diſtributed according to the *proportion* of the walls; thoſe within are placed ſomewhat thinner than thoſe on the outſide of the *building*.

In ſome places they *found* the piers of bridges, and other *buildings* near the water, on ſacks of *wool*, laid like matraſſes; which, being well preſſed, and greaſy, will never give way, nor *rot* in water.

The *foundation* is properly ſo much of the *maſonry* as reaches as high as the ſurface of the *ground*. Sometimes it is maſſive, and continued under the whole *building*; as in the antique arches, and aqueducts, and ſome amphitheatres: more uſually it is only in ſpaces, or intervals, either to avoid expence, or becauſe the vacuities are at too great a diſtance; in which latter caſe they make uſe of inſulated pillars, bound together by arches.

Having fix'd on the *ground-plot* for our *building*, we will make *draughts* of the *ichnography*, or *ground-plot* of each *floor*, or *ſtory*; which *ichnography* is a tranſverſe ſection of a *building*, exhibiting the circumference of the whole edifice, and of the ſeveral rooms and apartments in the given ſtory, together with the thickneſs of the walls and partitions, the dimenſions of the doors, windows, and chimneys; the projectures of the columns, and piers, with every thing viſible in ſuch ſection. On this draught of the *ichnography* depends the *form* or *diſpoſition* of our *building*, which muſt be either *ſimple* or *mix'd*.

The *ſimple forms* are either *circular*, or *angular*; and the *circular* ones either *compleat*, or *juſt ſpheres*; or *deficient*, as *ovals*.

The *circular form* is very commodious, of the greateſt capacity of any; ſtrong, durable beyond the reſt, and very beautiful: but then it is found of all others the moſt chargeable; much *room* is loſt in the bending of the walls, when it comes to be divided; beſides an ill diſtribution of light, except from the center of the roof. It was on this conſideration that the ancients only uſed the *circular form* in temples and amphitheatres, which needed no compartition. *Oval forms* have the ſame inconveniencies, without the ſame conveniencies, being of leſs capacity.

For *angular figures*, Sir *Henry Wotton* obſerves, that *buildings* neither love many, nor few *angles*: the *triangle*, v. gr. is condemned above all others, as wanting capacity and firmneſs; as alſo becauſe irreſolvable into any other regular figure, in the inward partitions, beſides its own. For figures of five, ſix, ſeven, or more *angles*, they are fitter for *fortifications* than *civil buildings*. There is, indeed, a celebrated *building* of *Vignola*, at *Caprarola*, in form of a pentagon; but the *architect* had prodigious difficulties to grapple with, in diſpoſing the lights, and ſaving the vacuities. Such *building*, then, ſeems rather for curioſity than conveniency, and for this reaſon rectangles are pitched on, as being a medium between the two extremes. But,

again,

again, whether the rectangle is to be juft a fquare, or an oblong, is difputed. Sir *Henry Wotton* prefers the latter, provided the length do not exceed the breadth by above one third. Mixed figures, partly circular, and partly angular, may be judged of from the rules of the fimple ones; only they have this particular defect, that they offend againft uniformity. Indeed, uniformity, and variety, may feem to be oppofite to each other; but Sir *Henry Wotton* obferves, they may be reconciled; and for an inftance mentions the ftructure of the human body where both meet.

Suppofe the *building* to be erected is of a *circular form*, according to the *ichnography*: the *foundation* muft be as thick again as the wall intended to be raifed upon it. The plan of the trench muft be exactly level, that the weight may prefs equally in all parts, and not lean more to one fide, than the other, which occafions the cracking and dividing of the walls. The *foundations* muft always flope, or diminifh, in proportion as they rife; yet fo as that there may be as much left on one fide as on the other, and fo as the middle wall above may be directly perpendicular over the middle of that below; which muft be alfo particularly regarded in the diminifhing of walls above ground; for this will make the fabrick much ftronger than if the diminutions or fet offs were made any other way.

Palladio is of opinion, that in large *buildings* it is very proper to make vents, or holes, through the body of the walls, from the very *foundations* to the *roof*, in order to let out the winds and vapours, which are very prejudicial to the fabrick, diminifh the expence, and will likewife be found extremely convenient in cafe winding ftairs are to be made from the bottom to the top.

The *foundations* being laid, we are to erect the walls. The antients made fix kinds of walls. The firft were called *reticolata*, or *net-work*; the fecond were compofed of *quadrels*, or *bricks*; the third of *cement*, confifting of *cement* or *pebbles*; the fourth of irregular and various ftones, and called *Ruftick*; the fifth of *free-ftone*; and the fixth of *Riemputa*, or *coffer-work*. They generally made the angles, or corners, of the building of bricks, and laid between every two foot and a half, three courfes of bricks, which ferve as a kind of band to the whole work.

The moderns diftinguifh *walls* into *plaifter'd* or *mud-walls*, *brick-walls*, *ftone-walls*, *flints*, or *boulder-walls*, and *boarder-walls*.

Mud and *plaiftered-walls* are chiefly in ordinary timber *buildings*. Thefe *walls*, being quartered and lathed between the timber, or fometimes lathed over all, are plaiftered with lome, which being almoft dry, is plaiftered over-again with white mortar.

Brick-walls are the moft important and ufeful among us. In thefe, particular care is to be taken about the laying of the bricks, *viz.* That in fummer they be laid as wet, and in winter as dry as poffible, to make them bind the better with mortar: that in fummer, as faft as they are laid they be covered up, to prevent the mortar, *&c.* from drying too faft: that in winter they be covered well, to protect them from rain, fnow, and froft, which are all enemies to the mortar: that they be laid joint on joint, in the middle of the walls, as feldom as may be, but good bond made there, as well as on the out-fides. Care is alfo to be taken that the angles be firmly bound: in order to which, in working up the angles of a building, it is not advifable to raife any *wall* above three feet high, ere the next adjoining *wall* be wrought up to it. That good binding may be made in the progrefs of the work.

Palladio's fentiment is, that *brick-walls*, intended for any great building, ought to be faced on both fides with brick, and the middle filled with cement, rammed clofe together with brickbats; and that to every three feet in height, there ought to be three courfes of *bricks* of a larger fize than the others to bind the whole breadth of the wall. That the firft courfe fhould be laid, fo that the leffer fide of the *brick* may be outward; the fecond length-ways, that is to fay, with its larger fide on the outfide, and the third as the firft.

Flint, or *boulder walls* are ufually raifed by a right and left-handed man, who has had a hod of mortar poured down on the work, which they part betwixt them; each fpreading it towards himfelf, and fo they lay in the flints. The mortar for this work is to be very ftiff. Thefe *walls* are ufed for fence-walls, a-round courts, gardens and out-houfes.

The *cement walls* of the antients were made fo, as there fhould be three courfes of bricks, and difpofed as above, to every two foot at the leaft. In erecting their *Ruftick-walls*, made of irregular ftones, they ufed a leaden rule, which being bent, according to the place, where the ftone was to be fet, demonftrated how it was to be fquared; fo that when it was once cut, they immediately fixed it in its place.

Their *walls*, called *coffer-work*, were made by taking planks laid edge-way, according to the thicknefs of the *walls*, filling the void with cement, and all forts of ftones mingled together, and continued, after this manner, from courfe to courfe of ftones laid level, or of the fame height, through-

out

out the whole length of the *building*, and not interrupted by any aperture.

Walls as they advance, muſt diminiſh proportionably in their thickneſs; and ſuch as appear above ground muſt be half as thick as thoſe in the foundations. Thoſe of the ſecond ſtory muſt be half a brick thinner than thoſe of the firſt, and in like manner to the top of the fabrick: due care, however, muſt be taken, not to make the upper part too weak. The middle of the *wall* above muſt be exactly perpendicular over the middle of thoſe below; which will give the whole *wall* a pyramidical form. Moreover, if we be forced to make the ſuperficies of the upper *wall*, exactly over that beneath, it muſt be done inwardly; for the floors, the beams, the vaults, and other ſupports of the edifice, will keep the *walls* from falling inward.

The ſet off, or diſcharged parts, on the outſide, muſt be covered with a *faſcia* and a cornice, which ſurrounding the whole fabrick, will bind as well as beautify it. As the angles of an edifice are common, to two ſides or faces to keep them upright and faſt together, we muſt take care to make them very ſtrong and ſubſtantial, and to hold them with long and hard ſtones, as it were with arms. The windows, therefore, and other openings, ought to be as far diſtant from the angles as poſſible; or at leaſt, ſo much ſpace ought to be left, as is the breadth of the ſaid opening.

In *London*, by a ſtatute made for rebuilding the city after the fire; it is enacted, that in all houſes of two ſtories, beſides cellars and garrets, and fronting bye-ſtreets, and lanes, the *walls* in front and rear, as high as the firſt ſtory, ſhall be full the thickneſs of the length of two bricks; and thence upwards to the garret of the thickneſs of one brick and an half, and that the thickneſs of the garret *walls*, on the back part, be left to the diſcretion of the builder; ſo that the ſame be not leſs than one brick in length; and that the thickneſs of the *party-wall*, in the garret, be of the thickneſs of the length of one brick, at leaſt. That in houſes of three ſtories high, beſides cellars and garrets, the *walls* in the front and rear, as high as the firſt ſtory, be two bricks and a half thick; and from thence upwards to the garret floor, of one brick and an half thick; and the thickneſs of the garret *walls*, on the back part, be left to the diſcretion of the *builder*, ſo that the ſame may not be leſs than one brick thick; and alſo that the thickneſs of the *party-walls*, between every houſe of this ſecond and larger ſort of *building*, tbe two bricks thick, as high as the firſt ſtory, and hence upwards to the garret of the thickneſs of one brick and a half. That houſes of four ſtories high, beſides cellars and garrets, the *walls* in front and rear as high as the firſt ſtory, be two bricks and an half in thickneſs, and from thence upwards to the garret floor, of the thickneſs of one brick and an half; and that the thickneſs of the garret *walls*, on the back part, be not leſs than one brick: And alſo that the *party-walls* between every houſe of this third, and larger ſort of *building*, be two bricks thick, as high as the firſt floor, and thence upwards to the garret floor one brick and an half.

We have obſerved in this treatiſe of *Architecture*, that there are five Orders of *columns*, *viz. Tuſcan*, *Doric*, *Ionic*, *Corinthian*, and *Compoſite*. Now ſays *Palladio*, the ſtrongeſt and moſt ſubſtantial of thoſe orders, which is the *Tuſcan*, muſt lie undermoſt; though this order, becauſe of its plainneſs and ſimplicity, be ſeldom uſed above ground, except in fabricks where one order only is employed, never, therefore, in regular, and ſumptuous edifices, eſpecially houſes, in which the *Dorick* ſupplies its place, as next to it for ſimplicity.

From this we'll paſs to apertures, which are either *gates*, *doors*, *windows*, *ſtair-caſes*, *chimneys*, or *ſewers* for the ſullage, *&c.*

Palladio pretends, that no ſettled and determinate directions can be given for the altitude, and breadth of the *gates* of ſpacious edifices; nor for the doors and windows of rooms; and gives this for reaſon, that when an Architect makes any gates, he is forced to adapt them to the largeneſs of the fabrick; to the dignity of a perſon who employs him, and the conveniency of whatever goes backwards and forwards, either to and from the ſame; though the method he likes beſt is to divide the ſpace from the ground to the ſuperficies of the joiſts into three parts and a half; two whereof muſt be allowed to the altitude of the void, or opening, and one and a half to the breadth.

Some will have *gates*, through which coaches, *&c.* are to paſs, not leſs than ſeven feet broad, nor more than twelve; the height to be one and a half the breadth.

The *gates* and principal doors muſt be ordered in ſuch a poſition that an eaſy acceſs from all parts of the houſe may be had to them. The doors of rooms muſt not exceed three foot wide, and ſix and a half high; nor be leſs than two foot wide, and five foot high. They ought to be as few in number, and as moderate in dimenſions as poſſible, ſince all openings are weakenings; though by turning arches over them, they are diſcharged, in ſome meaſure of the ſuper-incumbent weight. They are not to approach too near the angles of the walls; it being a glaring ſolecisſm to weaken that part which muſt weaken all the reſt. They ſhould be, if poſſible, right over one another; that void may be over void;

void; and full over full; and alſo oppoſite to each other, ſo as that one may ſee from one end of the houſe to another; which will not only be graceful, but alſo convenient; as it affords a means of cooling the houſe in ſummer, by letting in air; and of keeping out the wind in winter, which way ſoever it ſits.

In ſmall *Buildings*, the breadth of the *Door* of the entry ſhould be four foot, or four and a half; and the breadth of the *Doors* of the chambers $3\frac{1}{2}$, $3\frac{3}{4}$, or 4. In middling *Buildings* the Breadth of the entry *Door* ought to be 5 or 6 foot; and that of the chamber *doors* 4, or $4\frac{1}{2}$.

There are *gates* (A, ſee Plate V.) and *doors* of the *five Orders*, *viz.* *Tuſcan*, *Dorick*, *Ionick*, *Corinthian*, and *Compoſite Doors*.

Gates and Doors have their heads generally ſquare, and ſometimes circular, which laſt muſt not be uſed, if the impoſt be not above the height of a man.

Note, That *impoſts*, in architecture, are the capitals of pillars or pilaſters, which ſupport arches. An *impoſt*, ſometimes alſo called *Chaptrel*, is a ſort of *plinth*, or little cornice, which crowns a peer, and ſupports the firſt ſtone, whence an arch or vault commences. *Impoſts* conform to their proper order. The *Tuſcan* is a *plinth* only; the *Dorick* has two faces crowned; the *Ionick* a larmier over the two faces, and its moulding may be carved; the *Corinthian* and *Compoſite* have a larmier, freeze, and other mouldings. The Projecture of the *impoſt* muſt not exceed the naked of the pilaſter. Sometics the entablature of the order ſerves for the *impoſt* of the arch; and this looks very grand and ſtately. The *impoſt* is a thing eſſential to an ordonnance; in as much as without it, in the place where the curve line of the arch meets with the perpendicular line of the pillar, there always ſeems a kind of elbow.

Palladio gives the following rules for the decorations of *doors*, which decorations conſiſt of the *Architrave*, *Freeze* and *Cornice*. 1. That the *Architrave* ſhould turn about the *door*, and be as thick as the jambs or pilaſters, which muſt not be leſs than a ſixth part of the breadth of the opening, nor more than a fifth. 2. The thickneſs of the *Freeze* and *Cornice* is to be taken from the ſame opening. 3. The *Architrave* muſt be divided into four parts, three of which are to be for the altitude of the *Freeze*, and five for that of the *Cornice*. 4. The *Architrave* muſt be again divided into four parts; three whereof go to the firſt *faſcia*, four to the ſecond, and the other three are ſubdivided into five parts; two whereof are for the *Regolo*, or *Orlo*, and the other three are for the *ſcima reverſa*, otherwiſe call'd *cymatium*. Its projecture is equal to its altitude, and the fillet projects leſs than half its thickneſs. 5. To deſign the *Cymatium*, we muſt draw a right line from below the fillet to the upper part of the ſecond *faſcia*, which line is to be divided into two equal parts, each whereof is made the baſe of an iſoceles triangle, or which has two ſides equal; then the place of the fix'd foot of our compaſs muſt be plac'd in the angle over againſt the baſe, by which we'll draw the curve lines which give the *Cymatium*.

The *Freeze* ought to be three fourths of the *architrave*, and form'd by the ſegment of a circle, leſs than a ſemicircle, and its convexity, or ſwelling is to be perpendicular to the *cymatium* of the *architrave*.

The five parts to be given to the *cornice*, muſt be thus diſtributed to its members; one to be for the *cavetto*, with its *liſtella*, which is the fifth part of the *cavetto*, the projecture whereof is two thirds of its altitude; and an iſoceles triangle muſt be drawn to deſign it, ſo that the *cavetto* will be the baſe of the triangle. Another of the ſaid five parts muſt be allow'd to the *ovolo*, the projecture whereof ſhall be two thirds of its altitude, and is form'd by drawing an iſoceles triangle. The other three to be ſubdivided into ſeventeen parts, eight whereof we'll allow to the *corona* with its *liſtella's*, of which that above takes one of the ſaid eight parts, and that below, which makes the hollow of the *Corona*, muſt have but a ſixth part of the *ovolo*. The other nine will be given to the *ſcima recta* and its *fillet*, which will be one third of the ſaid *ſcima*.

Note, that Decoration in *Architecture*, is any thing that adorns and enriches a *building*. The orders of *Architecture* contribute greatly to the *decoration*, but then the ſeveral parts of thoſe orders muſt have their juſt proportions, characters, and ornaments; otherwiſe the fineſt order will bring confuſion, rather than richneſs.

As for our other apertures, which are Windows, (*B*) we muſt obſerve the following rules: 1. That they be as few in number, and as moderate in dimenſions, as may conſiſt with other reſpects; 2. That they be plac'd at a convenient diſtance from the angles, or corners of the *building*; 3. Care muſt be taken that the *windows* be alſo equal one with another, in their rank and order; ſo that thoſe on the right hand may anſwer to thoſe on the left; and thoſe above be right above thoſe below;

As to their *Dimenſions*, regard is to be had to the bigneſs of the rooms which are to receive the light.

The apertures of *windows*, in middle-ſiz'd houſes

houses, may be four and a half, or five feet between the jambs; and in the greater *buildings* six and a half, or seven feet; and their height may be double of the length, at least; but in high rooms, or larger *buildings*, their height may be a third, a fourth, or half their breadth, more than double their length.

Such are the proportions for *windows* of the first story; and according to these must those in the upper stories be for breadth; but as to height, they must diminish; the second story may be one third part lower than the first, and the third story one fourth part lower than the second.

There are different sorts of *windows*, viz. *Architrave windows*, *Dormer windows*, or *Luthern*, and *Transom windows*.

Architrave windows of timber, are commonly an *ogee* rais'd out of the solid timber with a list over it; though sometimes the mouldings are struck, and laid on, and sometimes are cut in brick. *Dormer windows*, or *Luthern*, are a kind of *window* over the *cornice*, in the roof of a *building*, standing perpendicularly over the naked part of the walls, and serving to illuminate the upper story. *Transom window* is a double-light *window*, so call'd from the piece that is fram'd a-cross it.

Windows, like doors, vary likewise with respect to the different orders of *Architecture*, and have their various decorations in common with doors.

Windows and *Doors* are also often adorn'd with Balconies; which are a jutty, or projecture, in the front of a house, supported by pillars, or consoles, and encompass'd with a ballustrade; which is an assemblage of one or more rows of ballusters, high enough to rest the elbow on, i. e. about four feet.

The next apertures which fall under our consideration, are the *Chimneys*.

Chimney, from the *French Cheminee*, is that part of the house where the fire is made. The *Chimney* is compos'd of jambs, or sides, of the back or wood; the mantle-tree resting on the jambs; the tube, or funnel, which conveys away the smoak; the chimney-piece, or moulding, on the fore-side of the jambs over the mantle-tree, and the hearth, or fire-place. But as we are yet on the out-side of the house, we'll consider first the funnel, or tube, which, according to *Palladio*, must never be made too wide, or too narrow; for in the former case the wind having too much room, will drive the smoak downward, and not let it ascend, or go freely out; and in the latter case the smoak, for want of a free vent, will fly back again. Therefore in the *Chimneys* of rooms the funnels must not be narrower than half a foot, nor wider than nine inches, nor above two foot and a half in length. The mouth of the pyramid, where it joins to the funnel, must be made somewhat narrower, that the smoak driving downward, it may keep it from going into the room. Some make the funnels crooked, that by their winding and the strength of the fire, which forces it upward, they may prevent the smoak from flying back into the room. The funnels, or openings a-top, says the same learned author, through which the smoak should be convey'd, ought to be wide, and set at a distance from any substance that is apt to take fire.

According to *Wolfius*, the breadth of the aperture at bottom ought to be to the height, as three to two; to the depth, as four to two. In small apartments the breadth is three foot, in larger five. In bed-chambers four. In small banquetting-rooms five and a half, in large six; but the height never to exceed two and a half, lest there be too much room for the air and wind to drive the smoak into the room. Nor must the height be too little, lest the smoak miss its way, and be check'd at first setting out. The same author advises, to have an aperture thro' which the external air may, on occasion, be let into the flame, to drive up the smoak, which the internal air would otherwise be unable to do.

Felibien orders the mouth of the tube, or that part join'd to the *chimney*-back, to be a little narrower than the rest, that the smoak coming to be repell'd downwards, meeting with this obstacle, may be prevented from getting into the room.

To prevent *smoaking chimneys*, Mr. *Lucar* advises two holes, or two pipes, one over the other, to be left on each side of the *chimney*, one sloping upwards, the other downwards: through one of these, says he, the smoak will pass in any position. *De Lorme* will have a brass ball full of water, with a small aperture, to be hung up in the *chimney*, at a height a little above the greatest flame: here, as the water grows hot, it will rarefy, and drive through the aperture in a vapoury stream, which will drive up the smoak that would otherwise linger in the funnel. Others place a kind of moveable vane, or weather-cock, a-top of the *chimney*; so that what way soever the wind comes, the aperture of the *chimney* will be skreen'd, and the smoak have free egress. Indeed the best prevention of a *smoaking Chimney* seems to lie in the proper situation of the doors of the room, and the apt falling back of the back, and convenient gathering of the wings and breast of the *chimney*.

Chimneys are made in the thickness of the wall, and

and care muſt be taken that no timber be laid within twelve inches of the fore-ſide of the *chimney* jambs, that all joiſts, on the back of the *chimney*, be laid with a trimmer, at ſix inches diſtance from the back; and that no timber be laid within the funnel.

The ancients, in order to heat their apartments, built their *chimneys* in the middle, with columns or conſoles, to uphold the *architraves*, over which they fixed the pyramidal funnel, through which the ſmoke was conveyed; though the obſcurity of the rules given by *Vitruvius*, on that head, would make one conclude, that the ancients had no *chimneys*, but only ſtoves, whereof they had entire apartments.

Palladio pretends, that the ſtoves of the ancients, us'd inſtead of *chimneys*, conſiſted of certain tubes, or pipes, in the thickneſs of the wall, though which the heat of the fires, which were made under thoſe chambers aſcended, and iſſued out through certain vents, or mouths, at the top of the ſaid tubes, or funnels.

In the year 1713, was publiſh'd a *French* book, intituled, *La Mechanique du feu*, or the art of augmenting the effects, and diminiſhing the expence of fire, by M. *Gauger*; ſince tranſlated into *Engliſh*, by the celebrated Dr. *Deſaguliers*. Wherein the author examines what diſpoſition of *chimneys* is moſt proper to augment the heat, and proves geometrically, that the diſpoſition of parallel jambs, with the back inclined, as in the common *chimneys*, is leſs fitted for reflecting heat into the room, than parabolical jambs, with the bottom of the tablette horizontal. He gives ſeveral new conſtructions of his new *chimneys*, and the manner of executing them.

Note, That Chimney Jambs are the ſides of a *chimney* uſually ſtanding out perpendicularly, ſometimes circularly from the back; on the extremities whereof the mantle-tree reſts.

We'll paſs now to the Stair-Case, (*C ib.*) defin'd an aſcent incloſed between walls, or a baluſtrade, conſiſting of ſtairs or ſteps, with landing places, and rails; ſerving to make a communication between the ſeveral ſtories of a houſe.

We muſt be very curious in placing our *ſtair-caſe*, ſince it is difficult to find a convenient place for it, which, at the ſame time, will no ways damage the reſt of the fabric. A proper ſituation, therefore, muſt be aſſigned to it, that it may not interfere with any other parts of the houſe, nor receive any inconvenience from them.

The common rules to be obſerved in *ſtair-caſes*, are as follow: 1. They muſt have three openings; the firſt of which is the door by which we go up to them, which the leſs it is concealed from ſuch as enter the houſe, the more ornamental it will appear; and, in *Palladio*'s opinion, it ſhould be plac'd in ſuch a manner, that before we come at it, we may have a ſight of the beſt part of the houſe: for, then, the edifice, though little in reality, will appear large. The ſecond opening is the windows requiſite to light the *ſtair-caſe*, and which muſt be ſituated in the middle, and made high, by which means they will diffuſe the light in equal proportion. The third opening is the landing-place, through which we enter into the rooms of the firſt ſtory, and muſt lead into the moſt handſome, ſpacious, and beſt furniſhed rooms of the houſe.

2. *Stair-caſes* muſt be made ſpacious in proportion to the bigneſs and quality of the building, and never narrower than three or four foot, that when two perſons meet, they may have room enough to paſs.

3. The ſteps muſt be no more than ſix or ſeven inches ſteep, and if they ſhould be leſs, eſpecially if the *ſtair-caſes* are long, and have no landing-places, it will make them ſtill more convenient, and leſs tireſome, by not obliging people to lift their feet ſo high; but then they muſt be four inches ſteep at leaſt. The breadth of the ſteps muſt not be more than one foot and a half, nor leſs than a foot.

The kinds of *ſtair-caſes* are various; for in ſome the *ſtairs* are ſtrait, in others winding; in others both ways, or mixt: again, of ſtrait *ſtair-caſes*, called alſo, *flyers*, ſome fly directly forwards; others are ſquare; others triangular; and others are called *French flights*.

For the making of ſtrait *ſtair-caſes*, the whole ſpace muſt be divided into four parts; two whereof muſt be allowed to the ſteps, and the other two to the void in the middle; whence the *ſtair-caſe*, in caſe it were left open, will receive the light. They may be made with the wall inward, and then the wall itſelf is incloſed in the two parts, which are allowed to the ſteps; tho' there be no abſolute occaſion for this.

Direct-flyers or *plain-flyers*, are thoſe which proceed directly from one *floor* to another, without turning either to the right or left; ſeldom uſed, except for garret, or cellar *ſtairs*. Square *flyers*, are thoſe which fly round the ſides of a ſquare newel, either ſolid or open; having at every corner of the newel, a ſquare half ſtep, taking up one fourth of a circle, ſo that they fly from one half ſtep to another; and the length of the *ſtairs* is perpendicular to the ſide of the newel. *French flyers*, fly, firſt directly forwards, till they come within the length of a *ſtair* of the wall; and then have a ſquare half pace, from which you immediately aſcend to another half-pace; from which the *ſtairs* fly directly back again, parallel to their firſt flight.

Of *winding-ſtairs*, called alſo *ſpiral-ſtairs*; ſome are ſquare, ſome circular, and ſome eliptical: and theſe again, are various, ſome winding round a ſolid, and others an open newel.

There are four kinds of circular *winding-ſtairs viz.* ſuch as wind about a ſolid newel; the fore-edge of each being in a right line, pointing to the centre of a newel; commonly uſed in church-ſteeples, and great old houſes. Such as wind round an open newel, the fore ſide of each being in a right line, pointing to the centre of the newel; as thoſe in the monument of *London*. Such as wind round a ſolid newel, only the foreſide of each, an arch of a circle; either concave or convex, pointing near to the circumference of the newel. And as ſuch reſemble the laſt, in all other reſpects, ſave that they have an open newel. Any of theſe *winding-ſtairs*, take up leſs room than other kinds.

When a *ſtair-caſe* winds round a ſolid newel, or a column, *Palladio* will have it made in the manner following: the diameter being divided into three parts, two muſt be for the ſteps, and one for the newel; or the diameter ſhall be divided into ſeven parts, three of which are to be allowed to the newel, and the four others to the ſteps; and in caſe the *ſtair-caſes* be made circular, they will appear very ornamental, and be longer, than if they had been made ſtrait. But in open *ſtair-caſes*, the ſame celebrated *architect*, divides the diameter into four parts, two of which he gives to the ſteps, and two to the void in the middle.

He divides *eliptical*, and circular *ſtair-caſes*, in one and the ſame manner, and judges them very handſome and agreeable, all the windows and doors being at the head, and in the middle of the *elipſis*.

Palladio mentions another kind of *ſtair-caſes*, in the portico of *Pompey* at *Rome*, in the way that leads to the quarter of the *Jews*, which conſiſts of three winding *ſtairs*, of a very pretty and artful invention; for being placed in the middle of the *building*, whence they could receive no light but from above; they were ſet upon columns, to the end that the light might be equally diffuſed; in imitation whereof *Bramante*, a celebrated *architect*, in his time, made one in the *Belvidera*, but without ſteps; and compoſed it of the four orders following: *viz.* the *Dorick*, *Ionick*, *Corinthian* and *Compoſite*. This kind of *ſtair-caſe*, is made, by dividing the ſquare into four parts; two of which are given to the void in the middle, and one to each ſide of the ſteps, or columns.

Mixt-ſtairs, are ſuch as partly fly, and partly wind; whence ſome call them *flyers* and *winders*: Of theſe are ſeveral kinds; as *doglegged-ſtairs*, which, firſt fly directly forwards, then wind a ſemicircle; and then fly directly backwards, parallel to that. *Square flyers* and *winders*, which have a ſquare newel, either ſolid or open, and fly by the ſides of the newel, winding a quadrant of a circle, at each corner. *Solid* and *open newelled-flyers*, and *winders*, which are of two kinds; the one winds a quadrant of a circle of about a ſolid newel, then flies by the ſide of a ſquare open newel; then winds again, by the ſide of a ſolid newel; then flies again, and ſo alternately. The other flies firſt, then winds, and then flies again alternately.

Several modern *Architects*, eſpecially the *French*, have introduced *twiſted rails*, in many of their *ſtair-caſes*; which are formed in the following manner:

When we have made our plan, and thereby found the breadth, or tread of the ſteps, and have alſo fixed on the bigneſs of the intended *rail*, with the form and projection of the mouldings; then the front of the ſecond ſtep muſt be continued out farther, and thereon a circle deſcribed, touching the inſide of the *rail*, and whoſe diameter muſt be equal to the breadth of two ſteps, which we'll divide into eight equal parts; then we'll deſcribe on the center of the ſaid circle, another circle, equal to the bigneſs of the *rail*, and alſo another circle to the extremities of the mouldings.

If we draw a diagonal line, and deſcribe the part of a circle, and dividing it into eight equal parts, continue it from the center to the line, we have the diminiſhing ſcale for the formation of the *ſcroll*. Then transferring the reſpective diſtances within the great circle, on each eighth part thereof, and finding the center of the eye, or block, for the firſt eighth part of the *ſcroll*, and proceeding from thence to all the diſtances, we have the whole *ſcroll* compleated, and finiſhing in the block, at one *revolution* of a circle. But here it is to be obſerved, that the inſide *ſcroll*, though drawn from the ſame centers, muſt not meet on the aforeſaid eight parts of the great circle, but a line drawn from the outer *ſcroll* to each center reſpectively.

For forming the ſcroll of the firſt *ſtep*, the ſame method is to be uſed as above; obſerving, only, that as it begins to be circular from the ſecond eighth part, the diſtance to the *rail* muſt be divided into ſeven parts, and gathering in, one at a time, it will be compleated.

Should it be required to make the *ſcroll* of a larger *revolution*, we muſt deſcribe a circle whoſe diameter is equal to three *ſteps*, and divide the diminiſhing ſcale into twelve parts; and by proceeding, as before,

ore, to ſtrike one eighth of the great circle at a time, we have the *ſcroll* at one *revolution* and a half of a circle. But wanting it ſtill larger, we'll make a circle, whoſe diameter is equal to the breadth of four *ſteps*, and the diminiſhing ſcale divided into ſixteen parts, the *ſcroll* will be formed at two *revolutions* of the circle.

Having carried the walls as high as we are determined they ſhall go, having made the vaults, laid the joiſts of the floors, (which *joiſts* are thoſe pieces of timber framed into the girders and ſummers, on which the boards of the floor are laid,) brought up the *ſtair-caſes*, &c. in the next place we muſt raiſe the *roof* (D *ib.*) which as it embraces all the parts of the fabric, and preſſes the walls thereof equally with its weight, is, by that means, a kind of bandage to the whole, and ſerves for ſhelter, to carry off the rain from the walls.

Note, That the Joists are from ſix to eight inches ſquare, and ought ſeldom to lie at a greater diſtance from each other than ten inches, never twelve: nor ought they ever to bear at a greater length than ten foot, or to lie leſs into the wall than eight inches. Sometimes carpenters *furr* their *joiſts*, as they call it; that is, lay two rows of *joiſts* one over the other. *Summer* is a large ſtone, the firſt that is laid over columns and pilaſters, in beginning to make a croſs vault; or it is the *ſtone*, which being laid over a *piedroit*, or column, is hollow'd to receive the firſt haunce of a plat-band. *Girders* are the largeſt pieces of timber in a *floor*; their ends are uſually faſtened into the *ſummers*, or *breaſt ſummers*; and the *joiſts* are framed in at one end to the *girders*. By the *ſtatute*, for rebuilding *London*, no *girder* is to lie leſs than ten inches into the walls; and their ends to be always laid in loam, &c.

Palladio will have *roofs* made more or leſs ſhelving, according as the climate is either hot or cold; for which reaſon, in *Germany*, ſays he, where the ſnow falls in great quantity, the *roofs* are made very ſharp, and are covered with ſhingles, or little thin pieces of wood, or elſe with very thin tiles; for otherwiſe the weight of the ſnow would cruſh them. But thoſe who live in gentle and moderate climates ſhould raiſe their roofs with grace and politeneſs, and to ſuch an altitude, as that the rain may eaſily roll off. Therefore the breadth of the plate to be *roof'd*, continues he, muſt be divided into nine parts; two whereof ſhall be the pitch; for if it were made of one fourth of the breadth. the *roof* would be too ſharp, ſo that the tiles would ſcarce cleave; and if they were made but of a fifth part, the *roof* would be too flat, whereby the ſuperincumbent weight of the tiles, ſhingles, and ſnows would preſs too much upon it. He concludes, by obſerving, that gutters are uſually made all round the houſe, into which the water which falls from the tiles is conveyed away, by ſpouts, at a conſiderable diſtance from the walls That the gutters muſt have a foot and a half of wall over them, which will not only keep them in much ſtronger, but likewiſe preſerve the timber in the *roof* from any damage which the rains might otherwiſe occaſion.

When the *roof* is *pointed*, its moſt beautiful proportion is, to have its profile an equilateral triangle; when *ſquare*, that is, when the pitch, or angle of the ridge, is a right angle, it muſt be conſidered as a mean proportion between the pointed and the flat-form. A *flat roof* is that in the form and proportions of a triangular pediment. Sometimes the *roof* is in the pinnacle form; ſometimes it has a double ridge; ſometimes it is cut or mutilated; that is, conſiſts of a true and a falſe *roof* laid over the former; ſometimes it is truncated, that is, inſtead of terminating in a ridge, or angle, it is cut ſquare off, at a certain height, and covered with a terraſs, and ſometimes, alſo, encompaſſed with a balluſtrade. Sometimes it is in manner of a dome, that is, its plan is ſquare, and the contour circular; ſometimes it is round, that is, the plan is round, or oval, and the profile ſpherical. Sometimes the baſe being very large, it is cut off to diminiſh its height, and covered with a terraſs of lead, raiſed a little in the middle with ſky-lights, from ſpace to ſpace, to give light to ſome corridore, or other intermediate piece, which without ſuch an expedient would be too dark.

There is alſo the *hip-roof*, which is a *roof* that has neither gable-head, ſhread-head, nor jirkin-head; which laſt are both gable and hip at the ſame end. A *hip-roof* has rafters as long, and with the angles at the foot, &c. at the end of *buildings*, as it has at the ſides; and the feet of the rafters on the end of ſuch *buildings*, as have *hip-roofs*, ſtand on the ſame plan, *viz.* parallel with the horizon, and at the ſame height from the foundation with rafters on the ſides of the *roof*.

All kinds of *roofs* are compoſed of *beams*, *rafters*, *hips*, &c. A *beam* is the largeſt piece of wood in a *building*, being laid a-croſs the walls, and ſerving to ſupport the principal *rafters* of the *roof*. No houſe has leſs than two of theſe *beams*, *viz.* one at each head: into theſe the girders of the garret-floor are alſo framed; and if the *building* be timber, the teazle tenons of the poſts.

The proportions of *beams* near *London*, are fixed by ſtatute as follows: A *beam* 15 feet long muſt be ſeven inches on one ſide its ſquare, and five on the other; if it be 16 feet long, one ſide muſt be eight inches, the other ſix; if 17 feet long, one ſide muſt be ten inches, the other ſix. In the country they uſually make them ſtronger. Sir *H. Wotton* adviſes theſe to be of the ſtrongeſt, and moſt durable timber.

Hence Mr. *Parent* remarks, that the common practice of cutting the *beams* out of trees, as ſquare as poſſible, is ill huſbandry; and hence takes occaſion to determine geometrically what dimenſions the baſe of a *beam*, to be cut out of any tree propos'd ſhall have, in order to its being of the greateſt poſſible ſtrength; or, which is the ſame thing, a circular baſe being given, he determines the *rectangle* of the *greateſt reſiſtance* that can be inſcribed, and finds, that the ſides muſt be nearly as 7 to 5, which agrees with obſervation. Hitherto the length of the *beam* has been ſuppos'd equal; if it be unequal, the baſes will reſiſt ſo much the leſs, as the *beams* are longer.

Mr. *Parent* has calculated *tables* of the *weights* that will be ſuſtain'd in the *middle*, in *beams* of various *baſes* and *lengths*, fitted at each end into walls, on a ſuppoſition that a *piece* of *oak* of an inch ſquare, and a foot long, retained horizontally by the two *extremes*, will ſuſtain 315 pounds in its *middle* before it breaks, which it is found, by *experience*, it will.

Rafters are pieces of *timber*, which ſtanding by pairs upon the *reaſon*, meet in an angle at the top, and form the roof. No *rafters* ſhould ſtand farther than 12 inches from one another. For the ſizes, or ſcantlings of *rafters*, it is provided, by act of parliament, that *principal rafters*, from 12 feet 6 inches, to 14 feet 6 inches long, be 5 inches broad a-top, and 8 at the bottom, and 6 inches thick; thoſe from 14 feet 6 inches, to 18 feet 6 inches long, to be 9 inches broad at the foot, 7 at the top, and 7 thick; and thoſe from 18 feet 6 inches, to 21 feet 6 inches, to be 10 inches broad at the foot, 8 at the top, and 8 thick. *Single rafters* 6 feet 6 inches long, to be 4 feet, and 3 inches in their ſquare; thoſe 8 feet long, muſt be $4\frac{1}{2}$, and $3\frac{3}{4}$ inches ſquare.

The *hips* are thoſe pieces of *timber*, plac'd at the corners of the roof. The *hips* are much longer than the *rafters*, by reaſon of their oblique poſition, and are plac'd not with a right or ſquare angle, but a very oblique one; and, by conſequence, are not, at leaſt ought not to be ſquare at any angle, (as *rafters* are at all) but *bevel* at every one of them; and, which is yet more, as rafters have but four plains, theſe commonly have five. *Hips* are called by country workmen *corners*; ſome call them *principal rafters*, and others *ſleepers*. Indeed *hips* and *ſleepers* are much the ſame, only the *ſleepers* lie in the vallies, and join a-top with the *hips*; but thoſe ſurfaces, or plains, which make the back of the *hips*, are the under ſides of the *ſleeper*. The *backs* of a heap are thoſe two *ſuperficies*, or plains, on the out-ſide of the *hips*, which lie parallel, both in reſpect of their *length* and *breadth*, with the *ſuperficies* of the adjoining ſides, and end of the roof.

The higheſt part of the roof, or rather the piece of wood wherein the *rafters* meet, is called the *ridge* of the roof.

Having finiſhed the outward caſe of the *edifice*, the next thing is, to diſtribute the ground-plot into apartments; in which diſtribution regard muſt be had to *gracefulneſs*, and *uſefulneſs*, for rooms of *office*, and *entertainment*, as far as the capacity thereof, and the nature of the country, will allow.

The *gracefulneſs* conſiſts in a double *analogy*, or *correſpondency*, firſt, between the parts of the whole, whereby a large fabrick ſhould have large partitions, entrances, doors, columns, and, in brief, all the *members* large; the ſecond between the parts themſelves, with regard to *length*, *breadth*, and *height*.

Palladio will have a *building* diſpoſed and ordered in ſuch a manner, as that the moſt noble and beautiful parts of it be the moſt expoſed to all ſpectators, and the leſs agreeable thrown into by places, and removed, as much as poſſible, from publick view; becauſe the refuſe of the houſe, or whatever may produce any ill effect, or incumbrance, ought to be carried thither; and for this reaſon the cellars, wood-houſes, coal-holes, pantries, kitchen, ſervants-hall, laundries, ovens, and other offices, which are for ever in uſe, ſhould, in his opinion, be placed in the lower and moſt obſcure part of the edifice, and ſome of them a little under ground.

The *uſefulneſs* conſiſts in having a conſiderable number of rooms of all kinds, with entries, halls, and light ſtair-caſes, which muſt be made ſpacious, and eaſy, to go up and down; and the *meaneſt*, and *leſs graceful* of them, ſituated advantagiouſly, to ſerve the other more ſpacious apartments. The rooms muſt be large, moderate, or middle-ſiz'd, and ſmall, and all contiguous to one another. *Convenient partitions* muſt be likewiſe contrived for *cloſets*, *libraries*, *horſe-furniture*, and other things which are in daily uſe, and which would appear *very indecent* in a *bed-chamber*, *dining-room*, or other place ſet a-part for the *reception* of *ſtrangers*.

Palladio orders the *ſummer rooms* to be ſpacious, and open to the *North*; and the *winter* ones ſmall, and expos'd to the *South* and *Weſt*. But the rooms intended

intended for *ſpring* and *autumn*, ought to be towards the *Eaſt*, and have their *proſpect* towards *greens* and *gardens*. *Studies* and *cloſets* ſhould likewiſe have the ſame *proſpect*. But, where the *Architect* is confined within certain limits, beyond which he has no *power* to go, *neceſſity* obliges him to ſuit himſelf according to the ſituation of the place.

In the partition, an *Architect* has often occaſion for ſeveral ſhifts; through which his own ſagacity, more than any rules, muſt conduct him. Thus he is frequently put to ſtruggle with ſcarcity of ground; ſometimes to damn one room, for the benefit of the reſt; as to hide a buttery under a *ſtair-caſe*, &c. at other times, to make thoſe the moſt beautiful, which are moſt in ſight; and to leave the reſt, like a painter in the ſhadow, *&c.*

Since the *hall*, or *ſalle*, is properly the firſt, and fineſt partition of an apartment, and is placed at the entrance of a fine houſe, palace, or the like; it therefore deſerves, firſt, our attention.

Vitruvius mentions three ſorts of *halls*: the *tetraſtyle*, which has four columns ſupporting the plat-form, or cieling: the *Corinthian*, which has columns all around, let into the wall, and is vaulted over; and the *Egyptian*, which had a periſtyle of inſulated *Corinthian* columns, bearing a ſecond order with a cieling. Theſe were called *Occi*.

To make a *Tetraſtyle* hall, according to *Palladio*'s deſign, its length ſhould be divided into five equal parts, three thereof muſt be allowed to the breadth. The wings (that is, the ſpace between the wall and the pillars, or columns, which is not included in the breadth of the hall) have in breadth a fifth part of the altitude of the columns. The columns, of what order, pleaſe moſt the Architect, and which he thinks moſt proper for the ornament and magnificence of the *hall*; which, commonly is the *Corinthian*. The diameter of thoſe columns, ought to be equal to the breadth of one half of the wings: the opening above, one third part of the breadth of the *hall*.

The length of a *Corinthian-hall*, ſhould be the diagonal of its ſquare; and the wings have in breadth, two ſevenths of the length of the *hall*, that is, one for every wing; the diameter, and height of the columns, in proportion; as well as the opening in the middle.

The *Egyptian-halls*, are very much like *Baſilicas*, or the courts of juſtice of the antients; becauſe they have a portico, in which the columns are diſtant from the wall, like in the *Baſilicas*; and upon theſe columns, are placed the architrave, freeze, and cornice. The ſpace, or diſtance between the columns and the wall, is covered with a platform, ſurrounded by a corridore with rails, and balluſters. Above the ſaid pillars there is a continued wall, with half columns, on the inſide of it, one fourth part leſs than the lower ones. The windows which give light to the *hall*, and through which, when laid open, ſuch as are on the platform can look into it, are placed between the ſaid half columns.

The antients had another ſort of *hall*, called *teſtitudinated*; that is, made in a form of a *tortoiſe*. The length of a *teſtitudinated-hall*, is equal to the diagonal of its ſquare, and has its full breadth in height; which reaches as far as the ſummer, or architrave of the roof. The rooms on the ſide are ſix feet leſs in height; and above the walls, which ſeparate them from the *hall*, there are columns, which bear the roofs of the ſaid *hall*. Between theſe columns, there are ſome apertures, or windows, which give light to the *hall*. A little farther are the *periſtylos*, about which are piazzas, that are the height of the columns. The chambers are of the ſame breadth, and their height to the impoſts of the arches, is equal to their breadth; as the arches have in height the third part of their diameter.

The length of *halls* ſhould never exceed twice their breadth; but the nearer they are to a ſquare, the more uniform and commodious they will be.

We muſt not confound *halls*, with *entries*, tho' we often give to *entries*, the name of *halls*; though *entries* be in the lower parts of the houſe, and *halls* in the upper. *Entries* are but a ſort of landing-place, with which all the other principal parts of the houſe have a communication, and where perſons wait till the maſter of the houſe appears; and after the *galleries*, are the firſt places that preſent themſelves to ſuch as enter the houſe.

The *galleries* are covered places in palaces, much longer than broad; which ſerve to walk in. If there be but one, 'tis uſually made in the fore, or back front of an edifice; if two, in the wings. They are either large, or ſmall, as conveniency, and the quality of the *building*, may require; but they ſhould never be above twenty feet broad; or leſs than ten. The *galleries* of the *Louvre* are magnificent.

The *rooms* muſt be diſtributed equally on each ſide of the *entry*, and the *hall*; and care muſt be taken that thoſe on the right hand, anſwer to, and be of an equal largeneſs, with thoſe on the left, whereby there will be a juſt harmony, and proportion in the ſeveral parts of the edifice; and the wall will be in equal proportion preſſed by the roof: for if the apartments are bigger on one ſide the edifice than on the other, in the former caſe they will reſiſt the weight with eaſe, becauſe of the ſolidity, and thickneſs of the walls; but in the latter they will be too weak, which will create great inconveniencies, and at laſt, deſtroy the whole ſtructure.

Palladio ſays, that in the deſigning of *rooms*, there are ſeven beautiful proportions; for either they are made round or ſquare; but that the former is now entirely neglected, and laid aſide; or their length is the diagonal of their ſquare; or of one ſquare, and a third; or a ſquare, and a half; or a ſquare, and two thirds; or laſtly, of two ſquares.

For the altitude of *rooms*, it muſt be taken from the different form of the cieling; which is either arched or flat. If flat, the altitude from the *floor* to the *joiſts*, muſt be in equal proportion to their breadth; and the *rooms* over them, muſt be a ſixth part lower than thoſe beneath. If arched, as they uſually are in the firſt ſtory (for this gives them a grace and beauty, and renders them leſs liable to fire) their altitude, in ſquare *rooms*, is a third part more than the breadth of the *rooms*. But in thoſe, where the length exceeds the breadth, an altitude muſt be ſought equal to their length and breadth; and dividing the whole into two equal parts, one of which will be the exact altitude of the arch. Or if the chambers, to be arched, be twelve foot in length, and ſix in breadth, we muſt add the two numbers together, and the ſum is eighteen, which divided by two, gives nine, and this is the altitude of the arch required.

Another method of finding the altitude of a *room* by numbers, is, by finding (after the length and breadth of the room has been given) a number that bears the ſame proportion to the breadth, as the length does to it; which is performed by multiplying the leſſer extreme by the greater, and the ſquare root of the product, will be the height. For example, ſuppoſe the place to be arched be nine feet long, and five feet broad, the altitude of the arch will be ſix feet; and the ſame proportion that nine has to ſix, ſix has to four. But however we muſt obſerve, that this altitude cannot always be found by numbers.

To find in numbers,. another altitude, which though it be leſs, will ſtill be in proportion to the *room*; we muſt firſt have found by the length and breadth of the chamber, its altitude according to the firſt rule; which in the foregoing inſtance was nine, and having added the length, breadth, and altitude together, we'll multiply the nine by twelve, and afterwards by ſix: ſetting the product, made by twelve, under twelve, and the product made by ſix under ſix; when this is performed, we'll multiply ſix by twelve, and ſet the product thereof, which is 72, under 9; laſtly, having found a number, that, multiplied by 9, produces 72, which in this inſtance will be eight; eight foot muſt be the altitude of the arch. Theſe ſeveral altitudes have this relation between themſelves, *viz.* that the firſt exceed the ſecond, in the ſame *ratio*, or proportion, as the ſecond exceeds the third. Each of theſe altitudes may then be uſed, according to the conveniency which they give for contrivance; that various *rooms* of ſeveral dimenſions may be ſo made, as to have all their arches of an equal altitude; and be at the ſame time exactly proportionate: by this means the chamber will look agreeable, and be very convenient for the *floor* above, which will be upon a level. There are other proportions for the altitude of arches, which do not come under any particular rules; and are therefore left to the *Architect*, to uſe them as neceſſity requires.

For our private *buildings*, here in *London*, the parliament, after the conflagration, thought proper to determine the ſeveral proportions of the apartments, according to the bigneſs of the houſe, *viz.* in houſes fronting by ſtreets or lanes, of two ſtories high, beſides cellars and garrets; the cellars ought to be ſix feet and a half high, if the ſpring of water hinder not; and the firſt ſtory nine feet from the *floor* to the *cieling*, and the ſecond ſtory as much. That in houſes fronting ſtreets or lanes of note, and the river of *Thames*, which ought to be three ſtories high, beſides cellars and garrets; the cellars ſhould be ſix feet and half high, if the ſprings hinder not; the firſt ſtory full ten feet from the *floor* to the *cieling*; the ſecond ten feet; the third nine feet. That in houſes fronting the high and principal ſtreets, which ſhall be of four ſtories high, beſides cellars and garrets, the firſt ſtory be full ten feet and a half in height, from the *floor* to the *cieling*; the ſecond ten feet, and the third nine feet; the fourth eight feet and an half.

In large *buildings*, and ſumptuous edifices, the *rooms* are arched. *Palladio* reckons ſix kinds of arches adapted to that purpoſe, *viz.* croſſed, faſciated, flat, circular, grinded, and ſhell-like; all which are in altitude one third of the breadth of the *room*. The four firſt were uſed by the antients, and the two laſt are of the invention of the moderns, who divide arches, into *circular*, *elliptical*, or *ſtrait*; and ſubdivide the *circular*. into *ſemicircular*, *ſcheme*, and *arches of the third and fourth point*.

Semicircular-arches, are thoſe which make an exact *ſemicircle*, and have their center in the middle of the chord of the arch; called alſo by the *French* builders, *perfect arches*, and arches *en plaine cinture*. *Scheme-arches* are thoſe which are leſs than a *ſemicircle*, and conſequently are flatter arches; containing ſome 90 degrees, others 70, and others 60: called alſo *imperfect-arches*. *Arches of the*

third

third and fourth point, confift of two *arches* of a circle, meeting in an angle at the top, and are drawn from the divifion of the chords, into three or four parts at pleafure. Of this kind, there are many in old *Gothick buildings*; but on account of their weaknefs and unfightlinefs, they ought, according to Sir *Henry Wotton*, to be for ever excluded out of all *buildings*.

Elliptical arches confift of a *femi-ellipfis*; and were formerly much ufed, inftead of *mantle-trees*, in *chimneys*. Thefe have commonly a key-ftone, and chaptrels or impofts. *Strait-arches* are thofe whofe upper and under edges are *ftrait*; as in the others they are curved; and thofe two edges alfo paral el, and the ends and joints, all pointing towards a centre. Thefe are principally ufed over windows, doors, &c.

Circular-arches, are made in fquare chambers, and, according to *Palladio*, raifed in this manner: in the angles of the *room*, are left certain *mutules*, or *modillons*, which fuftain the *femi-circle* of the arch; which is flat in the middle, but more *circular* the nearer it approaches the angles.

As for the *cielings* of our *rooms*, there are different methods of making them; for fome people are very curious to have them of beautiful and well wrought *joifts*; in which cafe particular care muft be taken, that the diftance between the *joifts*, be once the thicknefs and a half of the faid *joifts*; for that diftribution will make the *cieling* very agreeable, and fo much of the wall will be left between the ends of the *joifts*, as will fuffice to fupport the weight over it; but in cafe they are made at a greater diftance, they will look very unhandfome; and if at a leffer, they will divide as it were the upper wall from the lower; and if the *joifts* fhould prove rotten, or by any cafualty be fet on fire; the upper wall muft fall of courfe. Others are fond of compartments made of *ftucco-work*, or of timber; thefe they fill wifl with pictures, fo that they may be varioufly decorated, and therefore no fixed and pofitive precepts, can be prefcribed upon this topick. Though thofe which are to have a picture in the middle, are commonly divided into fquare pannels in the corners, and a large circle in the middle proper for painting; the borders or margin, being ornamented with *frets* and *guilochis*.

Note, That Fret in *Architecture*, is a kind of knot, or ornament; confifting of two lifts, or fillets, varioufly interlaced, or woven; and running at parallel diftances, equal to their breadth. A neceffary condition of thefe *frets*, is, that every return, and interfection, be at right angles. This is fo indefpenfible, that they have no beauty without it; but become perfectly *Gothick*. Sometimes the *fret* confifts but of a fingle *fillet*; which if well managed, may be made to fill its fpace exceedingly well. The antients made great ufe of thefe *frets*; the places they were chiefly applied on, were even, flat members, or parts of *buildings*, as the faces of the corona, and eaves of cornices; under the roofs, foffits, &c. on the plinths of bafes, &c. The appellation was occafioned hence, that the *French* word *frette*, literally fignified the timber work of a roof, which confifts chiefly of beams, rafters, &c. laid a-crofs each other and as it were *fretted*. *Frets* and *guilochis* are fynonimous. Thefe ornaments, though fmall, if they be well adjufted, are very pleafing. They are frequently ufed in picture-frames, foffits, of arches, and on architraves, and fometimes on *fafcia's*, and the plinths of bafes, if the other members be carved.

As we have left our *chimneys* without *ornaments*, we'll return to them, and have them *decorated*, each with its *chimney-piece*; which is a compofition of certain mouldings, of wood or ftone, ftanding on the *forefide* of the jambs, and coming over the *mantle-tree*.

Chimney-pieces muft be made *larger*, or *fmaller*, in proportion to the *fize* of the *rooms* where they are intended. As for the various *ornaments* of *chimney-pieces*, they are at the *difcretion* of the *Architect*, provided they prove anfwerable to the other *ornaments* of the *rooms*.

Our Floors are to be of earth, bricks, ftones, or timber. *Palladio* obferves, that brick *pavements* are very *ornamental*, and ftrike the eye *agreeably*, as well on account of the variety of colours which they borrow from the various forts of earth of which they are compos'd, as from the various forms which may be given them. He obferves, further, that the *floors* of chambers are but feldom made of *natural ftones*, fince they are too cold in *Winter*; but that they are *agreeable* enough in *galleries*, and apartments for publick *entertainments*.

Carpenters never *floor* their rooms with boards till the carcafe is fet up, and alfo inclos'd with walls, left the *weather* fhould wrong the *flooring*; yet they generally rough plane their boards for the *flooring*, before they begin any thing elfe about the *building*, that they may fet them by to dry, and feafon; which is done in the moft careful manner.

It muft be obferved, that fuch chambers as are upon the fame *ftory*, muft have their *pavements level*, and fo as that the *threfholds* of the *doors* may be no higher than the reft of the plan of the *rooms*; and if any little *room*, or *clofet*, fhould not rife to that height, the remainder muft be fupply'd with a *Mezarin*, or *falfe cieling*.

He that intends to build a Country Seat has fome other matters to confider peculiar to a country life. The fituation fhould be near the center of the

the eftate, well covered, if poffible, from the wind, and near a river, or fome head of water.

It is not adviſeable to *build* in *valleys* inclofed by *mountains*; becaufe *houfes* will lie concealed in fuch places, befides the difadvantage of their having no diftant *profpects*, and not being confpicuous to the eyes of others; by which means, all their *beauty* is loft, befides their being, in all refpects, prejudicial to *health*. Being then determin'd to *build* upon an *eminence*, we will chufe fuch a *fituation* as is expofed to the moft *temperate region* of the air, and is neither always *overfhadowed* by higher hills, nor *fcorched*, as it were, with two funs, by the reflection of the real one from fome adjacent rock; for in either of thefe cafes it becomes an *incommodious habitation*. But if we cannot avoid *building* on *low ground*, we muft fet the firft *floor* above the *ground* the higher, to fupply what we want to fink in our *cellar* in the ground; for in fuch *low*, and *moift grounds*, it conduces much to the *drynefs* and *healthinefs* of the air, to have *cellars* under the *houfe*, fo that the *floors* be good, and cieled underneath. *Houfes* built *too high*, in places expofed to the winds, and not well *defended* by *hills*, or *trees*, require more materials to build them, and alfo more reparations to maintain them; and are not fo *commodious* to the inhabitants as thofe which have thofe *advantages*.

As for the diftribution of the apartments, in *country houfes*, it is made in the fame manner as in *city houfes*, i. e. according to the quality of the *mafter*, the numerous companies he is to *entertain*, and the number of his *fervants*. On both fides of the *court* (the *houfe* being in the *front*) may be *built*, the *ftables*, *cellars*, *granaries*, and fuch other *commodious places*, for the *fervice* of the *houfe*.

The ARCHITECT is to be learned alfo in other parts of ARCHITECTURE: fuch as the building of temples, or churches, bridges, and other public edifices.

A CHURCH is defin'd, by *Daviler*, a large, *oblong edifice*, in form of a *fhip*, with *nave*, *choir*, *ifles*, *chapels*, *belfries*, &c.

Palladio is of opinion, that the moft agreeable, and moft regular forms a *church* can be made in, are the round, and the triangular; and, again, of thefe two he chufes the round form as the moft perfect, for the following reafons: 1. Becaufe, fays he, the round form alone, among all figures, is fimple, uniform, equal, ftrong, and moft capacious; and therefore can contain a greater multitude of people. 2. That its being included in a circle, wherein neither end nor beginning can be found; having all its parts alike, and each of them partaking of the figure of the *whole*, and the extream in every part being equally diftant from the *center*; it is therefore the moft proper figure to denote the unity, Effence, uniformity and juftice of GOD.

Churches, according to the fame *author*, fhould have large *portico's*, with greater *columns* than are requifite in common *buildings*. The orders of the *columns* fhould be as beautiful as poffible, and each order ought to have its own proper and convenient decoration. *Churches* fhould alfo be made of the choiceft, and moft valuable materials. White, of all colours, continues *Palladio*, is the moft fuitable to *temples*; becaufe the purity of it, expreffed in the purity of life, is *highly acceptable* to the *Almighty*. But in cafe they muft be painted, there ought to be no ftatues nor pictures in them that may, in the leaft, tend to the alienation of man's mind from the contemplation of the Divinity.

Thefe are *Palladio*'s general obfervations on the ftructure of *temples*, from which he enters into particulars, with regard to the compartments of *churches*, confidering that it is abfolutely neceffary that all their parts fhould correfpond together, and have fuch a proportion, that there be none of them by which the whole may not be meafured, as well as every individual part. But, however, as he fuppofes the round and quadrangular forms the two moft regular, he confines himfelf to give us the neceffary directions and rules followed by the antients in the *building* of thofe two kinds of *temples*.

The diameter of the whole fpace which the *temple* was to take up, is divided into three equal parts; one whereof is given to the fteps, that is, the afcent of the *floor*; and two remained for the *temple* itfelf, and the columns, which are placed upon pedeftals, and with their bafes and capitals, are as *high* as the diameter of the leaft courfe of the fteps, and a tenth part as *thick* as they are *high*. The architraves, freezes, and other decorations, are made according to the rules given in our treatife of *Architecture*.

But fuch *churches* or *temples* as are made with a *nave*, are either wing'd round, or made with a *portico* only in the front. The compartments of fuch as are wing'd round, are as follows:

Two courfes of fteps are made quite round, and the pedeftals are fet upon them, and upon thefe the columns. The wings are a fifth part of the diameter of the *temple*, taking the diameter from the inner part of the pedeftals. The columns are as long as the cell is large, being a tenth part as thick as they are long. The *cupola* is to be raifed above the architrave, freeze, and cornice of the wings, proportionable to the half of the whole work. The columns, which begin from the floor, and confequently are without pedeftals, render the *temple* more pompous and majeftic; pedeftals, befides, obftructing the going into the *temple*. If a *portico* be erected in the front only of a round *temple*, it muft be made as long as the *nave* is large, or an *eighth part* leſs; and tho' it may be made ſhorter, yet it muſt, however, never be ſhorter than *three quarters* of the *breadth* of the *church*; nor muſt it ever be made broader than a *third part* of its *length*.

In quadrangular *temples*, the *portico's* in the front are to be made as long as the *temple* is broad, and if the manner be *Euſtylos*, (i. e. whoſe columns have proper and convenient intervals) which is the moſt elegant and beautiful, the compartments muſt be made in this manner: if the proſpect be of four columns, the whole front of the *temple* (omitting the projecture of the baſes of the columns in the corners) muſt be divided into eleven parts and a half; one whereof might be called a *module*, or the ſtandard whereby the other parts are to be meaſured; four whereof are to be given to the columns, if they be one *module* thick; three to the middle intercolumnation; and four and a half to the other two; that is, two and a quarter to each. But in caſe the front has ſix columns, it muſt be then divided into eighteen parts; if eight, into twenty-four and a half; and if ten, into thirty-one; giving always one of theſe parts to the thickneſs of the columns, three to the middle void, and two and a half to each of the other. The height of the columns muſt be managed according as they are either *Ionic* or *Corinthian*.

The *ante-temple* was beyond the *portico*, and the *nave* after the former. The breadth was divided into four parts, and the length of the *temple* conſiſted of eight ſuch; five whereof were given to the length of the *nave*, including the wall wherein the door is; and the other three remained to the *ante-temple*, which has two wings of walls on its ſide, continued to the wall of the cell. At the end of theſe are made two *ante's*, that is, two pilaſters as *thick* as the columns of the *portico's*; and ſince between theſe wings there may be a greater or leſs ſpace, if the larger be twenty foot, there ought to be two columns put between the ſaid pilaſters, nay, more, if there ſhould be occaſion, directly oppoſite to the columns of the *portico*. The uſe of them is to ſeparate the *ante-temple* from the *portico*; and the three, or more voids, that will be between the pilaſters, muſt be cloſed with pannels of wood, or marble; the neceſſary opening however, muſt be left for entering into the *ante-temple*. But if the *breadth* exceeds forty foot, there muſt be other columns placed within, over-againſt thoſe between the pilaſters; and they muſt be made as *high* as thoſe without, tho' not quite ſo *thick*; for the open air will take away from the *thickneſs* of thoſe without, and the incloſure will not let the ſmallneſs of thoſe within be ſeen, ſo that they will appear equal.

Thus the antients (according to *Vitruvius*) ordered the compartments of their *temples*, which had always *portico's* to them, to ſhelter the people, who waited for the hour of the ſacrifice, againſt the injuries of the *weather*. But we *Chriſtians*, not regarding whether the *portico* ſurrounds the *temple* or not, *build* our *churches* much like the antient *baſilica's*, or court of juſtice, with *portico's* within; the reaſon whereof is, that the firſt who embraced the *Chriſtian* religion uſed to meet for fear of the *Gentiles*, in the *baſilica's* of private perſons; and obſerving, afterwards, that this form was very convenient, becauſe the altar could be placed in the room of the tribunal to great advantage, and that the choir could ſtand round the altar in good order, while the remaining part might hold the people, they have not thought proper to alter it ſince.

Some *authors* pretend, that the *choir*, in the *Chriſtian churches*, was not ſeparated from the *nave* till the time of *Conſtantine*; that from that time the *choir* was railed in with a balluſtrade, with curtains drawn over, not to be opened till after the conſecration. That in the 12th century they began to incloſe the *choir* with walls, but the antient balluſtrades have been ſince reſtored, out of a view to the beauty of *architecture*. In nunneries, the *choir* is a large hall, adjoining to the body of the *church*, ſeparated by a grate, where the religious ſing the office.

Moſt of the *Chriſtian churches* were made, for a conſiderable number of centuries, in the form of a croſs. In that part which makes the foot of the croſs, is the entrance over-againſt the great altar, and the choir; and in the two iſles extending like arms on each ſides, are two other entrances, or two altars.

There are churches in a *Greek croſs*; and others in a *Latin croſs*. Churches in a *Greek croſs*, are thoſe where the length of the tranſverſe part is equal to that of the *nave*; ſo called, becauſe moſt of the great churches are built in this form. Churches in a *Latin croſs*, are thoſe whoſe *nave* are longer than the *croſs* part, as moſt of our antient *churches*.

There are alſo churches in *rotundo*, which are thoſe, whoſe plan is a perfect circle; and which in *Palladio*'s opinion, are the moſt beautiful, commodious, and regular. In all theſe different ſorts of churches, the dimenſions, with reſpect to their breadth, length, the height, and bigneſs of the pillars; their different orders, *&c.* ſhould be obſerved as above preſcribed; avoiding as much as poſſible, their having too great a number of mon-

ſtrous

ſtrous columns in the *nave*; which is a choaking imperfection, in our church of St. *Paul*'s in *London*.

Palladio gives us the deſcription of a *church*, called *the Baptiſm of Conſtantine*, and which is at St. *John de Lateran*, at *Rome*; this he ſuppoſes to have been built of the ſpoils and ruins of antient fabrics: as learned authors believe the deſign beautiful, and the decorations very well carved, I will inſert it here, for the benefit of *Architects*, who have not *Palladio*'s works. The columns are of *porphyry*, and of the *Compoſite* order. the baſe is a compound of the *Attic* and *Ionic*, but inſtead of two aſtragals, which are made between the ſcotias in the *Ionic*, this has one only, which takes up the room of two: all theſe members are beautifully carved, and have fine intaglias. The baſes of the columns in the portico, are embelliſhed with leaves, running up along the ſhaft of the column; and though the ſhafts of the columns, are not ſo long as they ſhould be, yet by this management the work is not robbed in the leaſt, of its beauty and majeſty. The capitals are compounded of *Ionic* and *Corinthian*, with *acanthus* leaves. The architrave is very well carved, its cimaſe having a fuſarole, and above half an ovolo; inſtead of a gula inverſa, the freeze is plain. The cornice has two *gulæ rectæ*, one above the other, which is a thing that very ſeldom happens: ſince two members of the very ſame ſort, ſhould not be put over each other, without ſome other intermediate member beſides the liſtel. Over theſe gula-rectas or cymatiums, is a dentil, and then the corona with its ogee, and laſt of all a gula recta, or another cimaſe; ſo that the *Architect* in this cornice, has, by making dentils, avoided modillons.

Vitruvius had diſtinguiſhed *temples*, with regard to their conſtruction, into various kinds; as, *temple in antæ*, *ædes in antis*, which were the moſt ſimple of all *temples*; having only angular pilaſters, called *antæ*, or *paraſtatæ*, at the corners; and two *Tuſcan* columns on each ſide the doors. *Tetraſtyle*, which was a *temple* that had four columns in front, and as many behind. *Proſtyle*, which had only columns on its front, or fore-ſide. *Amphiproſtyle*, which had columns both before and behind; and which was alſo *tetraſtyle*. *Pireptere*, which had four rows of inſulated columns around, and was *hexaſtyle*; that is, had ſix columns in front. *Diptere*, which had two wings, and two rows of columns around, and was alſo *octaſtyle*, or had eight columns in front.

There were alſo *pſeudodiptere temples*, which had eight columns in front, and a little row of columns all around; by which it was diſtinguiſhed from the *diptere*, which had two rows of columns all around. *Hypæthros*, which had no roof, or covering. *Monoptere*, which was round and without walls, having its dome ſupported by columns.

From the *building of churches*, we will paſs to the erection of Bridges, which are edifices either of ſtone or timber, conſiſting of one or more arches; erected over a river, canal, or the like, for the conveniency of croſſing, or paſſing over from one ſide to the other.

Bridges ſhould be always well deſigned, commodious, durable, and well decorated. The piers of ſtone are to be equal in number, that there may be one arch in the middle, where commonly the current is ſtrongeſt. Their thickneſs not to be leſs than a ſixth part of the ſpan of the arch, nor more than a fourth. They are commonly guarded in front with an angular ſtarling, or ſpur, to break the force of the current; though this defence is ſometimes alſo turned *ſemicircularly*; in the antient *bridges*, it is always a right angle; which has the advantage of being ſtronger, and more durable than acute ones. The ſtrongeſt arches are thoſe whoſe ſweep is a whole *ſemicircle*.

The breadth of a *bridge*, according to *Baptiſta Alberti*, ought to be the ſame as that of the highway which abuts on it: the breadth of the piers is to be one third of the apertures of the arches; the ſtarling to be one half the breadth of the piers, and to riſe above the greateſt height, to which the water ever mounts.

Palladio ſays, that four things are to be conſidered in the erection of *ſtone bridges*, viz. the heads which are made at the banks; the piles, or pilaſters, which are fixed in the river; the arches which theſe pilaſters ſupport; and the pavement which is made over the arches.

He obſerves, that the heads of theſe *bridges*, ſhould be made as firm and ſubſtantial as poſſibly can be; becauſe they not only ſerve to ſupport the weight of the arches as the other pilaſters do, but they likewiſe keep the whole *bridge* together, and the arches from cracking or opening. That they are made, therefore, where the banks are of ſtone, or at leaſt of ſolid earth; and that no bank of earth being naturally ſolid enough for this occaſion, art muſt be uſed to make them firm and ſtrong, and other arches and buttreſſes muſt be added; that if the water ſhould happen to deſtroy the bank, yet the way to the *bridge* might ſtill be preſerved. That the pilaſters, which are to be made in proportion to the largeneſs of the river, ſhould always be even in regard to their number; not only the better to ſupport the weight, but that they ſhould likewiſe ſtrike the eye agreeably, and render the work more ſubſtantial, ſince the current of the river

river in the middle (where it is naturally more rapid, as being more diſtant from the banks) is thus free, and does not prejudice the pilaſters by perpetually ſhaking them. For this reaſon the pilaſters ought to be ſo comparted, as to fall in that part of the river where the courſe is leaſt rapid. That the foundation of *bridges* ought to be made at that time of the year when the waters are loweſt, which is in *autumn*; and in caſe the bottom of the river be of ſtone or gravel ſtone, or any ſoſt ſtone whatſoever, which is a kind of earth that is partly ſtone, the foundations are already made without any trouble of digging, becauſe theſe are naturally the beſt oundations; but in caſe the bottom of the river be and or gravel, it muſt be digged therein till the fworkmen come to the ſolid ground; or if that ſhould prove too laborious or impracticable, he muſt dig moderately deep in the ſand or gravel, and then drive in oaken piles, which will reach the ſolid and firm ground, with the iron by which their points are to be armed. That to lay the foundation of the pilaſters, only one part of the bed of the river muſt be encloſed from the water, and then build there, that the other part being leſt open, the water may have its free current; and ſo to go on from part to part. That the pilaſters muſt not be leſs in dimenſion, than the ſixth part of the breadth of the arch; nor generally ſpeaking larger than a fourth. That they ſhould be made of great ſtones joined together with cramps, and bars of iron, faſtened with lead, that they may be, as it were, all of one piece by ſuch ligaments That the fronts of the pilaſters, or that ſide which faces the ſtream, ſhould be made angular; that is, ending in a right angle; and ſometimes, they are made circular (as we have already obſerved) in order to divide or break the water; and that thoſe things which are impetuouſly brought down the river, when they ſtrike againſt them, may be ſhoved from the pilaſters, and paſs through the middle of the arch. That the arches too, ſhould be made very ſtrong and ſubſtantial, and with great ſtones, well united together, the better to reſiſt the conſtant paſſing of carriages, or any other weight that ſhall happen to come over them; which arches are the ſtrongeſt, when they conſiſt of a ſemicircle, becauſe they entirely reſt upon the pilaſters, and never preſs upon each other; but, that if by the nature of the ſituation and diſpoſition of the pilaſters, a perfect ſemicircle ſhould not be commodious, as rendering the aſcent and deſcent difficult, a leſſer ſection muſt be then made uſe of, and ſuch arches ſhould be made as riſe only the third part of the diameter; and in this caſe, the foundations muſt be made extreamly ſtrong upon the banks. Laſtly, that the pavement of theſe *bridges*, ought to be made exactly like thoſe of ways and ſtreets. Theſe are *Palladio*'s inſtructions and rules for the erection of *bridges*

Notwithſtanding all theſe rules given by *Palladio*, and other eminent *Architects*, as *Alberti*, *Scammozzi*, *Goldman*, *Hawksmoor*, and *Gautier*, who has a piece expreſs on *bridges*, ancient and modern, viz *Traité des Ponts*, *Paris*, 1716, 12*mo*, complaints are ſtill made, that no demonſtrative reaſons are given, of the ſeveral proportions of the moſt eſſential parts of *bridges*; much of which is ſtill left to the diſcretion of the *builder*, to be regulated according to the circumſtances, deſign, place, magnitude, &c. of the deſigned edifice.

The current of a river is ſometimes diminiſhed, to ſecure the piers of the *bridge* which are *building* over it; which is done either by lengthening its courſe, by making it more winding, or by ſtopping its bottom with rows of banks, ſtakes, or piles, which break the current. The piers always diminiſh the current of a river: ſuppoſe this diminution one fifth part, it will follow, that in caſe of inundations, the bed muſt be ſunk, or hollowed one fifth part more than before, ſince the waters gain in *depth* what they have loſt in *breadth*. And, as the quantity of the water remains ſtill the ſame, it will paſs with greater velocity, by one fifth part, in the place where ſuch contraction is; all which conduces to waſh away the foundation. The ſtream thus augmented in velocity, will carry away flints and ſtones, which, before, it could not ſtir.

Palladio gives us the *draught* of a *bridge* of his own invention, which was to be *built* over a very rapid river, one hundred and eighty feet broad. The whole *breadth* of the *bridge* is divided into three *arches*, that of the middle to be ſixty feet *broad*, and the other two forty-eight each. The pillars for the ſupport of the *arches* were twelve feet *thick*, being, thereby, a fifth part of the middle *arch*, and a fourth part of the leſſer ones; which tho' deviating from the common meaſures of *pilaſters*, were made ſo *thick* on purpoſe that they might project very far from the body of the *bridge*, in order to reſiſt the rapidity of the current, and oppoſe the ſtones and trees which fall down with the ſtream. The *arches* were to have been a portion of a circle leſs than a ſemicircle, that the *aſcent* and *deſcent* of the *bridge* might be plain and eaſy. The *archivolte* of the *arches* to have been made a 17th part of the void of the middle *arch*, and a 14th part of the other two. Over the *pilaſters* were to have been *niches*, and *ſtatues*, and a *cornice*, on both ſides, the *whole length* of the *bridge*.

Bridges are alſo often made of wood, and conſiſt of beams and joiſts ſuſtained by punchions, well cramp'd, and bound together.

Palladio pretends, that the particulars for the erection of *wooden bridges* being innumerable, no certain or determinate rules can be given about them; but, however, he prefents us with fome *draughts* of feveral *bridges* of that kind and by particularizing their feveral proportions, believes, that an *Architect* who has the leaft genius, can hence take its meafures for the erection of *wooden bridges.* Among his feveral *draughts*, he propofes that of the *wooden bridge* built over the *Cifmone*, a river which falls from the mountains that divide *Italy* from *Germany*, and enters into the *Buenta* a little above *Baffano*, as the moft fubftantial, beautiful, and commodious. The river over which this *bridge* ftands, is a hundred foot broad, which *breadth* is divided into fix equal parts, and at the end of each part (except at the banks, which are ftrengthen'd with two folid butments of ftone) are placed the beams which conftitute the bed, and *breadth* of the *bridge.* Over thefe, directly with the firft, are placed the *Colonelli*, or little pillars, on each fide; thefe pillars are faften'd to the beams, (which make the *breadth* of the *bridge)* with iron cramps, contriv'd to pafs through a hole, made for that purpofe, in the heads of the faid beams, in that part which advances beyond thofe pieces which conftitute the fides. Thefe cramps being in the upper part, along the faid ftrait and plain pillars, perforated in divers places, and in the under part, near to thofe thick beams before-mentioned, and with a moderately big hole, went into the pillars, and faften'd again below with little bars, or pins of iron, made for that purpofe. Hence the whole work becomes, as it were, united; fo that the beams, which make the *breadth* of the *bridge*, and thofe of the fides, are, in a manner, one piece with the pillars; which thus come to fupport the beams that make the *breadth*, as thefe are again fupported by the arms which extend from one pillar to the other. Thus all the parts mutually fupport each other, and their difpofition is fuch, that the greater *weight* there is on the *bridge*, fo much the fafter do they clofe together, and corroborate the work. All thofe arms, and other pieces of timber, which make up the body of the *bridge*, are but a *foot* in *breadth*, and *three fourths* in *thicknefs*; but thofe pieces which make the bed of the *bridge*, that is to fay, thofe laid *length-wife*, are confiderably fmaller.

The fame learned *author* affures us, that *wooden bridges* may be made without any pofts in the water, in the following manner: the banks having been ftrengthen'd with butments, as far as it is convenient, one of the beams which make the *breadth* of the *bridge*, muft be laid at a fmall diftance from them, and then the beams, which make the fides, difpos'd upon it, which, with one of their heads, are to lay upon the bank, and to be faften'd to it; then upon thefe, direct with the beam laid for the *breadth*, the *colonelli*, or pillars, muft be plac'd, which are to be faften'd into the faid beams with iron cramps, and fupported by the braces well fix'd in the head of the *bridge*; that is to fay, in the beams which make the fides upon the bank. Afterwards, leaving as much fpace as fhall be left by the faid beam for *the breadth* to the bank, the other beam muft be laid for the *breadth*, which fhall be in like manner faftened to the beams which are to be laid over it *length-wife*, and to the pillars likewife, as they will be fupported by their braces. And thus muft it be done from one end to the other, or as far as it will be requifite, always obferving, in fuch *bridges*, that in the middle of the *breadth* there be a pillar, the braces whereof fhall meet over-againft one another, and in the upper parts other beams muft be put, which extending from one pillar to another, will keep them united, and (together with the braces plac'd in the head of the *bridge)* they will make a portion of a circle lefs than a femicircle. Thus making every brace fupport its pillar, and every pillar the crofs beam, and thofe that make the fides, every part fupports its own *weight.* Such *bridges* are large at their heads, and grow narrow near the middle of their *length.* They are called *pendant*, or *hanging*, or *philofophical bridges.*

Dr. *Wallis* gives the defign of a *timber bridge*, feventy foot long, without any pillars; and Dr. *Plot* affures us, that there was formerly a large *bridge* over the caftle ditch of *Tutbury* in *Staffordfhire*, made of pieces of timber, not much above a yard long, and yet not fupported underneath, either with pillars, or *arch-work*, or any other fort of prop whatever.

Note, That Butments, in this place, are thofe fupporters, or props, on, or againft which, the feet of *arches* reft. *Cramps*, are pieces of iron bent at each extreme, ferving to bind together pieces of wood, ftones, or other things. *Brace*, a piece of timber fram'd in with bevel-joints; ferving to keep the *building* from fwerving either way.

As for the other forts of *bridges*, as *draw-bridges*, *flying-bridges*, *bridges of boats*, &c. which properly belong to *fortification*, we'll defer treating of them till we come to our treatife of *fortification.*

As there is alfo an art in judging of *buildings*, as well as in erecting of them, Sir *Henry Wotton* has been fo kind to lay down, for that purpofe, the following rules: that before fixing any judgment a perfon ought to be inform'd of its age, fince if apparent decay be found to exceed the proportion of

 time,

time, it may be concluded, without further inquisition, either that the situation is naught, or the materials, or workmanship, too slight. If it be found to bear its years well, we must run back from the ornaments, and things which strike the eye first, to the more essential members; till we be able to form a conclusion that the work is commodious, firm, and delightful; the three conditions, in a good *building*, laid down at first, and agreed on by all *authors*.

Vassari proposes another, *viz.* by passing a running examination over the whole *edifice*, compar'd to the structure of a well-made man; as whether the walls stand upright on a clean footing and foundation; whether the *building* be of a beautiful stature; whether for the breadth it appears well burnish'd; whether the principal entrance be on the middle line of the front, or face, like our mouths; the windows as our eyes, set in equal number and distance on both sides; the offices, like the veins, usefully distributed, *&c.*

Vitruvius gives a third method of judging; summing up the whole art under these six heads: *ordination*, or settling the model, and scale of the work; *disposition*, the just expression of the first design thereof; (which two, Sir *H. Wotton* thinks he might have spar'd, as belonging rather to the *artificer*, than the *censurer*;) *Eurythmy*, the agreeable harmony between the *length*, *breadth*, and *height* of the several *rooms*, &c. *symmetry*, or the agreement between the parts and the whole; *Decor*, the due relation between the *building* and the inhabitant; whence *Palladio* concludes, the principal entrance ought never to be limited by any rule, but the dignity and generosity of the master; and, lastly, *distribution*, the useful casting of the several rooms for offices, entertainment, or pleasure. These last four are ever to be run over, before a man passes any determinate censure; and these alone, Sir *Henry* observes, are sufficient to condemn or acquit any *building* whatever.

Dr. *Fuller* gives us two or three good *aphorisms* in *building*; as, 1. Let not the common rooms be several, nor the several rooms common; *i. e.* the common rooms not to be private, or retired, as the *hall*, *galleries*, &c. which are to be open; and the *chambers*, &c. to be retir'd. 2. A house had better be too little for a day, than too big for a year; houses, therefore, ought to be proportion'd to ordinary occasions, no extraordinary. 3. Country houses must be substantives, able to stand of themselves; not like city *buildings*, supported and shelter'd, on each side, by their neighbours. 4. Let not the front look asquint on a stranger, but accost him right at his entrance. 5. Let the offices keep their due distance from the mansion house; those are too familiar which are of the same pile with it.

ARITHMETICK.

WE have very little intelligence about the origin and invention of *arithmetick*; history neither fixes the author, nor the time. In all probability however, it must have taken its rise from the introduction of commerce, and consequently be of *Tyrian* invention.

From *Asia* it passed into *Egypt*, (*Josephus* says by means of *Abraham*) here it was greatly cultivated and improv'd; insomuch that a large part of their philosophy and theology, seems to have turned altogether upon numbers, hence those wonders related by them about unity, trinity; the numbers seven, ten, four, *&c.* In effect, *Kircher* in his *Ædip. Ægypt. Tom.* II. *p.* 2. shews that the *Egyptians* explained every thing by numbers; *Pythagoras* himself affirming that the nature of numbers goes through the whole universe; and that the knowledge of numbers is the knowledge of the deity.

From *Egypt*, *arithmetick* was transmitted to the *Greeks*, who handed it forward, with great improvements, which it had received by the computation of their *astronomers*, to the *Romans*; from whom it came to us.

The *antient* ARITHMETICK however, fell far short of that of the *moderns*; most of what they did was to consider the various divisions of numbers; as appears from the treatises of *Nicomachus*, wrote in the third century of *Rome*, and that of *Boethius* still extant. A compendium of the antient *arithmetick*, wrote in *Greek*, by *Ptellus*, in the ninth century from our Saviour, was given us in *Latin* by *Xylander*, in 1558. A more ample work of the same kind was wrote by *Jordanus*, in the year 1200; published with a comment by father *Stapulensis*, in 1480.

Arithmetick, under its present state, is divided into different kinds; *viz.* *Theoretical*, *practical*, *instrumental*, *logarithmetical*, *numerous*, *specious*, *decimal*, *dignamical*, *tetractical*, *duodecimal*, *sexagesimal*, &c.

Euclid furnishes a *theoretical arithmetick*, in the seventh, eighth, and ninth books of his elements (which *theoretical arithmetick* is the science of the properties, relations, *&c.* of numbers considered abſtractedly with the reaſons and demonſtrations of the ſeveral rules.) *Barlaamus Monachus* has alſo given a theory for demonſtrating the common operations, both in *integers* and broken numbers, in his *Logiſtica*, publiſhed in *Latin* by *J. Chambers* an *Engliſhman*, in 1600. To which may be added *Lucas de Burgo*, who in an *Italian* treatiſe, publiſhed in 1523, gives the ſeveral diviſions of numbers from *Nicomachus*, and their properties from *Euclid*; with the algorithm, both in integers, fractions, extractions of roots, &c.

The firſt entire body of *practical arithmetick* (which is the art of numbering or computing from certain numbers given, or finding certain others, whoſe relation to the former is known, as if a number be required equal to two given numbers 6 and 8) was given by *Nich. Tartaglia* a *Venetian*, in 1556, conſiſting of two books; the former, the application of *arithmetick* to civil uſes; the latter, the grounds of *algebra*. Something had been done before by *Stifelius*, in 1544; where we have ſeveral particulars concerning the application of irrationals, &c. no where elſe to be met withal.

There is almoſt an infinite number of practical authors, who have appeared ſince; as *Gemma Friſius*, *Metius*, *Clavius*, *Ramus*, *Buckley*, *Diggs*, *Record*, *Wingate*, *Cocker*, *Leyburn*, *Ward*, *Malcolm*, &c.

The theory of *arithmetick* is joined with the practice, and even improved in ſeveral parts by *Maurolicus*, in his *Opuſcula Mathematica*, 1575; *Heneſchius* in his *Arithmetica Perfecta*, 1609, where the demonſtrations are all reduced into the form of ſyllogiſms; and *Tacquet* in his *Theoria & Praxis Arithmetices*, 1704.

Inſtrumental Arithmetick is that where the common rules, are performed by means of inſtruments contrived for eaſe and diſpatch; ſuch are ſeveral ſcales and ſliding rules; more particularly thoſe called *Neper*'s Bones, an inſtrument whereby multiplication and diviſion of large numbers are facilitated and expedited; and ſo called from its inventor *John Neper*, baron of *Marchiſton* in *Scotland*.

This inſtrument is made of five rods, plates, or lamellæ, of wood, metal, horn, paſt-board, or other matter of an oblong form, and divided each into nine little ſquares; each of which is reſolved into two triangles by diagonals. In theſe little ſquares are wrote the number of the multiplication table, in ſuch manner as that the units, or right-hand figures, are found in the right-hand triangle; and the tens, or the left-hand figures in the left-hand triangle. See *Multiplication* and *Diviſion*.

To *Neper*'s bones may be added Sir *Sam. Moreland*'s inſtrument, the deſcription whereof was publiſh'd by himſelf in 1666; that of Mr. *Leibnitz*, deſcribed in the *Miſcellan. Berolin*; that of the *Polenus*, publiſhed in the *Venetian Miſcellany*, 1709; the *Arithmetica Logarithmica* of *Hen. Briggs*, publiſhed 1624: and the univerſal *arithmetical tables of Proſthaphæreſes*, publiſhed 1610, by *Herwart ab Hoheburg*; whereby *Multiplication* is eaſily and accurately performed by *Addition*, and *Diviſion* by *Subtraction*.

The *Chineſe* have little regard to our rules in their calculations; inſtead of which, they uſe an inſtrument made of a little plate, a foot and half long, a-croſs which are fitted ten or twelve iron wires, on which are ſtrong little round bales. By drawing theſe together, and diſperſing them again one after another, they count ſomewhat after the manner in which we do by counters: but with ſo much eaſe and readineſs, that they will keep pace with a man reading a book of accounts, let him make what expedition he can: and at the end the operation is found done; and they have their way of proving it.

The *decimal Arithmetick* is not of a very antient date; ſince it was firſt introduced into *Europe*, by *Gerbert*, afterwards pope, under the name of *Silveſter* II. who borrowed it from the *Moors* of *Spain*. No doubt it took its origin from the ten fingers of the hands, which were made uſe of in computation before *arithmetick* was brought into an art. The eaſtern miſſionaries aſſure us, that to this day the *Indians* are very expert at computing on their fingers, without any uſe of pen and ink. Add, that the natives of *Peru*, who do all by the different arrangement of grains of maiſe, out-do any *European*, both for ſureneſs and diſpatch, with all his rules.

ARITHMETICK is the art or ſcience of numbering: and is that branch of pure mathematicks, which treats of the powers and properties of *numbers*.

NUMBER in *arithmetick*, according to *Euclid* is a collation or aſſemblage of ſeveral *units*, or things of the ſame kind. But Sir *Iſaac Newton* makes it to conſiſt in the abſtract *ratio* of a quantity of any kind, to another quantity of the ſame kind, which is the *unity*.

Number, thus defined, is by him alſo divided into *integers*, *fractions*, and *hundreds*, of which reſpectively we ſhall treat in their proper place.

UNIT is the number *one*, or one ſingle individual part of *diſcrete quantity*.

The manner of expreſſing theſe *units* in *arithmetick* is by certain *characters*, or *figures*.

Nine of theſe Characters or Figures are called *ſignificant* figures, and are thus written,

1 One
2 Two
3 Three
4 Four
5 Five
6 Six
7 Seven
8 Eight
9 Nine

There is a tenth called a *cypher* 0

Of Numeration.

All Numbers are either a *ſimple* or *compound*.

Every *ſingle* figure is a *ſimple number*; as 2, 4, 6, 8 or 1, 3, 5, 7, 9.

A *compound number* is compoſed of two or more figures in one line; as 15, 223, 1759, &c.

Every *ſignificant* figure has a *certain* and *uncertain* value.

Every *ſingle* figure is of a certain value, as 2 can ſignify no more than *two*; 3, no more than *three*, &c. but when any figure is to be compounded with ſome other, it takes its value occaſionally from its place or poſition in the ſum to be numbered; thus 4 prefixed to 2, as in 42 is valued at *forty*, but if the 4 ſhould be placed on the right ſide of the 2, as in 24, the 4 is valued at no more than *four*. Thus 5 may be placed to ſignify no more than five, and it may be placed ſo as to ſignify *fifty-five* 55, *five hundred and fifty-five* 555, *five thouſand five hundred and fifty-five* 5555, &c.

Where you may obſerve that the *order* of placing figures to encreaſe their value, is from the right hand to the left: the firſt figure or cypher on the right hand, being the place of the *units*; the ſecond the place of the *tens*; the third the place of the *hundreds*; and in this order, it muſt be remembered that a cypher 0 or cyphers, give the value to the figure according to its place; thus 10 ſignifies *ten*, 100, one *hundred*, 1000, one *thouſand*; becauſe the *ſignificant* figure, in ſuch ſums, ſtands in the place of *tens*, *hundreds*, *thouſands*, &c. the value of every figure increaſing in a decuple proportion, as they fall back from the right hand to the left; every place being *ten times* the value of that immediately before it; as will more fully appear in the following ſchemes.

Numeration Table.

Hundreds of Millions	*Tens of Millions*	*Millions*	*Hundreds of Thouſands*	*Tens of Thouſands*	*Thouſands*	*Hundreds*	*Tens*	*Units*	*The numbers in the* Table *are thus to be read,* viz.
9	8	7	6	5	4	3	2	1	987 Mil. 654 Th. 321
1	2	3	4	5	6	7	8	9	123 Mil. 456 Th. 789
	2	3	4	5	6	7	8	9	23 Mil. 456 Th. 789
		3	4	5	9	7	8	9	—3 Mil. 456 Th. 789
			4	5	6	7	8	9	——— 456 Th. 789
				5	6	7	8	9	——— 56 Th. 789
					6	7	8	9	——— 6 Th. 789
						7	8	9	——— 789
							8	9	——— 89
								9	——— 9

A *cypher* is of itſelf *inſignificant*, but by its place alters the value of the ſubſequent figure: and, ſince the value of each place is *ten times* the value of the next before it, it is certain

$$\text{that}\left\{\begin{array}{c}1\\2\\3\\\&c.\end{array}\right\}\begin{array}{c}\text{in the firſt}\\\text{place is}\end{array}\left\{\begin{array}{c}10\\20\\30\\\&c.\end{array}\right\}\begin{array}{c}\text{in the}\\\text{ſecond,}\end{array}\left\{\begin{array}{c}100\\200\\300\\\&c.\end{array}\right\}\begin{array}{c}\text{in the}\\\text{third,}\end{array}\left\{\begin{array}{c}1000\\2000\\3000\\\&c.\end{array}\right\}\begin{array}{c}\text{in the}\\\text{fourth,}\\\&c.\end{array}$$

The value of each figure in any rank of numbers, how large ſoever, is readily found by the following rule.

Begin at *units*, ſet a point under the *ſeventh* place; then reckoning that as *one*, count forwards, and ſet another under the next *ſeventh* place, ſo continue to the end.

$$\text{Then the}\left\{\begin{array}{l}\text{firſt}\\\text{ſecond}\\\text{third}\\\text{fourth, \&c.}\end{array}\right\}\begin{array}{c}\text{point from units}\\\text{ſtands under}\end{array}\left\{\begin{array}{l}\textit{millions,}\\\textit{billions,}\\\textit{trillions,}\\\textit{quadrillions,}\text{ \&c.}\end{array}\right.$$

As

As is evident in the following example,

Periods	Quadril.	Trilllions	Billions	Milllions	Units
Half-periods	th. units	th. units	th. units	th. units	th. units
Degrees	c x u c x u	c x u c x u	c x u c x u	c x u c x u	c x u c x u
Figures	1 2 3 4 5 6	7 8 9 0 9 8	7 6 5 4 3 2	1 0 1 2 3 4	5 6 7 8 9 1

N. B. A PERIOD is a million times the value of the place before it. A HALF PERIOD is a thouſand times the value of the place before it. By this means you may have as clear a notion of, and may as eaſily read a number of *ſeventy* places, as of *ſeven*.

The next enquiry is to find how theſe figures are to be rendered uſeful; which will be ſhewn under diſtinct RULES, or operations to find the ſums or *numbers* unknown, and to facilitate the art of *computation*.

RULE I.

ADDITION.

ADDITION is the firſt of the four principal rules in *Arithmetic*, whereby we are taught to find a *ſum* equal to ſeveral ſmall ones.

ADDITION of *Simple Numbers*.

If you were to add 136 and 42 together, they muſt be placed one under the other as followeth, *viz.*

```
136     Or,     42
 42            136
```

Having placed the given numbers as before is directed, then draw a ſtreight line under them, and (beginning at the place of *units)* add all the figures together that ſtand over one another in that *rank*; putting their ſum under the ſaid ſtrait line; as in this example, I ſay, 2 and 6 is 8, wherefore I put 8 under the line, and in its proper place, under 2 and 6, and proceed to the next rank, which is the place of tens; ſaying, 4 and 3 is 7, wherefore I put 7 in its own proper place under the line; and proceed to the next and laſt rank, where I find only 1, wherefore I put one in its proper place under the line, and ſo the work is finiſhed; and I find thereby that the total ſum of 136 and 42 to be 178. *See* the operation as followeth.

```
136        42
 42       136
---       ---
178       178
```

If, in adding together any of the ranks the ſum amounts to, or exceedeth 10, or any number of tens, then in ſuch a caſe you are either to ſet down a *cypher* under the line in its proper place, or elſe the *exceſs* above the *ten* to *tens*: and for every *ten* carry an *unit* to be added to the next rank of figures. As, if it amount to 30, then ſet down (0) a cypher, and carry 3 (for the three tens) to be added to the next rank; if it amount to 34, then ſet down 4 under the rank that you add, and carry three to the next, *&c.* And when you have caſt up the laſt rank or ſeries towards the left-hand, ſet down the total that it amounteth to, as in the following examples.

	(1)	(2)	(3)	(4)
	748	4558	1648	20864
	364	6673	3472	78987
	296	2891	1865	6217
	242	1862	3479	4320
Sum	1650	15984	10464	110388

In the firſt of theſe examples I begin, ſaying, 2 and 6 is 8, and 4 is 12, and 8 makes 20, which is juſt two tens; wherefore I put down 0 under the line, and carry 2 to the next rank for the two tens, and proceed, ſaying, 2 that I carry, and 4 is 6, and 9 is 15, and 6 is 21, and 4 is 25, which is 5 above 20, wherefore I put down 5 under the line, and carry 2 for the two tens to the next rank, and then proceed, ſaying, 2 that I carry, and 2 is 4, and 2 is 6, and 3 is 9, and 7 makes 16, wherefore (becauſe it is the laſt rank) I put down 16 under the line, and ſo the work is finiſhed, the total ſum of the *Addition* being 1650. The ſame is to be obſerved in the reſt of the examples.

To prove your *Addition* after you have added up your whole ſum, draw a line with your pen under the uppermoſt number, and when you have ſo done, add all the other numbers, except the uppermoſt; and when you have ſo done, add the amount or ſum thereof to the uppermoſt ſum above the line; and if the ſum be the ſame with the ſum firſt found, your work is true, otherwiſe not.

In

In ADDITION of *diverse denominations*, place the given numbers in such order under each other, that each rank from top to bottom may consist of one and the same value.

ADDITION of MONEY.

In ADDITION of ENGLISH *money*, it is necessary first of all to understand the meaning and signification of all the characters superscribed over every sum, as *lib. s. d.*

Note, That *lib.* signifies *libra*, a *pound*, not here in respect to common weight, but *money*, and for distinction is called a *pound sterling*. So *s.* stands for a shilling. *d.* stands for *denarius*, a *penny*, the 12th part of a shilling. For until the reign of *Henry* VI. a *penny* was the 20th part of an ounce of silver, and in his reign made the 30th. By *Edward* IV. 40 *pence* make an ounce. By *Henry* VIII. there was allowed 45 *d.* to the ounce. And by Queen *Elizabeth* an ounce of silver was divided into 60 parts, called *pence*, as it is at this day.

PENCE TABLE.

d.		s.	d.		d.		s.
20	make	1	8	AND	12	make	1
30		2	6		24		2
40		3	4		36		3
50		4	2		48		4
60		5	0		60		5
70		5	10		72		6
80		6	8		84		7
90		7	6		96		8
100		8	4		108		9
110		9	2		120		10
120		10	0		132		11
130		10	10		144		12

ENGLISH MONEY.

4 Farthings	make	One penny.	*d.*
12 Pence		One shilling.	*s.*
20 Shillings		One pound.	*l.*

NOTE, These are the general names of *English* money observed in trade and accounts; but there are other names in common use, whose value is according to the following table.

		l.	s.	d.
A Half-penny	valued at			
A Two-pence				2
A Three-pence				3
A Groat				4
A Six-pence				6
A Half crown			2	6
A Crown			5	0
A Quarter-guinea			5	3
A Half-guinea			10	6
A Guinea		1	1	0

Having first drawn a line under the ranks, add them together, considering how many of each smaller denomination make an unit of the next that is superior to it (always observing to begin at the least denomination) and for every such unit, carry one to the next superior denomination, *viz.* for every 4 in the farthings you must carry 1 to the pence; for every 12 in the pence carry 1 to the shillings; and for every 20 contained in the shillings, carry 1 to the pounds, according to the table; and the odd farthings, pence, and shillings, set down in their proper ranks under the line, as in the following example.

When you would write down three *farthings*, or a *half-penny*, or a *farthing*, write it thus.

$\frac{3}{4}$ ——— Three Farthings.
$\frac{1}{2}$ ——— A Hal-penny.
$\frac{1}{4}$ ——— A Farthing

Let it be required to add together 134 *l.* 16 *s.* 8 *d.* $\frac{1}{4}$. and 286 *l.* 10 *s.* 4 *d* $\frac{3}{4}$. and 489 *l.* 13 *s.* 5 *d.* $\frac{1}{2}$. and 794 *l.* 18 *s.* 09 *d.* $\frac{1}{4}$. Then in order to the work I set them down, and draw a line under them, as followeth.

l.	s.	d.
134	16	8 $\frac{1}{4}$
286	10	4 $\frac{3}{4}$
498	13	6 $\frac{1}{2}$
794	18	9 $\frac{1}{4}$

First, begin with the least denomination, which is that of farthings, and add them together, saying, $\frac{1}{4}$ and $\frac{1}{2}$ is $\frac{3}{4}$ and $\frac{3}{4}$ is 6, and $\frac{1}{4}$ is 7 farthings, which is 1 penny and 3 farthings, wherefore put 3 farthings under the line, and under the denomination of farthings, and carry 1 (for the penny) to the next denomination of pence, saying, 1 that I carry and 9 is 10, and 6 is 16, and 4 is 20, and 8 is 28, now 28 pence is 2 shillings and 4 pence, wherefore put 4 under the line, and carry 2 shillings to the denomination of shillings, saying 2 that I carry and 18 is 20, and 13 is 33, and 10 is 43, and 16 is 59 shillings, which is 2 pounds 19 shillings; whereof put the 19 shillings under the line, and under the denomination of shillings, and carry 2 (for the 2 pounds) to the denomination of pounds, and proceed, saying, 2 that I carry and 4 is 6, and 8 is 14, and 6 is 20, and 4 makes 24, wherefore put down 4 under the line, and carry 2 for the two tens to the next rank, saying, 2 that I carry and 0 is 11, and 9 is 20, and 8 is 28, and 3 is 31, which is 1 above 30, wherefore I put 1 under the line and carry 3 (for the three tens) to the nex rank, and proceed, saying, 3 that I carry and 7 is 10, and 4 is 14, and 2 is 16, and 1 is 17, wherefore put 17 under the line, becauſe it is the ſum of the laſt rank, and ſo the whole work is finiſhed, and we find the ſum of the given numbers to be 1714 *l.* 19*s.* 4*d.* 3*qr.* as by the following work appeareth.

	l.	*s.*	*d.*
	134	16	8 ¼
	286	10	4 ¾
	498	13	6 ½
	794	18	9 ¼
Sum	1714	19	4 ¾

To prove your *Addition*, after you have added up your whole ſum, draw a line with your pen under the uppermoſt number or ſum, and then add together all the other numbers, except the uppermoſt. And when you have ſo done, add the amount, or ſum thereof to the uppermoſt ſum above the line; and if that ſum be equal to the ſum firſt found, the work is true, otherwiſe not

The ſame method is uſed to prove *Addition* of diverſe denominations, as above in ſums of one denomination.

Here, *Note*, *once for all*, That whatſoever ſums you are to add together, whether of *Money*, *Weight*, *Meaure*, *Time*, &c. that when you come to the greateſt denominations, as you caſt up the ſeveral ranks thereof, you are to carry the tens of every preceding rank to that which follows it, as is directed in the *fifth Section* of this chapter, and as the ranks in the denomination of pounds in the laſt *Example* are caſt up.

In adding up of money, *firſt*, caſt up your pence, or make a ſmall comma at every 60 *d* which is 5 *s.* (and it will be a great eaſe to the memory where ſums are long) and by the Table you may readily know, how many ſhillings and pence your pence amount to; then ſet down your odd pence under the place of pence, and carry your ſhillings to the unit of ſhillings, and then add them up as in *Addition of ſingle numbers*, by ſetting down the odd above the tens, and carry the tens to the tens of *ſhillings*.

Addition of Weights.

The Weight uſed in *England* for large and coarſer commodities, as *cheeſe*, *wool*, *lead*, &c. is called *Avoirdupois:* the pound whereof is made up of ſixteen ounces, and bears the proportion of 17 to 14 to a pound *Troy*.

The Table for Avoirdupois Weight.

16 Drams	make	One Ounce	*oz.*
16 Ounces	make	One Pound	*lb.*
28 Pounds	make	One Quarter	*Qr.*
4 Quarters	make	One Hundred	*C.*
20 Hundred	make	One Ton	*Tn.*

Note, This weight differeth in diverſe goods and places by cuſtom and ſtatute law; for,

	lb.
A barrel of anchovies weighs	30
— Figs from	26¼
——— to	98
— Raiſins	112
— Gun powder	112
— Candles	120
— Potaſh	200
— Butter	224
— Soap	256
A puncheon of prunes 10 or 12 C.	
A ſtone of glaſs	5
——— Butchers meat	8
——— Iron, wool, *&c.*	14
——— Butter and cheeſe	16
A quintal of dry fiſh	100
A faggot of ſteel	120
A ſeam of glaſs	120
A burden of gad ſteel	180
A clove of cheeſe and butter	8
A wey in *Suffolk*	256
——— in *Eſſex*	336
A fodder of lead	19 C and 56

Note, That in Reduction of *Averdupois weight* there are certain allowances to the buyer, which muſt be deducted out of the groſs or whole weight and package, before you can reduce the neat weight.

Theſe allowances are called *tare*, *tret* and *cloff*.

Tare is an allowance for the weight of the box, bag, *&c.* according as ſhall be agreed between buyer and ſeller.

Tret is 4 *lb.* in 104 *lb.* for waſte, *&c.* in ſome kind of goods.

Cloff, is 12 *lb.* on every draught above 300 *lb.* weight, allowed only to the citizens of *London* on Sumac, Argol, *&c.*

Sometimes there happens to be *tare* and *tret* in the ſame parcel of goods; then you muſt deduct the tare firſt, and the remainder is termed the ſubtle weight. *See* Reduction.

Obſerve once for all, That the neat weight of any goods is their real weight after all allowances are deducted.

Addition of Avoirdupois *weight.*

Here *note* alſo that *T.* ſtands for *tons*, *C.* for *hundred weight*, *qr.* for *quarters of hundred*; *lb.* for *pound weight*; *oz.* for *ounces*; *dr.* for *drams*.

Example.

EXAMPLE.

Ton	C.	qr.	lb.	C.	qr.	lb.	oz.
25	14	2	24.	154	1	19	10
57	16	3	25.	275	3	19	11
42	10	1	17	476	2	10	07
96	14	2	27.	57	3	14	08
54	17	2	18.	45	1	10	10
59	16	3	22.	17	2	22	11
35	14	2	19.	45	3	17	09
64	17	3	26	76	2	19	14
438	04	0	18	1150	1	23	00

Let it be required to add up the ſum above, expreſſing *Tuns. C. qr.* and *Pounds*. Firſt, add up the pounds by making a ſpeck or tittle at every 28 you find in the place of pounds, as you may ſee in the abovementioned *Example*, where is found to be ſix ſpecks, and 18 *lb.* over, which 18 place under the denomination of pounds, and carry 6 to the quarters, and add them up they make 24, which is 6 *C.* for which put a (0) under the place of *qr.* and carry 6 *C.* to the place of *C.* Then proceed to add up your *C.* after the ſame manner as you carry from ſhillings to pounds, becauſe 20 *C.* make a *Ton.* Laſtly, add up the *tons*, and the total will appear to be 438 *tuns*, 4 *C.* 0 *qr.* 18 *lb.*

The pound *Avoirdupois*, containing 16 ounces, is equal to 14 *oz.* 12 *dwt. Troy-weight*. And the pound *Troy-weight*, conſiſting of 12 ounces, is about 13 ounces, 2 drams and a half of *Avoirdupois-weight*.

Wool is weighed with *Avoirdupois weight*, but the diviſions are ſomewhat different. For in wool,

7 Pounds is a clove, 2 clove is a ſtone, 2 ſtone is a todd, 6 todds 1 ſtone, or 13 ſtone is a wey, 2 weys is a ſack, 12 ſacks is a laſt of wool.

Note, That according to the foregoing diviſion 182 *lb.* is a wey, but in ſome counties the wey is 256 *l. Avoirdupois*, as in *Suffolk*, &c. And in *Eſſex* there is 336 *lb.* in a wey.

ADDITION of TROY *Weight* has its particular *marks* and *denominations*, as in the following Table.

The TABLE of TROY WEIGHT.

24 Grains	make	One penny wt.	*dwt.*
20 Penny wt.	make	One ounce	*oz.*
12 Ounces	make	One pound	*lb.*

NOTE, This weight only gives five ſcore to the hundred.

EXAMPLE.

Let it be required to add the following particulars together, *viz.* 24 ℔. 9 *oz.* 6 *dwt.* 11 *gr.* and 164 ℔. 10 *oz.* 14 *p. wt.* 18 *gr.* and 82 ℔. 7 *oz.* 17 *dwt.* 20 *gr.* and 8 ℔. 11 *oz.* 18 *dwt.* 22 *gr.*

To find out the ſum of theſe given quantities, place them one under another orderly, as you ſee here, and draw a line under them.

℔.	*oz.*	*dwt.*	*gr.*
24	09	06	11
164	10	14	18
82	07	17	20
8	11	18	22
281	03	17	23

Then begin with the denomination of *grains*, making a dot with a pen at every 24, (for caſe) and bear the overplus to the next above, ſaying, 22 and 20 is 42, which is 18 above 24, wherefore make a dot at 20, and carry the 18 up higher, ſaying 18 and 18 is 36, which is 12 above 24, wherefore make a mark at 18, and carry the 12 to the next above, ſaying, 12 and 11 makes 23, which put under the line in its proper place, and obſerve how many dots are made in the caſting up this denomination, which you'll find to be 2, wherefore carry 2 to the next, and proceed (as in the *ſhillings* in *Addition of Money*, becauſe you carry one for every 20) ſaying, 2 and 8 is 10, and 7 is 17, and 4 is 21, and 6 is 27, and (then down again with the tens) 10 is 37, and 10 is 47, and 10 is 57 *penny-weights*, which is 2 *oz.* 17 *dwt.* wherefore put 17 *dwt.* in its place under the line, and carry the 2 *oz.* ſaying, 2 that I carry and 1 is 3, and 7 is 10, and 9 is 19, and 10 is 29, and 10 is 39 *ounces*, which is 3 *lb.* 3 *oz.* wherefore put the 3 *ounces* in its proper place under the line, and carry 3 *lb.* to the *pounds*. and proceed to finiſh the work as is before directed; which being done, you will find the total ſum to be 281 *lb.* 3 *oz.* 17 *pw.* 23 *gr.* as above.

ADDITION of APOTHECARIES *Weight*, is performed nearly the ſame way as *Troy weight*; only the ſubdiviſions of the pound are different, as followeth, *viz.*

Note, That 20 grains is a ſcruple, 3 ſcruples is a dram, 8 drams is an ounce, and 12 ounces is a pound weight.

The marks or characters, by which *Apothecaries* weights are known, are theſe, *viz.* For pounds (℔), ounces (℥), drams (ʒ), ſcruples (℈), grains (*gr.*)

℔.	℥	ʒ	℈	*gr.*
76	00	2	0	15
54	10	5	2	17
68	11	7	1	12
28	04	4	1	14
16	10	0	2	18
35	06	1	0	14
280	7	6	1	10

ADDITION of LIQUID MEASURE.

The leaſt denomination in LIQUID *Meaſure* is a pint, which was heretofore deduced from a pound *Troy-weight*, a pound of wheat *Troy-weight* making a pint *liquid meaſure*, but in regard of the diſagreement thereof with the rules of ſolid *Geometry* in the gauging of brewers veſſels, ſome taking 288 ſolid inches for a gallon, ſome 286 *&c.* it occaſioned a difference between the brewers and the managers of his Majeſty's exciſe, till the parliament, taking the matter into conſideration, ordained, That 282 *ſolid inches* ſhould make the *gallon* of *beer meaſure*, and the *gallons* being ſubdivided into 2 *pottles*, each *pottle* into 2 *quarts*, and each *quart* into 2 *pints*, ſo that the *pint* being the eighth part of a *gallon*, muſt contain 28 *ſolid inches* and 7 *eight parts* of an *inch* for *Wine Meaſure*, and 35 *ſolid inches*, and a *quarter* for *Beer Meaſure*.

Wherefore *note*, That $35\frac{1}{4}$ ſolid inches make a pint of *Beer Meaſure*, 2 pints a quart, two quarts a pottle, 2 pottles, or 282 ſolid inches, a gallon, 8 gallons a firkin of ale, 9 gallons a firkin of beer, 2 firkins a kilderkin, 2 kilderkins a barrel, $1\frac{1}{2}$ a barrel, or 54 gallons a hogſhead of beer.

In WINE MEASURES.

2 Pints make a quart, 2 quarts a pottle, 2 pottles a gallon, 42 gallons a tierce, or third part of a pipe or butt, 63 gallons a hogſhead, 2 hogſheads a pipe or butt, and 2 pipes or butts a tun of wine.

Note, *Honey* and *oil* are bought and ſold by this meaſure.

EXAMPLE *of* WINE MEASURE.

T.	*hhds.*	*gal.*	*pts.*
37	3	18	5
48	2	24	0
67	1	20	6
38	2	17	7
79	0	47	3
64	1	52	4
335	3	55	1

ADDITION *of* DRY MEASURE.

The leaſt denominative part of *Dry Meaſure* a pint, which is taken from *Troy Weight*.

With theſe are meaſured all dry ſubſtances, as *corn*, *ſalt*, *coal*, *ſand*, &c. The table followeth.

In *Dry Meaſure*, *Note*, That 2 pints make a quart, 2 quarts a pottle, 2 pottles a gallon, 2 gallons a peck, 4 pecks a buſhel *Land Meaſure*; 5 pecks a buſhel *Water Meaſure*; 8 buſhels a quarter; 4 quarters a chalder, and 5 quarters a wey.

Note, 36 Buſhel is a chaldron of ſea-coal in *London*.

EXAMPLE *of* DRY MEASURE.

Chalds.	*qrs.*	*Buſh.*	*pec.*
148	3	6	3
375	1	7	2
296	2	4	3
128	1	5	0
94	0	5	2
38	2	4	3
1082	1	2	1

ADDITION *of* LONG MEASURE.

Long Meaſure is originally deduced from a barley-corn taken out of the middle of the ear and well dried, from whence is deduced the following table.

3 Barley-corns make an inch; 12 inches a foot; 3 feet a yard; 3 feet 9 inches, or a yard and a quarter, is an ell *Engliſh*; 6 feet a fathom, 5 yards and a half, or 16 feet and an half, make one ſtatute pole, or perch; 40 poles or perches make a furlong, and 8 furlongs make an *Engliſh* mile.

EXAMPLE *of* LONG MEASURE.

Miles	*Fur.*	*Perch.*
48	7	24
37	3	18
65	3	28
36	5	00
107	1	07
205	6	17
501	3	14

ADDITION *of* CLOTH MEASURE.

4 Nails or 9 inches make a quarter of a yard; 3 quarters of a yard make an ell *Flemiſh*; 4 quarters a yard *Engliſh*; 5 quarters of a yard, or 45 inches, is an ell *Engliſh*.

Examples *of* Cloth Measure.

Yds.	*qr.*	*na.*	*Ells*	*qr.*	*na.*	*Ells Fl.*	*qr.*	*na.*
137	3	3	376	2	0	184	1	2
295	1	2	378	3	3	357	2	1
112	2	3	742	3	1	475	2	2
215	0	1	97	2	2	251	1	0
174	1	2	84	1	2	164	0	2
764	3	0	68	0	3	87	1	3
1700	0	3	1747	3	3	1521	0	2

Addition *of* Land Measure.

From the foregoing table of *Long Meaſure*, is alſo *Superficial Meaſure* deduced; that of *Land Meaſure* being as follows, *viz.*

In *Land Meaſure*, 40 ſquare *poles* or *perches* make a *rood*, and 4 *roods* make an *acre*.

Example *of* Land Measure.

Acr.	*Rood*	*Per.*
120	2	34
275	3	14
162	1	35
98	2	20
47	3	30
64	1	15
769	3	28

Addition *of* Time.

The denominative parts of *time* are originally deduced from the *ſun's* motion in the heavens, which is carried round the ſame from *eaſt* to *weſt*, by the rapid motion of the *primum mobile*, in one *day natural*, which day is divided into 24 ſuppoſed equal parts, called *hours*, and each *hour* is ſubdivided into 60 *minutes*, *&c.* whence ariſeth the following table.

60 Minutes make an hour, 24 hours make a natural day, 7 days make a week, 4 weeks make a month conſiſting of 28 days, 13 months, one day and ſix hours make a year.

Note, That the minute is uſually ſubdivided into 60 ſeconds, and each ſecond into 60 thirds, *&c.*

The *tropical* year, or the time the ſun leaves the tropick, till the time it returns to it again, by the obſervations of the moſt accurate *Aſtronomers*, is found to conſiſt of, 365 *days*, 5 *hours*, 49 *minutes*, 4 *ſeconds*, and 21 *thirds*.

Example.

10 *Ys.*	13 *Mo.*	4 *W.*	7 *D.*	24 *H.*	60 *Min.*
319	3	2	6	12	14
298	7	1	5	12	20
487	9	3	4	12	30
402	1	2	3	10	0
320	2	1	0	6	7
376	7	2	4	8	3
278	1	0	0	0	0
172	8	3	5	0	0
100	0	0	0	0	0
2755	3	2	1	31	14

Of SUBTRACTION.

Subtraction teacheth to take a *leſſer number* from a *greater*, or an *equal* from an *equal*; whereby we diſcover the *remainder*, *exceſs*, or *difference*.

If the numbers given be *integers*, that is, conſiſting of *one denomination*, then place the *biggeſt* number *uppermoſt*, and the *leſſer* in order *under* it, *viz.* *units* under *units*, *tens* under *tens*, *hundreds* under *hundreds*, *&c.* And draw a line under them, as in *Addition*.

Then begin at the place of *units*, taking the lowermoſt figure *out of* the uppermoſt, and place the *remainder* under the line; then proceed to the place of *tens*, and do in the ſame manner; and then to the place of *hundreds*, &c. till the whole work be finiſhed. The *number* under the ſaid line ſhall be the *remainder* or *difference*.

Example.

Let it be required to find the difference between 48 and 16? Place them thus.

From	48
Take	16
Remains	32

Firſt, put down the *biggeſt* number 48, and place 16 the *leſſer* number under it, and under both draw a line; then begin at the place of *units*, ſaying, 6 out of 8 and there remains 2, which place under the line and proceed to the next place, ſaying, 1 from 4 and there remains 3, which likewiſe place under the line, and the work is finiſhed. So that the *remainder* or *difference* between 48 and 16 is 32, as you may ſee by the work above.

But if the particular figure, which you are to *ſubtract*, be *greater* than the figure, *out of* which it is to be *ſubtracted*, then you are to borrow 10, and add it to the uppermoſt figure, and then *ſubtract* the ſaid lowermoſt figure from their ſum, and place the *remainder* underneath the line, and for that

 which

which you borrow, add 1 to the next figure in the lowermost line, and proceed. Let this be repeated as often as there is occasion.

EXAMPLE.

Let it be required to subtract 3872 from 43758.

$$\begin{array}{r} 43758 \\ 3872 \\ \hline 39886 \end{array}$$

The given numbers being placed, and a line drawn under them, as is before directed, begin at the right hand, saying, 2 from 8, and there remains 6, which set under the line, and proceed, saying 7 from 5 I cannot, but 7 from 15, and there remains 8, which put under the line, and proceed to the next, saying, 1 that I borrowed and 8 is 9, 9 from 7 I cannot, but 9 from 17 and there remains 8, which put under the line, and proceed to the next figure, saying, 1 that I borrowed and 3 is 4. 4 from 3 I cannot, but 4 from 13 and there remains 9, which put under the line; now, because there is no figure standing under the 4, I therefore suppose a (0) to be placed there, and because I borrowed 1 at the last figure, therefore I pay it here by subtracting it out of the 4, saying, 1 that I borrowed out of 4 and there remains 3, which put under the line, and the work in finished. and you will find (after the work of *Subtraction* is ended) the *remainder* to be 39886.

For *proof* of *Subtraction*, add the *rest*, or *remainder*, to the number subtracted, and if the sum be equal to the uppermost number, (*being the number from whence Subtraction is made*) your work is true, otherwise false.

SUBTRACTION *of* MONEY.

If the given number consist of divers denominations, such as *money*, *weight*, *measure*, *time*, &c. then you are to place the lesser number under the greater in such sort, that each *denomination* may stand under his correspondent name, as has been directed in *Addition*; and draw a line under them.

Then proceed to *subtract* the undermost from the uppermost, beginning at the *last denomination*, and proceeding gradually towards the left hand, setting the *remainder* of each *denomination* under the line, until the whole be finished.

EXAMPLE.

Let it be required to subtract 129*l.* 7*s.* 4*d* $\frac{1}{4}$ from 250*l.* 13*s.* 10*d.* $\frac{3}{4}$. First place them down, the lesser under the greater, and draw a line under them.

l.	*s.*	*d.* *f.*
250	13	10 $\frac{3}{4}$
129	7	4 $\frac{1}{4}$
121	6	6 $\frac{1}{2}$

Then begin at the right hand, saying, 1 *farthing* from 3 *farthings*, and there remains 2, which put under the line in the place of *farthings*, and proceed to the denomination of *pence*, saying, 4 from 10 and there remain 6, which put under the line in the place of *pence*, and then go to the denomination of *shillings*, saying, 7 from 13, and there rest 6, which put under the line in the place of *shillings*, and then proceed to finish the work, as directed above; which being ended, we find the remainder to be 121 *l.* 6 *s.* 6 *d* $\frac{1}{2}$, as in the example.

But if the lowermost number in any of the denominations chance to be greater than the uppermost, you must in such case borrow an unit from the *next greater denomination*, subtracting the lowermost number therefrom, and *adding the remainder* to the said uppermost number, and place that sum under the line, and then proceed, adding one to the next lowermost number to the left hand for that you borrowed, &c.

EXAMPLE.

Let it be required to subtract 178*l.* 15*s.* 9*d.* $\frac{1}{4}$ from 348*l.* 12*s.* 7*d* $\frac{3}{4}$

l.	*s.*	*d.*
348	12	07 $\frac{3}{4}$
178	15	09 $\frac{1}{4}$
169	16	10 $\frac{1}{2}$

First, place them down in order, and draw a line under them. Then begin at the *right hand* with the denominations of *farthings*, saying, 1 from 3, and there remains 2, which put under the line, and proceed to the denomination of *pence*, saying, 9 pence out of 7 I cannot, but borrowing 1 from the next denomination, which is *shillings*, and makes 12 pence, say, 9 from 12, and there remain 3, which add to 7 *pence*, and that makes 10 *pence*, wherefore put 10 *pence* under the line, and proceed to the next denomination which is *shillings*, and say, 1 that I borrowed, and 15 is 16, from 12 I cannot, but (borrowing 1 pound from the next denomination, which is 20 *shillings*) 16 from 20, and there remains 4, which added to the said 12, makes 16 shillings, which set down under the line, and proceed to the pounds, saying, 1 that I borrowed and 8 is 9, 9 from 8 I cannot, but 9 from 18, &c. And the work being finished, we find the *remainder* to be 169*l.* 16*s.* 10*d.* $\frac{1}{2}$, as appears by the work above.

The Proof.

	l.	s.	d. f.
From	348	12	7 ¾
Subtr.	178	15	9 ¼
Remain	169	16	10 ½
Proof	348	12	7 ¾

In this *example* the remainder is found to be 169*l.* 16*s.* 10*d.*½, which I add to 178*l.* 15*s.* 9*d.*¼ (this number being subtracted,) and the sum is 348*l.* 12*s.* 7d. ¾, which is equal to the uppermost of the given numbers, wherefore the subtraction is truly wrought.

Examples *for Practice.*

	l.	s.	d. f.	l.	s.	d. f.
Received	295	11	3 ¼	425	00	05 ½
Paid	107	14	9 ½	107	11	08 ¼
Rest	187	16	5 ¾	317	08	09 ¼
Proof	295	11	3 ¼	425	00	05 ½

Debtor	100	00	00	1072	01	05
Creditor	75	00	9	107	16	10 ½
Balance	24	19	3	964	04	06 ½
Proof	100	00	00	1072	01	05

Received	1010	10	10	100	00	09 ½
Disburst	942	13	11 ½	47	00	10
Rest	67	16	10 ½	52	19	11 ½
Proof	1010	10	10	100	00	09 ½

If a sum be lent, and payment thereof made *at several times* in part, and you would know how much remains due, in this case you must add the several payments into one sum, and subtract that sum from the sum lent, and the remainder will shew how much is due.

Examples.

	l.	s.	d. f.	l.	s.	d.
Borrowed	3475	10	05	572	11	5
Paid at several times	358	14	07 ½	154	9	7 ¼
	524	07	11 ¾	95	10	7
	294	16	09	6	14	5 ½
	344	10	08 ½	72	11	4
	365	15	10 ¼	16	17	2
	795	15	07 ¾	9	14	11 ½
	462	14	08	146	17	9
Paid in all	3146	16	02 ¼	502	15	10 ¼
Rests due	328	14	02 ¾	69	15	6 ¾
Proof	3475	10	05	572	11	5

	l.	s.	d. f.
Lent	4768	17	10 ¾
Received at several times,	347	14	7 ½
	785	11	11 ¾
	128	15	9 ¼
	420	16	5
	124	00	2 ¾
Received in all	1806	18	11 ¾
Remains due	2961	18	11

	l.	s.	d. f.	l.	s.	d. f.
Borrowed	3475	10	5	4620	00	00
Paid at several times,	358	14	7 ½	409	9	10
	514	7	11 ¾	276	15	7 ¼
	294	16	9	195	13	11 ¼
	344	10	8 ½	167	19	10 ½
	365	15	10 ¼	984	19	5 ¼
	792	5	6 ½	215	7	6
Paid in all	2670	12	3 ½	2250	6	2 ¾
Rests due	804	18	1 ½	2369	13	9 ¼
Proof	3475	10	5	4620	00	00

SUBTRACTION *of* AVERDUPOIS *Weight.*

A Salter buys 45 ton, 6 C. 1 qr. 12 ℔. *of logwood, of which he ſold* 19 ton, 14 C. 1 qr. 18 ℔.

I diſpoſe the given numbers according to the directions already given, drawing a line under them, as you ſee in the

EXAMPLE.

Ton	*C.*	*qr.*	℔.
45	7	1	12
19	14	1	18
25	12	3	22

Then begin at the right hand, which is *pound weight*, ſaying, 18 out of 12 I cannot, but 18 out 28 (borrowing a *qr.* of a *C.* (which is 28 ℔.) and and there remains 10, to which add the 12 ℔, it makes 22 ℔, which place under the ℔, and carry 1 to the *qrs*, and ſay, 1 that I borrowed and 1 is 2, now 2 *qrs.* out of 1 I cannot, but 2 out of 4 *qrs, (which is C. weight)* there remain 2, to which add the 1 *qr*, it makes 3, which place under the *qrs.* and proceed to the *C.* and ſay, 1 that I borrowed and 14 *C.* is 15 *C.* now 15 *C.* out of 7 *C.* I cannot, but 15 *C.* out of 20 *C.* (*which is 1 ton*) there remains 5, to which add the 7 *C.* it makes 12 *C.* which place under the *C.* and proceed to the *tons*, and ſay, 1 that I carried and 9 is 10, 10 out of 5 I cannot, but out of 15, reſt 5, and carry 1, and ſay, 1 that I carry and 1 is 2, 2 out of 4, and there remains 2, and the work is finiſhed, and we find the *remainder* or *difference* to be 25 *ton* 12 *C.* 3 *qrs.* 22 ℔.

More examples for the learners to practiſe.

	Ton	*C.*	*qr.*	℔.	*C.*	*qr.*	℔.
Bought	107	10	2	5	74	0	15
Sold	94	17	3	10	19	1	11
Reſt	12	12	2	23	54	3	04
Proof	107	10	2	05	74	0	15

If ſeveral quantities of *groſs weight* be given, out of which you would ſubtract the *tare*, in ſuch a caſe add the *groſs weight* into one total: and add the *tare* likewiſe into one total. Then ſubtract the total of the *tare* from the total of the *groſs*, the remainder is *neat* weight.

EXAMPLE.

A Merchant ſells 6 *hogſheads of* SUGAR, *viz.*

	C.	*qr.*	℔.		*C.*	*qr.*	℔.
No. 1 Gr.	14	2	10	Tare	1	3	5
2	7	1	19		2	0	5
3	16	2	14		2	1	10
4	17	1	10		2	1	16
5	18	2	17		2	1	12
6	14	1	22		1	3	22
Groſs	89	0	08	Tare	12	3	14
Tare	12	3	14				
Reſt neat	76	0	22				

SUBTRACTION *of* TROY *Weight.*

	oz.	*dwt.*	*gr.*	*oz.*	*dwt.*	*gr.*
Bought	115	7	5	966	11	6
Sold	94	3	10	149	14	11
Reſt	21	3	19	816	16	19
Proof	115	7	5	976	11	6

	℔.	*oz*	*dwt.*	℔.	*oz.*	*dwt.*	*gr.*
Bought	375	5	13	194	5	9	16
Sold	196	10	17	95	7	14	18
Reſt	178	6	16	98	7	14	22
Proof	375	5	13	194	5	9	16

I might proceed to give examples in *Subtraction* of *Liquid Meaſure*, *Dry Meaſure*, *Long Meaſure*, *Apothecaries Weight*, *Time*, *Motion*, &c. but there being no more difference between the working of theſe and thoſe examples, than only obſerving the tables of each, therefore I forbear; this being ſufficient for the meaneſt capacity.

Of MULTIPLICATION.

In *Multiplication* there are always *two numbers* given to find out a *third*, which ſhall contain either of the given numbers, as many times, as the other containeth a *unit*.

Of the two numbers given, the one is called the *Multiplicand*, and the other is called the *Multiplier*, and the number found out by the operation is called the *Product*.

The MULTIPLICAND is the number given to be multiplied, and is uſually, for order's ſake, the *biggeſt* of the two given numbers.

The

The MULTIPLIER is that, by which the *Multiplicand* is multiplied, and is usually the *least* number.

The PRODUCT is the number produced by the *Multiplication*, and it containeth the *Multiplier* as many times, as the *Multiplicand* containeth *units*: or it containeth the *Multiplicand*, as often as the *Multiplier* containeth *units*.

Multiplication is either *simple* or *compound*.

Simple Multiplication is when the *Multiplicand*, and the *Multiplier*, do each of them consist of *one single figure* only; as if it were required to multiply 4 by 3, 5 by 2, 9 by 7; here 3 times 4 is 12, and 2 times 5 is 10, and 7 times 9 is 63; now 12. 10, and 63, are the *Products* of each *Multiplication*.

All the variety of *Simple Multiplication* is contained in the following table, which must be learned by heart, before the learner can make any further progress.

Multiplication TABLE.

2 times	2 is	4
	3	6
	4	8
	5	10
	6	12
	7	14
	8	16
	9	18
	10	20
	11	22
	12	24
3 times	3 is	9
	4	12
	5	15
	6	18
	7	21
	8	24
	9	27
	10	30
	11	33
	12	36
4 times	4 is	16
	5	20
	6	24
	7	28
	8	32
	9	36
	10	40
	11	44
	12	48
5 times	5 is	25
	6	30
	7	35
	8	40
	9	45
	10	50
	11	55
	12	60
6 times	6 is	36
	7	42
	8	48
	9	54
	10	60
	11	66
	12	72
7 times	7 is	49
	8	56
	9	63
	10	70
	11	77
	12	84
8 times	8 is	64
	9	72
	10	80
	11	88
	12	96
9 times	9 is	81
	10	90
	11	99
	12	118

Compound Multiplication is when the *Multiplicand*, or *Multiplier*, or both of them, do consist of *compound numbers*, that is, of more figures or places than one.

As if it were required to multiply 324 by 2, here the *Multiplicand* is 324, which consisteth of 3 places, and the *Multiplier* is 2.

When it is required to multiply one number by another, first set down the biggest number for the *Multiplicand*, and under that the *Multiplier* in such order as has been taught in *Addition* and *Subtraction*, viz. *units* under *units*, *tens* under *tens*, &c. and and draw a *line* under them.

EXAMPLE.

To multiply 324 by 2, set them down thus,

The *Multiplicand*	324
The *Multiplier*	2

Then I begin with the place of units, saying, 2 times 4 is 8, which I put under the line; then 2 times 2 is 4, which I also put under the line, and 2 times 3 is 6, which I also put under the line, and the work is finished; so that I find 325 being multiplied by 2, produceth 648, as by the following work.

The *Multiplicand*	324
The *Multiplier*	2
The *Product*	648

When the *Product* of any single figure amounts to 10, or a certain number of *tens*, then you are to set down a *cypher*, and carry a *unit* for every *ten* to the *Product* of the next figure; or if it comes to above 10, or any number of *tens*, then set down the *excess*, and carry an *unit* for every *ten*, &c. as in

EXAMPLE.

Let it be required to multiply 785641 *by* 5, set it down thus:

$$\begin{array}{r} 785641 \\ 5 \\ \hline 3928205 \end{array}$$

The number being set down, begin, saying 5 times 1 is 5, which put under the line, and proceed, saying, 5 times 4 is 20, whereof put down 0, and carry 2 for the two tens to the next, saying, 5 times 6 is 30, and 2 that I carried is 32, whereof put down 2, and carry 3 for the three tens to the next figure, saying, 5 times 5 is 25, and 3 that I carried is 28, wherefore put down 8, and carry 2 to the next, saying, 5 times 8 is 40, and 2 that I carry is 42, so put down 2, and carry 4 to the next figure, saying, 5 times 7 is 35, and 4 that I carry is is 39, which being the last figure, put down 39 under the line, and so the work is finished, and we find that 785641 being *multiplied* by 5, the *Product* is 3928205, as appears by the whole work above.

Here, note, *that Multiplication is a compendious performance of Addition*; for in the last example, if instead of multiplying 785641 by 5, we had put down the *Multiplicand* 5 times in order one under the other, and added them altogether, then the *sum* of them would amount, to the *Product* that was found by the foregoing work of *Multiplication*, as appears by the work.

```
785641
785641
785641
785641
785641
-------
3928205
```

When the *Multiplier* consists of *divers places*, then must there be as many *particular Products* as there are *places* therein; and for the true placing of each *Product*, observe to put the first figure or place of units under its proper *Multiplier*, and when you have done, draw a line under the whole work, and add *the several Products* together, and their sum will be the total *Product* required.

EXAMPLE.

Let it be required to multiply 46753 *by* 46:

```
  46753
     46
-------
 280518
187012
-------
2150638
```

Having placed the given numbers thus in order, and drawn a line under them, begin to multiply with the 6, saying, 6 times 3 is 18, wherefore put down 8 under the line, and carry 1 to the next, saying 6 times 5 is 30, and 1 that I carry is 31, &c. so that the *Product* by 6 is 280518. Then begin with the 4, saying 4 times 3 is 12, wherefore put down 2 (under the line, and under the figure 4, by which multiply) and carry 1 for the ten to the next, saying 4 times 5 is 20, and 1 that I carry is 21; whereof set down 1, and carry 2 to the next, &c. and we find the single *Product* by 4 to be 187012, and so the *Multiplication* is ended: then draw a line under these *two particular Products*, and *add* them together, in the order as they stand, and the *sum* is 2150638, which is the true *Product* of 46753 being multiplied by 46, that is, 46 times 46753, is 2150638, and is equal to the *sum* of 46753, being set 46 times one under another, and added together. See the whole work of *Multiplication* above.

A general rule in Multiplication is chiefly to observe, that in whatsoever place the *figure* of the *Multiplier* (whether a *cypher* or *cyphers*) stand from the place of *units*, in the same place must the first *figure* of that *Multiplication* be set from the *unit* of the *Multiplicand*.

And since the greatest difficulty in *Multiplication* arises from having a *cypher* or *cyphers* in the *Multiplier*, I shall endeavour to make it plain and easy by the following examples.

EXAMPLE I.

Where there is one or more *cyphers* in the *Multiplier* betwixt *significant* figures.

```
    8465008              45793
       4006                507
-----------            -------
    5079004             320551
33860032008           2289650
-----------            -------
33910822048           23217051
```

In the first example, you see that the *cyphers* are put at the same distance from the *unit* of the *Multiplicand* that they stand in from the *unit* of the *Muliplier*; as 4, the fourth figure of the *Multiplier* (the first figure in that *Multiplicand*, which is 2) is set in the fourth place from the *unit* of the *Multiplicand*.

EXAMPLE II.

Where the *Multiplier* hath one or more *cyphers* to the right hand thereof.

```
     546735             7645932
       4620               48000
 ----------        ------------
   10934700            61167456
   3280410            30583728
  2186940          ------------
 ----------         36700S436000
 2525915700
```

Or, You may multiply by the *significant* figures, neglecting the cyphers (as in the *second* sum,) as if there were none, only to the product *annex*, as many *cyphers* as there were *cyphers* in the *Multiplier*.

EXAMPLE

EXAMPLE III.

Where the *Multiplicand* and *Multiplier* have each of them cyphers at the right hand.

58400	438700
760	67000
3504000	30709
408800	26322
44384000	29392900000

Or, you may neglect the cyphers, (as in the second sum) only to the Product annex as many *cyphers* as there were *cyphers* to the right hand of the *Multiplicand* and *Multiplier*.

When the *Multiplier* consists of an *unit* in the highest place towards the left hand, and all the rest *cyphers* towards the right hand, as 10, 100, 1000, *&c.* then is the whole work performed by annexing the *cyphers* of the *Multiplier* to the figures of the *Multiplicand*; as

EXAMPLES.

6507	6507	6507
1000	100	10
6507000	650700	65070

It is necessary for all such as would be dextrous and ready at Arithmetick to learn to *multiply*, by these *compound numbers* following, very readily at one operation, *viz.*

Exa. Mult.	574967	Mult.	842958
by	11	by	12
makes	6324637	makes	10115496
	345876		859427
	110		120
Product	38046360	makes	103131240
	7504675		3217295
	12		12
	90056100		38607540

Here 574967 is multiplied by 11; thus 11 times 7 is 77, put down 7, and carry 7, and then 11 times 6 is 66, and 7 I carry is 73, put down 3, and carry 7, then 11 times 9 is 99, and 7 I carry is 106, put down 6, and carry 10; then 11 times 4 is 44, and 10 I carry is 54, put down 4 and carry 5; then 11 times 7 is 77, and 5 is 82, put down 2, and carry 8; then 11 times 5 is 55, and 8 I carry is 63; which put down, the Product of 574967 multiplied by 11 is found to be 6324637.

In like manner to multiply 842958 by 12, say, 12 times 8 is 96, put down 6, and carry 9, then 12 times 5 is 60, and 9 I carry is 69, put down 9, and carry 6, and so proceed till you have gone through your sum.

To multiply any number, by 110, or 120, put down a cypher, and multiply as before.

Multiply	425760	Multiply	543760
by	12000	by	1200
Product	5109120000	Product	652512000

There are also some *abbreviations* in this ART. —— Thus, to *multiply* a number by 5, you need only add a *cypher* to it, and then halve it. —— To multiply by 15 do the same, then add both together, the sum is the product.

Use of Neper's *bones* in *Multiplication.* To multiply any given number by another; dispose the *lamellæ* in such manner, as that the top figures may exhibit the multiplicand; and to these on the left-hand, join the *lamellæ* of units; in which seek the right hand figure of the multiplicator; and the numbers corresponding thereto, in the squares of the other *lamellæ*, write out, by adding the several numbers occurring in the same rhomb together, and their sums. After the same manner write out the numbers corresponding to the other figures of the multiplicator, let them be disposed under one another, as in the common Multiplication: And lastly add the several numbers into one sum. For example:

Suppose the multiplicand 5978, and the multiplicator 937, from the outermost triangle on the right-hand, which correspond to the right-hand figure of the multiplicator 7, write out the figure 6, placing it under. In the next rhomb towards the left, add 9 and 5; their sum being 14, write the right-hand figure, *viz.* 4 against 6; carrying the left-hand figure 1, to 4 and 3, which are found in the next rhomb. The sum 8 join to 46 already put down; after the same manner in the last rhomb, add 6 and 5, the latter figure of the sum 11, put down as before, and carry 1 to the 3 found in the left hand triangle; the sum 4 join as before on the left of 1846: Thus will you have the factum of 7 into 5978; and after the same manner will you have the factum of the multiplicand, into the other figures of the multiplicator. The whole added together, gives the whole product.

```
   5978
    937
  41846
 17934
53802
5601386
```

The proof of *Multiplication* can only be made exactly by *Addition*; and therefore shall defer shewing the manner of doing it till we come to that *Rule*.

Of Division.

Division teacheth to divide any number into as many equal parts as you please: Or,

It is that by which we discover how often one number is contained in another.

In *Division* there are always three numbers *certain*, and a fourth *accidental*.

Of the three numbers *certain*, two are always given to find out a third, *viz.* The one of the numbers given is to be *divided*, the other number given, is that by which the first is *divided*, and the number found out is the *quotient*, and discovers how often the one number is contained in the other.

Therefore in this rule are three remarkable numbers, *viz.* The *dividend*, the *divisor*, and the *quotient*.

The Dividend is the number given to be divided into equal parts.

The Divisor is the number given by which the *dividend* is to be divided, which declareth into how many equal parts the *dividend* is to be divided.

The Quotient is the number obtained by the operation, and shews how often the *divisor* is contained in the *dividend*.

And the *remainder* is the number which remains after the *division* is ended, which is *uncertain*, or the fourth *accidental* number mentioned before.

As, suppose 15 were given to be divided by 3, or 15 shillings to be divided amongst 3 men, here 15 is the *dividend*, 3 is the *divisor*, and 5 is the *quotient*; for 3 is contained in 15 just 5 times, without any *remainder*; but if you were to divide 20 by 3, the *quotient* would be 6, and the *remainder* 2, for 3 is contained in 20, 6 times, and 2 remains over.

In Division (by one figure) you are first to write down the *dividend*, and then draw a crooked line, and place the *divisor* on the left hand thereof, then draw a line at the end of the *dividend*, after which place your *quotient*.

If 40 were given to be divided by 8, the number produced would be 5.

```
          Dividend
Divisor 8) 40 (5 Quotient
           40
           --
            0
```

This method must be observed in every *division*; *first*, ask how many. *Secondly*, multiply. *Thirdly*, subtract.

Example.

Let it be required to divide 88 by 4, first write down the *dividend*, and then draw a parenthesis, and place the *divisor* on the left hand thereof, then begin your work.

```
           Dividend
Divisor 4) 88
```

Thus having placed a *parenthesis* at each end of the *dividend*, that on the left hand for the *divisor*, and that on the right for the *quotient*; then if the *divisor* be a single figure, subscribe a point under the first figure of the *dividend* towards the left hand, and ask how often the *divisor* 4 is contained in the *dividend* 8; the answer is 2, wherefore write 2 in the *quotient*; then multiplying the *divisor* 4 by 2, (the number placed in the *quotient*) the product is 8, which place orderly under the *dividend* 8; and after a line is drawn underneath the product, subtract it from the *dividend* 8, and place the remainder underneath the line. Then proceed and place another point under the next place of the *dividend*, towards the right hand, and bring down the figure or cypher standing in that place to the remainder; that is, set it next after it, so the whole will be a new *dividual*: Thus a point being placed under the other 8, write down 8 next after 0, to wit, on the right hand of the remainder 0; so is 8 a new dividual or number, whereof the second question must be asked, and the number will stand thus:

```
4) 88 (22
   8 .
   --
   08
    8
   --
    0
```

A new *dividual* being brought down, which is 8, renew the question, and ask how often 4 is contained in 8; the answer is 2, wherefore write 2 in the *quotient*; then multiplying the *divisor* 4 by 2, the product is 8, which place under the *dividual* 8, and after a line is drawn, subtract the product 8, from the *dividual* 8, and there being no *remainder*, place 0 under the line: so the whole work is finished, the *quotient* is found 22. Wherefore if 88 pounds were to be divided among four persons, the share of each will be 22 pounds.

The operation is a great deal more difficult, when the *divisor* consists of *two*, *three*, or *several figures*; though it depends on the same rules; for *Example.* —— Let it be required to divide 896487 by 648, or, which is all one, to divide 896487 into 648 equal parts.

First a table must be made, to shew at first sight, any product of the *divisor*, it being taken twice, thrice, or any number of times under ten, so having written

written down the *diviſor* itſelf 648, and drawn a line on the right-hand thereof, place 1 on the right-hand of the line directly againſt the *diviſor*; then underneath the *diviſor* 648, place the *double* thereof, which is 1296, and place the figure 2 directly againſt the ſaid double on the other ſide of the line; again by multiplying the *diviſor* 648 by 3, the ſum is 1944, this *triple* place under the *double*, and place 3 on the other ſide of the line right againſt the *triple*; and ſo proceeding, in like manner, with the *quadruple*, *quintuple*, *ſextuple*, &c. to the *noncuple* of the *diviſor*:

	Diviſor 648	1
Multiplees of the Diviſor	1296	2
	1944	3
	2592	4
	3240	5
	3888	6
	4536	7
	5184	8
	5832	9

Now for a proof of the ſaid Table, adding the laſt number thereof, to wit 5832, which was found to be nine times the *diviſor*, to the *diviſor* 648, we find the ſum to be 6480, which is ten times the *diviſor*, as you may ſee in the margent; wherefore the table is true, becauſe the laſt number thereof is derived from all the ſuperior numbers.

648
10
———
6480

The principal method of *Diviſion* (which to thoſe who have the *multiplication table* by heart, is eaſy enough) is when the *diviſor* conſiſts of more places than one, to ſet out ſo many figures on the left-hand of the *dividend* for a *dividual*, and then put a point under the figure of the *dividual*, which ſtands next to the right-hand. Then ſeek how often the firſt figure towards the left-hand of the *diviſor*, is contained in the firſt figure towards the left-hand of the ſaid *dividual*, and place the anſwer in the *quotient*. Then multiply the whole *diviſor* by the ſaid figure ſo placed in the *quotient*, and place the *product* in order under the *dividend*. Which being done, ſubtract the ſaid *product* from the *dividual*, placing the *remainder* under the line. Then put a point under the next figure of the *dividend*, and annex it to the *remainder*, ſo you have a new *dividual*, in which you are to proceed, as ſhall be directed.

Example.

Let it be required to divide 8904 by 42, here the given number being diſpoſed of, as before directed, will ſtand thus;

42) 8904(

Then becauſe there are two figures in the *diviſor*, therefore you muſt take the two firſt figures on the left-hand of the *dividend* for a *dividual*, which is 89, putting a point under the 9. Then aſk how often the firſt figure 4 is contained in the firſt figure 8, the anſwer is two times; wherefore multiply 2 in the *quotient* by 42 the *diviſor*, and the *product* is 84, which place directly under 89, and ſubtract it, and there will remain 5. Then put a point under the next figure, which is 0, and annex it to the *remainder* 5, and it makes 50 for a new *dividual*, and the operation will ſtand as follows:

42) 8904 (21
84.
——
50

Aſking afterwards how often can have 4 in 5, the anſwer will be 1, which place in the *quotient*, and multiply the *diviſor* 42 by 1 which makes 42, which place under 50, and ſubtract it from 50, and there will remain 8, which place in order under the line, and thereto annex the next figure of the *dividend* which is 4, and then it makes 84 for a new *dividual*, and then the operation will ſtand as follows;

42)8904(212
84..
——
50
42
——
84
84
——
0
——

For a concluſion, aſk how often 4 is contained in 8, and the anſwer will be 2 times; wherefore put 2 in the *quotient*, and thereby multiply the *diviſor* 42 by 2, which makes 84, and by ſubtracting 84 from 84 the remainder is nothing, and the operation is ended; ſo that if I divide 8904 pounds amongſt 42 perſons, each perſon muſt have 212 pounds.

Whenever the *product* of the *Multiplication* by the *diviſor* is greater than the *dividual* from which it ought to be ſubtracted, ſuch *product* muſt be ſtruck out; and a leſſer figure is to be placed in the *quotient*, for you cannot ſubtract a greater figure from a leſſer. For Example, if it be required to divide 4763585 by 587, becauſe the *diviſor* 587, is bigger than the *dividual* 476, therefore put the point to 3, then the *dividual* becomes 4763, from which taking the *diviſor* 587 out of the *dividual*, we find it 8 times (for 9 times is too much) ſo placing 8 in the *quotient*, and having multiplied the *diviſor* thereby, which is 4696, and ſubtracting it out of 4763, the remainder is 67, to which, by putting a point to 5, then we have 675 for a new *dividual*,

dividual, and ſo proceeding according, as before taught, the *quotient* will be 8115, and 80 for the *remainder*.

Thus 587)4763585(8115
4696 . . .
———
675
587
———
883
587
———
3015
2935
———
80 the Remainder.
———

There is another method of *Diviſion*, preferable to any common way of dividing, by daſhing out of figures, where the ſteps of the *diviſion* are ſo confounded, by a promiſcuous *multiplication* and *diviſion*, that if any error happens, it can ſcarce be corrected without beginning the work a-new; but in this, explained underneath, the particular *multiplications*, *ſubtractions* and *remainders*, which belong to every figure of the *quotient*, are ſo diſtinctly and clearly ſet down, that if an error happen it may eaſily be reformed.

EXAMPLE.

Let it be required to divide 7910010295 by 59746; the operation will ſtand thus:

59746)7910010295(132393
59746 . . . . .
———
193541
179238
———
143030
119492
———
235382
179238
———
561449
537714
———
237355
179238
———
58117 Remainder.
———

132393 Quotient mult.
by 59746 Diviſor
———
794358
529572
926751
1191537
661965
———
7909952178
58117 Remaniderad.
———
7910010295 Proof
———

We muſt obſerve, that there are to be as many points in the *dividend*, as there are figures in the *quotient*, as in this Example, you have ſix points in the *dividend* and ſix figures in the *quotient*.

Diviſion is proved by multiplying the *quotient* by the *diviſor*, or the *diviſor* by the *quotient*, and adding what remains of the *diviſion*, if there be any thing. If the ſum be found equal to the *dividend*, the operation is juſt, otherwiſe there is a miſtake.

And the moſt certain proof of *Multiplication* is by *Diviſion*. They interchangeably prove each other. For, if the *product* be *divided* by the *multiplicand*, the *quotient* will be equal to the *multiplier*: and if the *product* be *divided* by the *multiplier*, the *quotient* will be equal to the *multiplicand*.

When the *diviſor* conſiſteth of any other number, with a *cypher* or *cyphers* annexed thereto, then cut off the *cyphers* of the *diviſor* with a daſh of the pen, and as many *cyphers* as you cut off from the *diviſor*, *ſo many places* muſt you cut off from the *dividend*; then proceed to divide by the remaining figures in the *diviſor*, as if there were no ſuch *cyphers* or *figures* of the *diviſor*, or *dividend* as you cut off, and if nothing remain after *Diviſion* is ended, then ſhall the figures you cut off from the given *dividend* be the true remainder; but if any thing do remain after *Diviſion* is ended, you are then to annex the figures of the *dividend* that were before cut off, ſo ſhall the ſaid *remainder*, with the figures annexed thereto, be the true *remainder*.

EXAMPLE.

Divide 486763 by 15000. *Firſt*, cut off the three *cyphers* of the *diviſor*, and alſo *three places* of the right hand of the *dividend*, ſo we have 15 for the diviſor, and 486 for the *dividend*, *viz.*

15|000) 486|793 (32
45
———
36
30
———
6

By the ſhort way of *Diviſion*.

15|000) 486|793
———36
32 6

Here I find the *quotient* to be 32, and the *remainder* is 6, to which annexing the figures cut off from the *dividend*, *viz.* 793, it makes 6793 for the true *remainder*.

Uſe of Neper's *bones in Diviſion.* Diſpoſe the *lamellæ* ſo as that the uppermoſt figures may exhibit the *diviſor*; to theſe on the left-hand join the *lamellæ* of units. Deſcend under the *diviſor*, till

‖ you

you meet thoſe figures of the *dividend*, wherein it is firſt required, how oft the *diviſor* is found, or at leaſt the next number, which is to be ſubtracted from the *dividend*; the number correſponding to this, in the place of units, write down for a *quotient*. By determining the other parts of the *quotient* after the ſame manner, the *diviſion* will be compleated. For Example:

Suppoſe the *dividend* 5601386, and the *diviſor* 5978; ſince it is firſt aſked how often 5978 is found in 56013, deſcend under the *diviſor*, till in the loweſt ſeries you find the number 53802 approaching neareſt to 56013; the former whereof is to be ſubtracted out of the latter, and the figure 9 correſponding thereto in the *lamellæ* of units, write down for the *quotient*. To the remainder 2211, join the following figure of the *diviſor* 8; and the number 17934 being found, as before, to be the next leſs number thereto, the correſponding number in the *lamellæ* of units, 3, is to be wrote down for the *quotient*; and the ſubtraction to be continued as before. After the ſame manner the third and laſt figure of the *quotient* will be found to be 7; and the whole 937.

```
5978) 5601386 (937
      53802
      -----
       22118
       17934
       -----
        41846
        41846
        -----
        00000
        -----
```

Of Reduction.

Having given the *operations* of the FOUR chief RULES in *Arithmetick*, we proceed with thoſe *operations*, which are built upon them and invented for expedition and exactneſs in different tranſactions and calculations.

REDUCTION teacheth to *reduce* numbers, whether *money*, *weight*, *meaſure*, *time*, *motion*, &c. from one denomination to another, diſcovering the ſame value, but in different terms.

Reduction is performed by *multiplication* and *diviſion*.

All *great* denominations are brought into *leſſer* of the ſame value by *multiplication*, and this is by ſome called *Reduction deſcending*.

All *ſmall* denominations are brought into *greater* of the ſame value by *diviſion*, and this is by ſome called *Reduction aſcending*.

To reduce *greater* denominations into *leſſer* of the ſame value. Conſider how many of the leſſer are equal to one of the greater, and multiply the given number thereby, ſo ſhall the product be the anſwer to the queſtion.

EXAMPLE.

Reduce 3468 ſhillings into pence.

```
 3468
   12
 -----
41616
```

Here conſider, 12 pence is a ſhilling, and the pence ought to be twelve times the number of ſhillings, wherefore multiply by 12 at one operation, and the product is 41616 pence.

To reduce *ſmaller* denominations into *greater* Conſider *how many* of the *ſmaller* are equal to *one* of the *greater*, and *divide* thereby; the *quotient* is the anſwer to the queſtion.

EXAMPLE.

Reduce 41616 pence into ſhillings.

```
12) 41616
   -------
    3468 ſhillings.
```

Firſt, conſider that 12 pence is a ſhilling, and that the ſhillings ought to be a twelfth part of the pence; wherefore divide the given number by 12 at one operation, and ſay, 12 in 41, three times, reſt 5, which to the 6 makes 56, then 12 in 56, 4 times, reſt 8, which makes the 1, 81; then 12 in 81, 6 times, reſt 9, which makes the 6, 96, then 12 in 96 is 8 times, and the *quotient* gives 3468 ſhillings, which is the anſwer to the queſtion, and may ſerve for a proof of the foregoing example.

In *Reduction* of *money*, multiply the ſhillings by 12 at one operation; and likewiſe divide by 12 at one operation.

EXAMPLE I.

In 685 *l.* I demand how many *ſhillings*, *pence*, and *farthings*.

```
   685 pounds,
    20
 ------
 13700 ſhillings,
    12
 ------
164400 pence,
     4
 ------
657600 farthings.
```

Firſt, multiply by 20 (becauſe 20 *ſhillings* is a pound,) and the product is 13700 *ſhillings*, then multiply the *ſhillings* by 12, (becauſe twelve pence is a ſhilling) and the product is 164400 *pence*; then multiply

multiply the *pence* by 4, (becauſe four farthings is a penny) and the product is 657600 *farthings*.

This or any other number of pounds, might be reduced into pence or farthings at one operation, without reducing it into the intermediate denominations.

For if you multiply pounds by 240 (becauſe ſo many pence make a pound) the product will be pence, and if you multiply pounds by 960 (becauſe 960 farthings is a pound) the product will be farthings: ſo, in the foregoing example, 685 *l.* being multiplied by 240, the product you will find to be 164400 pence, and if you multiply 685 *l.* by 960, the product will be 657600 farthings, for the reaſons before ſaid.

But you may ſay, you cannot well remember how many pence or farthings make a pound, I will therefore teach you how to find it out at any time when you have occaſion. You may eaſily remember 20 ſhillings is a pound, and that multiplied by 12 produceth 240 pence, which being multiplied by 4, produceth 960 farthings, as follows.

$$\begin{array}{rl} 20 & \textit{shillings}, \\ 12 & \\ \hline 240 & \textit{pence}, \\ 4 & \\ \hline 960 & \textit{farthings}, \end{array}$$

or *one pound*.

Example II.

In 657930 *farthings*, I demand how many *pence*, *ſhillings*, and *pounds*?

This queſtion is the reverſe of the former, and may ſerve for a proof thereof: firſt, I divide the farthings by 4, and the quotient is 164400 pence, then I divide the pence by 12, and the quotient is 13700 ſhillings, and the ſhillings I divide by 20, and the quotient is 685 pounds: which is equal to the given number in the firſt example. See the whole operation as followeth:

$$\begin{array}{rl} 4)\ 657600 & \textit{farthings}. \\ \hline 12)\ 164400 & \textit{pence}. \\ \hline 2|0)\ 1370|0 & \textit{shillings}. \\ \hline \text{makes}\ \ 685 & \textit{pounds}. \end{array}$$

When in Reduction deſcending, the number propounded to be reduced conſiſteth of diverſe denominations, as of *pounds*, *ſhillings*, *pence*, and *farthings*; or of *pounds*, *ounces*, *penny-weights*, and *grains*, &c. then you may readily reduce it into the loweſt denomination. Thus when you reduce an higher denomination into the next inferior, add to the product the expreſſed parts into which you reduce it, as if you were to reduce pounds into ſhillings, add to the product (as you multiply) the ſhillings that are expreſſed in the number propounded; proceed in the ſame method till you have reduced the given number into the denomination required, as in the following example.

Example III.

Reduce 567 *l.* 15 *s.* 6 *d.* ¾ into *farthings*.

Firſt, multiply by 20 to bring into *ſhillings*, ſaying, 0 times 7 is 0, but 5 is 5, (taking in the 5 that is in the place of units in the rank of ſhillings, and ſetting it in the place of units in the product) then 2 times 7 is 14, and 1 is 15, (taking in the 1 that is in the place of tens in the rank of ſhillings) ſo ſet down 5 in the place of tens in the product, &c. the product is 11355 ſhillings, then multiply the ſhillings by 12 to bring them into pence, ſaying, 12 times 5 is 60, and 6 is 66, (taking in the 6 that ſtands in the rank of pence) &c. and the pence make 136266; then multiply the pence by 4, to bring them into *farthings*, ſaying, 4 times 6 is 24, and 3 is 27, taking in the 3 which ſtands in the rank of farthings, &c. ſo the farthings amount to 545067, as by the whole operation appeareth, *viz.*

$$\begin{array}{rl} 567\,l.\ \ 15\,s.\ \ 6\,d.\,\tfrac{3}{4} & \\ 20 & \\ \hline 11355 & \textit{shillings}, \\ 12 & \\ \hline 136266 & \textit{pence}, \\ 4 & \\ \hline 545067 & \textit{farthings}. \end{array}$$

Obſerve the like in any other example.

When in *Reduction Aſcending* any thing remains after *diviſion* is ended, it is always of the ſame denomination with the *dividend*, as in the following example.

Example IV.

In 545067 *farthings*, I demand how many *pounds*?

Firſt, divide the given number of *farthings* by 4, and the *quotient* is 136266 pence, and there remains 3, which is 3 farthings; becauſe the *Dividend* was farthings.

Then divide the *pence* by 12, and the *Quotient* is 11355 *ſhillings*, and there *remains* 6, which is 6 *pence*; becauſe the *Dividend* was *pence*.

Then

Then divide the *shillings* by 20, and the *Quotient* is 567 *l.* and there remains 15, which is *shillings*; because the *Dividend* was *shillings*: so that we find by the work, 545067 farthings to be 576 *l.* 15 *s.* 6 *d.* $\frac{3}{4}$ as by the following work.

4) 545067

12) 136266 $\frac{3}{4}$

2|0) 11335|5 : 6 *d.*

makes £. 567 : 15 *s.* 6 *d.* $\frac{3}{4}$

This question is the inverse of the third example, and may very well serve for a proof thereof.

Here by the way take notice, that when you are (to divide any number by 20, that is) to bring shillings into pounds, the best way is to cut off a figure to the right-hand for shillings; and then to take half the figures to the left-hand for pounds, and if 1 remain, it is 10 shillings to be added to the figure first cut off. For example.

Where 11355 *shillings* are to be reduced into *pounds*, cut off the last figure 5 for *shillings*, and say, Half of 11 is 5, half of 13 is 6, half of 15 is 7, and there remains 1, which makes the 5 shillings to be 15 shillings.

1134 *l.* 5 *s.* 0 *d.*

makes 567 15 0

Note, Once for all, that *Reduction Ascending*, proves *Reduction Descending*, the one being a reverse to the other, as shall be demonstrated in the questions that follow, in all the varieties of *Reduction*.

Quest. I. In 7642 *l.* 17 *s.* 11 *d.* $\frac{1}{2}$, I demand how many *half farthings*?

Money] 20

152857 *shillings.*
12

1834295
8

14674364 *half farthings.*

Ton, *C.* *qr.* ℔.

Quest. II. In 95 11 3 15 how many *pounds* (weight?

Avoirdupois weight. } 20

1911 *hundreds.*
4

7647 *quarters.*
28

61181
15295

makes 214131 *pounds* weight.

C. *qr.* ℔. *oz.*

Quest. III. In 50 2 15 9 how many (*ounces!*
4

202
28

1621
405

5671
16

34035
5671

makes 90745 *ounces.*

By this you see, that if 50 *C.* 2 *qr.* 15 *lb.* 9 *oz.* be multiplied, the product will be 90745 ounces, which is the reverse or proof of the second Question.

Quest. IV. In 214131 *pounds weight*, how many (*tons*?

28) 181
133
4) 7647 211
2|0) 191|1 $\frac{1}{4}$ 15 *pounds.*

95 : 11 :

Proof 95 : 11 : 3 : 15. By this you see, that if 214131 pound weight be divided by 28, by 4, and by 20, it produces 95 *ton*, 11 *C.* 3 *qrs.* 15 *lb.* which is the reverse of the second Question.

Quest. V. In 90745 *ounces*, how many *hundred* (weight?

16) 107
114
28) 5671 25
71
4) 202 9
15 *ounces.*

C. 50 : 2 : 15 : 9 proof.

oz. *dw.* *gr.*

Quest. VI. In 50 10 11 how many *grains of Silver*?

Troy Weight. } 20

1010
24

4041
2021

makes 24251 *grains of Silver.*

Quest.

oz. dw. gr.

Queſt. VII. In 507 10 11 how many *grains* (of *Silver*?

Troy Weight.

20

10150 *penny weight.*

24

40601

20301

makes 243611 *grains.*

Queſt. VIII. In 243611 *grains*, how many *ounces* (of *Silver*?

24) 36

121

2|0)1015|0

11

Proof 507 10 *dw.* 11 *grains.*

Tun. hhd. gall.

Queſt. IX. In 54 2 25 how many *quarts* (of *Wine*?

Liquid Meaſure.

4

218 *hheads.*

63

659

1310

13759 *gallons.*

4

Proof 55036 *quarts.*

Queſt. X. In 55036 *quarts*, how many *tuns* of (*Wine*?

4)

63) 13759

115

4) 218 529

54 25 *gallons.*

tons. 54: 2 *hh.* 25 *gallons.*

Laſt. qr. buſh. gall.

Queſt. XI. In 75 5 3 2 how many *gallons* (of *Wheat*?

Dry Meaſure.

10

755 *quarters.*

8

6043 *buſhels.*

8

makes 48346 *gallons.*

Q. XII. In 48346 *gallons*, how many *Laſts* of (*Wheat*?

8)

6043 2

1|0) 7 |5 3

Proof 75 5 3 2

CLOTH MEASURE.

Queſt. XIII. In 207 *ells* 2 *quarters*, 2 *nails*, (*how many nails*?

5

1037 *quarters.*

4

makes 4150 *nails.*

Queſt. XIV. In 107 *yards*, 3 *quarters*, 1 *nail*, (how many *nails*?

4

431 *quarters.*

4

makes 1725 *nails.*

Queſt. XV. In 312 *ells* Flemiſh, 2 *quarters*, how (many *quarters*?

3

makes 938 *quarters.*

Queſt. XVI. In 112 *aulns*, 1 *quarter*, 2 *nails*, (how many *nails*?

6

673 *quarters.*

4

makes 2694 *nails.*

Note, An *auln* here is reckoned $1\frac{1}{2}$ yard.

LONG MEASURE.

Queſt. XVII. The cirumference of the earth being 360 degrees, and every degree 60 *Engliſh* miles, demand how many *miles*, *furlongs*, *perches*, *inches*, and *barley-corns* will reach round the *world*?

360

360	Degrees.
60	Miles a Degree.
21600	Miles about the Earth.
8	
172800	Furlongs about the Earth.
40	Perches in a Furlong.
6912000	Perches about the Earth.
33	Half Feet in a Pearch.
20736	
20736	
228096000	Half Feet about the Earth.
6	Inches in a half Foot.
1368576000	Inches.
3	Barley-Corns is an Inch.
4105728000	Barley-Corns about the Earth.

To expedite the practice, feveral compendious ways of *Reduction* have been invented. Thus yards are turned into ells, by fubtracting a fifth, and into ells *Flemifh* by adding a fifth. Ells *Flemifh* are reduced into yards by fubtracting a quarter. Ells *Flemifh* reduced to ells *Englifh* by multiplying by 6, and cutting off the right-hand figure. Great pounds of filk of 24 ounces, are reduced to pounds of 16 ounces, by adding one half. Pounds of 16 ounces into pounds of 24, by fubtracting one third.

TARE and TRET is alfo another kind of REDUCTION.

Tare is an abatement or deduction on the price of a commodity, on account of the weight of chefts, cafks, bags, frails, &c. The cafks, chefts, or whatever elfe contains the commodity, is alfo called *Grofs*.

Tret is an allowance made, in commerce, for the wafte, or the duft, that may be mixed with any commodity; which is always 4 pounds in every 104 pounds.

The *Tare* is very different in different merchandizes: in fome there is none at all allowed. It is a thing much more regarded in *Holland* than in *England*, or elfewhere. M. *Ricard* treating of the commerce of *Amfterdam*, obferves that the *Tares* are one of the moft confiderable articles a merchant is to be acquainted withal, if he would trade with fecurity.

Sometimes the *Tare* is, as it were, regulated by cuftom; but generally, to avoid all difpute, the buyer and feller make a particular agreement about it. We fhall here add from the forementioned author, fome inftances of *Tare* allowed at *Amfterdam*.

Spanifh wool is fubject to a kind of double *Tare*; for firft they deduct the *Tare* marked on the bales, and after that 24 pounds *Tare* for every 175 pounds weight, befides the *rebate* for prompt payment. Indeed for the common wools, the feller will feldom allow above 14 *per Cent*, for the whole *Tare*; for which reafon the bargain is to be agreed on before.

Tare of
- *Roman* Allum is 4 ℔. *per* fack.
- *Irifh*, &c. Butter, 20 ℔ *per Cent.*
- Crude Borax, 15 ℔. *per Cent.*
- Cinnamon, 17 ℔. the Burthen.
- Capers 33 ℔. *per Cent.*
- White Pepper, 40 ℔. *per* Barrel.
- Black Pepper, 5 ℔. &c.

But to reduce *Tare* and *Tret* into practice with regard to arithmetick; if I be afked, for example, in 48 *C.* 3 *qrs.* 14 ℔. *Tare.* 3 *C.* 3 *qrs.* 00 ℔. how many pounds neat? I proceed thus:

C.	*qrs.*	℔.	
48	3	14	*Grofs*
3	3	00	*Tare* deducted
45	0	14	
4			
180			Quarters
28			
1444			
361			
5054			Pounds neat

```
               C.   qrs.  ℔.
112)5054(45    0    14   neat
    448
    ---
     574
     560
     ---
      14
```

Which pounds neat being divided by 112, gives me 45 *C.* 0 *qrs.* 14 ℔. neat weight.

Or this other question: in 145 *C.* 2 *qrs.* 16 ℔. *Tare* 14 *per C. Tret* 4 *per* 104, how many pounds neat? to answer which I proceed in the following manner:

C. qrs. ℔.		C. qrs. ℔.	
145 2 16		145 2	
4		14	
582	Quarters	580	
28		145	
4662		2030	
1165		9	allowed for 2 *qrs.* 16 ℔.
16312	℔. Subtle	2039	
2039	℔. Tare		
14273	Remainder		
627	℔. Tret	26)16312(627 ℔. Tret	
13646	℔ neat	156··	

I divide the pounds subtle, by 26, because 4 pounds is the 26th of 104, the allowance always given for *Tret*.

71
52
192
182
10

C. qrs. ℔.
112)13646(121 3 10
112··

Or the pounds neat being divided by 112, makes 121 *C.* 3 *qrs.* 10 ℔. neat weight.

244
224
206
112
94

And thus of all other commodities or merchandizes, in proportion.

Of the Rule of Three.

The Rule of Three, otherwise called the Golden Rule and the Rule of Proportion, is one of the most useful operations in *Arithmetick.*

It is either *single* or *compound.*

The *single Rule of Three* is generally taught to contain two branches, called by the writers of *Arithmetick, direct* and *inverse:* but this is multiplying *rules* without reason, as will appear hereafter.

The Rule of Three Direct teaches how to find a fourth proportional number, to three others given.

In this rule we must always observe, in stating the question, to make our first and third number be of one denomination, and the second figure being the supposition, must, after the operation, be found in the same degree, with the fourth number sought. We must also make our first and third numbers both of one kind. Then go unto the second or middle number, and reduce that into the lowest value there named: then multiply our second number under our third, making that number our *Dividend*; and divide by our first number; and the *Quotient* of our *Division* answers the question demanded, and is always of the same denomination with our second number; whether pounds, shillings, pence, or farthings, or any other name or kind whatever: which if it shall happen to be of any greater number, whether *weight, measure,* or *time,* we may reduce them into its lowest value, by the rule of *Reduction* before taught.

Quest. If three degrees of the equator contain 70 leagues, how many do 360 degrees, the circumference of the earth, contain?

The rule is this: multiply the second term 70, by the third 360, divide the *Product* 25200 by the first term 3, the *Quotient* 8400 is the fourth term required.

The use of this *rule* is of vast extent both in *common life,* and the *sciences*; yet it has no place, but where the proportion of the given numbers is known. -- Suppose, for instance, a large vessel full of water to empty itself by a little aperture; and suppose three gallons to flow out in a minute; and it were required to know in what time 100 gallons would be thus evacuated: here indeed are three terms given and a fourth required, but as it is evident from experience, that water flows faster at first than afterwards, the quantity of flowing water is not proportional to the time; and therefore the question does not come under the *Rule of Three.*

The things which come under *commerce* are *proportionable* to their *prices*; twice as much of any commodity costing twice as much money, *&c.* The price therefore, of any quantity of a commodity being given, the price of any other quantity of the same, or quantity of the commodity answering to any other given him, is found by the *Rule of Three.*

Example.

If 3 ℔. cost 17 *s.* what will 30 ℔. cost? Since as 3 *lb.* are to 30 *lb.* so is the value of the former 17 *s.* to the value of the latter. The question stands thus:

℔.	*s.*	℔.
3 ——	17 ——	30
		17
		210
		30
8 *l.* 10 *s.*		3)510(170 *s.*

Again,

Again, if 3 pounds be bought for 17 *s.* how many will 170 *s.* buy; ſince as 17 *s.* is to 170 *s.* ſo are 3 pounds to the pounds required: the number will be found thus:

```
s.       ℔.       s.
17 ——— 3 ——— 170
                3
              ———
         17)510(30 ℔,
            51
            ——
            00
            ——
```

If the given terms be heterogeneous, *i. e.* have broken numbers among them, they do not bear the ſame proportion to each other with the things they expreſly bear. They muſt therefore be reduced to homogeneous ones, or to the ſame denomination, as pounds into ſhillings, *&c.*

EXAMPLE.

If 3 ℔. and 4 *oz.* coſt 2 *s.* 4 *d.* what will 2 ℔. coſt? The operation will run thus:

```
℔.  oz.        s.  d.        ℔.
3   4 ———————  2   4 ———————  2
16             12             16
—              —              —
52             28             28
                              32
                             ———
                             256
                             64
                             ———
                        52)896(17 d. 12/52
                           52
                           ———
                           376
                           364
                           ———
                            12
                            —
```

In many caſes of commerce and account, we have more compendious ways of working queſtions that come under the *Rule of Three*, than by the *Rule* itſelf, which by reaſon of their expediting Practice, are called PRACTICE, and conſtitute a particular rule of themſelves; eſpecially where the firſt term is 1, or unity. Theſe practices are called *Italian Practices* or *Uſages*, becauſe firſt introduced by the merchants, and negotiators of *Italy*. The moſt uſeful of theſe practices are as follow.

1. Since the uſe of the *Rule of Three*, is to find a fourth proportional to three given numbers, divide the firſt and ſecond, or the firſt and third, by ſome common number, if that can be done exactly; and work with the *Quotient* in their ſtead; as in the following example.

```
Price of 3 ℔. is 9 s. what is the price of 7 ℔?
      3) 1      3                          3
                                           —
                                   makes 21 s.
Price of 14 ℔. is 26 s. what is the price of 7 ℔?
      7)2      2)—                          1
           makes 13 s.
```

2. If the firſt term be 1, and the ſecond an aliquot part of a pound, ſhilling, or penny; divide the third by the aliquot part; the *Quotient* is the anſwer. *Note*, that the *aliquot* part is ſuch part of any number or quantity, as will exactly meaſure it, without any remainder. Or it is a part, which being taken a certain number of times, becomes equal to the whole or integer. Thus 3 is an aliquot part of 12, becauſe being taken four times, it will juſt meaſure it.

For example, if 1 ell coſt 10 *s.* what will 957 ells coſt?

makes 478 *l.* 10

3. If the firſt or third number be 1, the other not exceeding large, and the middle term a compound, *i. e.* conſiſts of ſeveral denominations; it may be wrought without *Reduction* thus:

Price of 1 ℔. is 3 *s.* 8 *d.* $\frac{3}{4}$ what is the price of 5 ℔.

```
       s  d.
       3  8  3/4
             5
      ————————
makes 18  7  3/4
```

For, four farthings making a penny, 5 times 3 farthings make 3 *d.* $\frac{3}{4}$ and 12 pence making one ſhilling, 5 times 8 pence make 3 *s.* 4 *d.* which with 3 *d.* from the place of farthings, make 3 *s.* 7 *d.* *Laſtly*, five times 3 *s.* make 15 *s.* and with the 3 *s.* from the place of pence 18 *s.* the price required therefore is 18 *s.* 7 *d.* $\frac{3}{4}$.

4. If the middle term be not an aliquot, but an aliquant part, reſolve the aliquant part into its aliquot parts; divide the middle term by the ſeveral aliquots, the ſum of the *Quotient* is the anſwer. *Note*, Aliquant part is that which will not meaſure or divide any number exactly, but ſome remainder will ſtill be left. Or, an aliquant part, is that which being taken any number of times, is always greater or leſſer than the whole. Thus 5 is an aliquant part of 12; for being taken twice it falls ſhort; and when taken three times it exceeds 12.

For an inſtance of this rule:

If 1 ell coſts 15 *s.* What coſts 124 ells?

½ ½) 62

¼ 31

makes 93 *l.*

5. If the firſt or ſecond term be 1; and in the former caſe the ſecond or third; in the latter the firſt, be reſolvable into factors; the operation may be performed in the mind without writing down any figures: as in the following example:

Price of 1 ℔. is 24 *s.* What is 20 ℔.

4 . 4

80

6 6

makes 480 *s* .or 24 *l.*

6. Where one of the given numbers is 1, we have ſeveral compendious uſages to ſave *Multiplication* and *Diviſion*, e. gr.

If 9 ℔. coſts 20 *s.* What does 1 ℔.

It is obvious the ſum required is had by adding to the tenth part of 20 ſhillings, *viz.* 2 *s.* the ninth part of that tenth, *viz.* 3 *d.* ½ and $\frac{2}{9}$ of a penny; the anſwer thereof is 2 *s.* 3 *d.* ½ and $\frac{2}{9}$.

Again if 5 ℔. coſts 45 *s.* What coſts 1 ℔.

Since 5 is half of 10, the double of the tenth part of the given price, *viz.* 10 *s.* 9 *d.* ¾, 9 is the ſum required,

Again if 1 ℔. coſts 18 *d.* What will 19 ℔. coſt?

Since 19 = 20 — 1; from the given price doubled and increaſed by a cypher, *viz.* 360, ſubtract the ſimple 18, the remainder is 342 *d.* = 28 *s.* 6 *d.* the ſum required.

7. If two terms of the ſame denomination differ by an unit, we have a peculiar kind of compound, which will be clear from the following examples, *e. gr.*

If 5 ℔. coſts 30 *s.* What will 4 ℔. coſt?

Since the price of 4 *lb.* is one fifth part ſhort of that of 5 *lb.* divide the given price 30 by 5; the quotient 6 being ſubtracted from the dividend, the remainder, *viz.* 24 *s.* is the ſum required.

Again, if 8 *lb.* coſts 24 *s.* What coſts 9 *lb?*

Since the price of 9 *lb.* exceeds that of 8 by one eighth part; divide the given price 24 by 8, and add the quotient 3 to the dividend; the ſum 27 is the anſwer.

8. Sometimes one may uſe ſeveral of theſe compounds or practices in the ſame queſtion, *e. gr.*

If 100 *lb.* coſts 30 *s.* 4 *d.* What coſts 50 *lb.*?

2)

makes 15 *s.* 2 *d.*

Again 60 *lb.* coſts 4 *s.* What coſts 2520 *lb.*?

6	42
24	6
7	7
186 *l.*	

The RULE of THREE INVERSE, is where the natural order of the terms is inverted. As if 100 workmen build a houſe in 2 years, in how long a time will 200 workmen build the ſame?

But there is no neceſſity for making a particular *Rule* for the matter; this coming naturally enough under the former, by only ranging the terms as the nature of the queſtion requires. Thus, it is evident, that as the number of men 200 is to 100, ſo is the ſpace 2 years, wherein 100 build the houſe, to the ſpace wherein 200 will build the ſame. For the leſs time the more hands are required; the queſtion then will ſtand thus:

100 M. ——— 2 Y. ——— 200 M.

2

200)200(1 Year.

COMPOUND RULE of THREE, or *Rule of five Numbers*, is where two *Rules of Three* are required to be wrought, before the number ſought be found. As if 300 *l.* in 2 years yield 30 *l.* intereſt, how much will 1000 *l.* yield in 12 years?

Here the firſt thing to be done is to find by the *Rule of Three*, what intereſt 1000 *l.* will give in 2 years; and then by the ſame *Rule* what it will give in 12 years?

This is conſidered by the writers, &c. of *Arithmetick*, as a particular *rule*, but without any neceſſity; a double operation ſolving it better, as in this example:

300 *l.* ——— 30 *int.* — 1000 *l.*

30

3|00)3000|0(100 *int.*

2 Y. ——— 100 *l.* ——— 12

12

2)12000(600 *int.*

But in queſtions of this kind a ſingle *Rule of Three* may do the buſineſs: for 300 *l.* give the ſame intereſt

intereſt in 2 years, which twice 300 give in one year; and 12 times 1000 *l.* give the ſame intereſt in one year, that 1000 give in 12: omitting therefore the circumſtances of time ſay, if twice 300 (that is 600) give 36 *l.* intereſt (in one year) what will 12 times 1000 (that is 12000) give (in one year)?

600 ——	36 ——	12000
		36
		72000
		36000
		6|00)4320|00)720 *l. int.*

Rules of Practice.

The even Parts.

Of a Pound.			*Of a Shill.*		*Of a Hund.*	
s.	*d.*	*l.*	*d.*	*s.*	*lb.*	*C.*
10	0 is	$\frac{1}{2}$	6 is	$\frac{1}{2}$	56 —	$\frac{1}{2}$
6	8 —	$\frac{1}{3}$	4 —	$\frac{1}{3}$	84 —	$\frac{3}{4}$
5	0 —	$\frac{1}{4}$	3 —	$\frac{1}{4}$	28 —	$\frac{1}{4}$
4	0 —	$\frac{1}{5}$	$1\frac{1}{2}$ —	$\frac{1}{8}$	14 —	$\frac{1}{8}$
3	4 —	$\frac{1}{6}$	1 —	$\frac{1}{12}$	16 —	$\frac{1}{7}$
2	6 —	$\frac{1}{8}$	—		8 —	$\frac{1}{14}$
2	0 —	$\frac{1}{10}$	—		7 —	$\frac{1}{16}$
1	8 —	$\frac{1}{12}$	—			

When the given price is pence, take your parts in ſhillings, the product divided by 20 gives the anſwer in pounds.

Or, you may bring it into pounds at once, by cutting off the laſt figure, and by conſidering that 240 pence is one pound, whereof 8 *d.* is $\frac{1}{30}$, 6 *d.* is $\frac{1}{40}$, 4 *d.* $\frac{1}{60}$, 3 *d.* is $\frac{1}{80}$, 2 *d.* is $\frac{1}{120}$.

		Example.	*d.*	71|6 *Ells* at 3 *d.*
		254 *lb.* of Tobacco at 1 *d.*	$3\frac{1}{80}$	*s.* - *d*
1	$\frac{1}{12}$	2|1 - 2*d.*		*l.* 8 - 14 - 0 *Facit.*
	l.	1 - 1 - 2 *Facit.*	*d.*	251 *lb.* at 4*d.*
		254 *lb.* at 2*d.*	$4\frac{1}{60}$	*s.* *d.*
				4 - 11 - 8 *Facit.*
2	$\frac{1}{6}$	4|2 - 4	*d.*	643 *Gal* at 6*d.*
		2 - 2 - 4 *Facit.*	$6\frac{1}{40}$	*l* 16 - 1 - 6 *Facit.*

The three laſt examples are brought into pounds at one operation, after which manner any ſum in practice may be readily caſt up.

Here you may ſee that 254 pounds of tobacco, at 1 *d.* a pound, divided by the $\frac{1}{12}$, gives 21 *s.* 2 *d.* and that divided by 20 (by cutting off the laſt figure, and taking $\frac{1}{2}$ of it,) gives 1 *l.* 1 *s.* 2 *d.* the price of 254 pound of tobacco; and for 2 *d.* a pound take the $\frac{1}{6}$, becauſe 2 *d.* is the $\frac{1}{6}$ part of a ſhilling, and for 3 *d.* a pound take $\frac{1}{4}$; and ſo for the others at 4 *d.* and 6 *d.*

When the given price is ſuch pence as are an even part of a ſhilling, take firſt the greateſt even part of a ſhilling, and then part of that part: add them together, and divide the product by 20, or cut off the laſt figure, and take $\frac{1}{2}$.

d.	2121 Ells at 5 *d.*	748 *lb.* at 7 *d.*
$4\frac{1}{3}$	707 *s.*	6 *d.* is $\frac{1}{2}$ or 374
$1\frac{1}{4}$	176 - 9 *d.*	of which 1 or $\frac{1}{6}$ is 62 - 4
5	88|3 - 9	436
	44 - 3 - 9 *Facit.*	£. 21 - 16 - 4

245 *lb.* of Tobacco at 9*d.* and 10 $\frac{3}{4}$ a *lb.*

d.			254 at 10 *d.* $\frac{3}{4}$.
$6\frac{1}{2}$	127	*d.*	
$3\frac{1}{2}$	63 - 6	$6\frac{1}{2}$	127 Sh. in 254 ſix pences.
		$4\frac{1}{3}$	84—8 in 254 groats.
$6\frac{1}{4}$	19|0 - 6	$\frac{1}{2}\frac{1}{8}$	10—7 in 254 half-penc.
		$\frac{1}{4}\frac{1}{2}$	5—$3\frac{1}{2}$ in 254 farthings.
	9 - 10 - 6 *Fac.*		22|7 - 6 $\frac{1}{2}$
			11|7 - 6 $\frac{1}{2}$ *Facit.*

Demonſtration. In 254 pounds of tobacco at 10 *d.* $\frac{3}{4}$ a pound, there muſt be 254 ſix-pences, which is 127 ſhillings and 254 groats, which is 84 *s.* 8 *d.* and 254 half-pence, which is 10 *s.* 7 *d.* and 254 farthings, which is 5 *s.* 3 *d.* $\frac{1}{2}$; all theſe added together, make 227 *s.* 6 *d.* $\frac{1}{2}$, which divided by 20, gave the *facit* 11 *l.* 7 *s.* 6 *d.* $\frac{1}{2}$

	614 *lb.* at 11 *d.*		1563 *lb.* at 11 *d.* $\frac{1}{2}$
$6\frac{1}{2}$	307	6 $\frac{1}{2}$	281 - 6 *d.*
$4\frac{1}{3}$	204 - 8 *d.*	4 $\frac{3}{4}$	187 - 8
$1\frac{1}{4}$	51 - 2	$1\frac{1}{2}$ $\frac{1}{4}$	70 - 4 $\frac{1}{2}$
11	56|2 - 10		53|9 - 6 $\frac{1}{2}$
	28|2 - 10 *Facit.*		26 - 19 - 6 $\frac{1}{2}$ *Facit.*

If the given price be any number of pence above 1 *s.* and leſs than 2 *s.* take the aliquot parts in pence (as in the laſt precedent) to which add the given quantity for the 1 *s.* and proceed as before.

Example.

		254 *lb.* at 15 *d.*		254 at 17 *d.*
3	$\frac{1}{4}$	63 - 6	$4\frac{1}{3}$	84 - 8
			$1\frac{1}{4}$	21 - 2
		31|7 - 6		35|9 - 10
		15 - 17 - 6 *Facit.*		17 - 19 - 10 *Fac.*

	264 *yds.* at 18 *d.*
$\frac{1}{2}$	132
	39|6
	19 - 16 - 0 *Facit.*

	295 *Gall.* at 19 *d.*
$\frac{1}{2}$	147 - 6
$\frac{1}{6}$	24 - 11
	46|7 *s.* - 5 *d.*
	23 - 7 - 5 *Facit.*

	672 *lb.* at 20 *d.* $\frac{1}{4}$
$\frac{1}{2}$	336
$\frac{1}{3}$	224
$\frac{1}{8}$	42
	1274
	63 - 14 - *Facit.*

	456 *Ells* at 21 *d* $\frac{1}{4}$
$\frac{1}{2}$	228
$\frac{1}{3}$	152
$\frac{1}{4}$	38
$\frac{1}{4}$	9 - 6
	88|3
	44 *l.* 3 - 6 *Facit.*

In 672 *lb.* at 22 *d.* $\frac{3}{4}$ a *lb.* I take $\frac{1}{2}$ for 6 *d.* the $\frac{1}{3}$ for 4*d.* and the $\frac{1}{8}$ for the $\frac{3}{4}$. because $\frac{3}{4}$ is the $\frac{1}{8}$ of 6 *d.* by which you will find that in 672 sixpences there is 336 shillings, and in 672 groats there is 224 shillings, and in 672 three farthings there is 42 shillings.

If the given price be such shillings as are an even part of a pound *Sterling*, take such a part of the given quantity, and the *quotient* is pounds.

	Ells. s. d.
	433 at 1 - 8
$\frac{1}{12}$	*l.* 36 - 1 - 8 *Facit.*
	674 at 2 *s.* 6 *d.*
$\frac{1}{8}$	84 - 5 - 0 *Facit.*

	Yards.
	271 at 2 *s.*
$\frac{1}{10}$	27 - 2 - 0 *Facit.*
	495 at 3 *s.* 4 *d.*
$\frac{1}{6}$	82 10 - 0 *Facit.*

	Crowns.
	457 at 5 *s.*
$\frac{1}{4}$	114 - 5 - 0 *Facit.*
	295 at 6 *s.* 8 *d.*
$\frac{1}{3}$	98 - 6 - 8 *Facit.*

	Dollars.
	612 at 4 *s.*
$\frac{1}{5}$	122 - 8 - 0 *Facit.*
	372 at 10 *s.*
$\frac{1}{2}$	186 - 0 - 0 *Facit.*

In this first Example of 433 Ells, at 1 *s* 8 *d.* I take the $\frac{1}{12}$, because 1 *s.* 8 *d.* is the $\frac{1}{12}$ of 2 *l.* and say, 12 in 43 is 3 times, rest 7, which makes the 3 to be 73, then 12 in 73, is 6 times, rest one, which is 1 *s.* 8 *d.* which I put down as above.

If the given price be such shillings and pence as are no even parts of a pound, multiply the given quantity by the number of shillings, and take the *aliquot* parts of pence, and proceed according to the second rule.

	Ells.
	375 at 8 *s.* 6 *d.*
	8
	3000
$\frac{1}{2}$	187 - 6
	318|7 - 6
	159 - 7 - 6 *Facit.*

	Ells.
	493 at 15 *s.* 10 *d.*
	15
	2465
	493
$\frac{1}{2}$	246 - 6 *d.*
$\frac{1}{3}$	164 - 4 *d.*
	780|5 - 10
	390 - 5 - 10 *Facit.*

	C. s. d.
	295 at 12. - 9
	12
	3540
$\frac{1}{2}$	147 - 6
$\frac{1}{2}$	73 - 9
	376|1 - 3
	188 - 1 - 3 *facit.*

	C. s. d.
	214 at 7. - 11.
	7
	1498
$\frac{1}{2}$	107
$\frac{1}{2}$	53 - 6
$\frac{1}{3}$	35 - 8
	169|4 - 2
	84 - 14 - 2 *Facit*

If your given price be any number of pounds, shillings and pence; reduce first your pounds and shillings into shillings, and proceed according to the last rule.

	Pieces l. s. d.
	754 at 4 — 3 — 7
	83 20
	2262 83
	6032
$\frac{1}{2}$	377
$\frac{1}{6}$	62 - 10
	6302|1 - 10
	3151 - 1 - 10 *Facit.*

	Tun. l. s. d.
	176 at 3—7—10
	67 20
	1232 67
	1056
	11792
$\frac{1}{2}$	88
$\frac{1}{3}$	58 - 8
	1193|8 - 8
	596 - 18 - 8 *Facit.*

If your given price be any number of pounds, and exceeding five pounds, then multiply your given quantity by the number of the pounds, and take your *aliquot* parts in shillings and pence, *viz.*

		C. l. s. d.
		74 at 11 —12—6
		11
s.		814
10	$\frac{1}{2}$	37 *d.*
$2\frac{1}{2}$	$\frac{1}{4}$	9 - 5 - 0
		860 - 5 - 0 *Facit.*

	hheads. l. s. d.
	394 at 16—16—3
	16
	2364 } at 16 *l.*
	39 }
	197 at 10 *s.*
$\frac{1}{2}$	98 - 10 at 5
$\frac{1}{4}$	19 - 14 at 1
$\frac{1}{3}$	4 - 18 - 6 at 3 *d.*
	6624 - 2 - 6 *Facit.*

If

If the given quantity be any number of *C. qrs.* or *pounds*, or *tuns C. qrs.* and *pounds*, &c. work as before, where no part is, and take your *aliquot* parts in *quarters* and *pounds*, or in *C. qrs.* and *pounds*, and add them to your firſt work. An Example or two will make this plain

	C.	s.	d.
	75 ½ at 22 - 6		
	22	11 - 3	
	150		
	150		
⅓	37 - 6		
	11 - 3		
	1691 8 - 9		
	84 - 18 - 9 *Facit*		

	C.	s.	d.
	63 ¾ at 12 - 11		
	12 Mult.		
	756 *s.*		
½	31 - 6 *d.*		
⅓	21		
	9 - 7 ½ *C.*		
	818 - 1 ½ *Sum.*		
l.	40 - 18 - 1 ½ *Facit.*		

In the *Example* of 63 *C* ¾ at 12 *s.* 11 *d.* the *C.* weight, I multiply the *C.* by 12 *s.* and take the parts in pence for the odd pence, then for the ¾ of *C.* I firſt take the ½ of the price of a *C.* and that makes 6 *s.* 5 *d.* the price of ½ a *C.* and then I take the ½ of that which gives 3 *s.* 2 *d.* ½. the price of a *qr.* of a *C.* Add them together, it gives the price of ¾ of a *C.* which is 9 *s.* 7 *d.* ½. and muſt be added to your firſt work.

Of Fellowship or Company.

Fellowship is a rule of great uſe in balancing accounts amongſt partners, or where two or more have a joint ſtock and trade together, in order to aſcertain the proportion of profit and loſs to each party.

Fellowship is either *with* or *without time.*

Queſtions *without time*, or in the *ſingle rule of Fellowſhip*, as it is frequently called, are wrought by the following proportion.

As the whole ſtock to the whole gain or loſs, ſo is each man's particular ſtock to his particular ſhare of gain or loſs.

Example.

A, B, and C make a joint ſtock: A puts in 460 *l.* B 510 *l.* and C 480 *l.* they gain 340 *l.* what part of it belongs to each ?

In order to the ſolution of this queſtion, find the total of their joint ſtock, *viz.*

A's ſtock 460 *l.* + B's ſtock 510 *l.* + C's ſtock 480 *l.* = 1450 *l.* the total ſtock. Then 1. To find A's ſhare of the gain, ſtate as follows: If 1450 *l.* : 340 *l.* : : 460 *l.* which being worked by the Rule of Three, the anſwer will be 107 *l.* 17 *s.* 2¾ *d.* for A's ſhare of the profit.

2. B's ſhare of the gain, by ſtating thus, if 1450 *l.* : 340 *l.* : : 510 *l.* and working by the Rule of Three, will be found to be 119 *l.* 11 *s.* 8½ *d.*

3. C's ſhare will appear 112 *l.* 11 *s.* 0¼ *d.* when worked as before, after having ſtated thus. If 1450 *l.* : 340 *l.* : : 480 *l.*

Again, ſuppoſe three partners, A, B, and C make a joint ſtock in this manner: A puts in 24 *l.* B. 32 *l.* and C 40 *l.* in all 96 *l.* with which they trade, and gain 12 *l.* required each man's true ſhare of that gain? The firſt operation for A's part of the gain will ſtand thus,

96 *l.* : 12 *l.* : : 24 *l.* : 3 = A's gain.
96 *l.* : 12 *l.* : : 32 *l.* : 4 = B's gain.
96 *l.* : 12 *l.* : : 40 *l.* : 5 = C's gain.

Proof 3 *l.* + 4 *l.* + 5 *l.* = 12 *l.* the whole gain. That is, if the total of all their *particular* gains amounts to the *whole* gain, the work is true; if not, ſome miſtake has been committed.

Fellowship *with Time*, (uſually called the *Double Rule of Fellowſhip*, becauſe every man's money is to be conſidered with relation to the time of its continuance in the joint ſtock) is worked thus, Multiply each man's ſtock by the reſpective time he puts it in for, and add all the products; the total of which muſt be your firſt number through all the ſtatings: the gain or loſs the ſecond, as before; and each man's particular ſtock multiplied by its time, the third.

Note, All the particular times (if not ſo given) muſt be *reduced* into one denomination, *i. e.* all years, all months, all weeks, or all days, *&c.* See Reduction.

Example I.

A put into company 560 *l.* for eight months, B 279 *l.* for ten months, and C 735 *l.* for ſix month; they gained 1000 *l.* What ſhare of it muſt each have? For the ſolution of this queſtion proceed as follows.

A's ſtock 560 *l.* × 8 its time = 4480, B's ſtock 279 *l.* × 10 its time = 2790, C's ſtock 735 *l.* × 6 its time = 4410. Then 4480 + 2790 + 4410 = 11680.

Now, 1. To find A's ſhare of the profit, ſtate thus. If 11680 *l.* : 1000 *l.* : : 4480 *l.* which being worked by the *Rule of Three*, the anſwer will be 383 *l.* 11 *s.* 2¾ *d.* for A's ſhare of the gain.

2. For finding B's ſhare, ſtate thus, if 11680 *l.* : 1000 : : 2790 *l.* and working as before directed, the anſwer will be 238 *l.* 17 *s.* 4¾ *d.*

3. To find C's proportion of the gain, ſay, if 11680 *l.* : 1000 *l* : : 4410 *l.* then working it by the *Rule of Three*, the true amount of his ſhare will appear to be 377 *l.* 11 *s.* 4¼ *d.*

Ex-

Example II.

Three merchants, A, B, and C, enter into partnership thus; A puts into the stock 65 *l.* for eight months; B puts in 78 *l.* for twelve months; and C puts in 84 for six months. With this joint stock they traffic, and gain 166 *l.* 12 *s.*

It is required to find each man's share of the gain proportionable to his stock and time of employing it.

1. A's stock 65 *l.* × 8 months, the time it was employed = 520
2. B's stock 78 *l.* × 12 months, the time it was employed = 936
3. C's stock 84 *l.* × 6 months, the time it was employed = 504

The sum of all those products is 1960

Then, as before, the several proportions will stand thus:

1960 : 166,6 : : 520 : 44, 2 = 44 *l.* 4 *s.* for A's share.
1960 : 166,6 : : 936 : 79,56 = 79 *l.* 11 *s.* 2½ *d.* for B's share.
1960 : 166.6 : : 504 : 42,84 = 42 *l.* 16 *s.* 9½ *d.* for C's share.
The whole gain = 166 *l.* 12 *s.*

Of Barter.

Barter is the *exchanging* of *wares* for *wares*, or one commodity for another.

Two merchants barter. A. has 3 *C* 2 *qrs.* of pepper at 13 *d.* ½ *per lb.* B has ginger at 15 *d.* ¼ *per lb.* I would know how much ginger must be delivered for the pepper. The process is thus:

1. If 1 *lb.* of pepper costs 13 *d.* ½. What will 3 *C.* 2 *qrs.*?

13 *d.* ½	3 *C.* 2 *Qrs.*
4	4
54	14
	28
	112
	28
12	392
4)21168(5292(44|1	54
48 . . 22|1	1568
49	1960
48	21168
12 *Answer* 22 *l.* 1 *s.*	
12	
0 Pepper.	

2. If 15 *d.* ¼ buys 1 *lb.* of ginger, what will 22 *l.* 3 *s.*

4	20
61	443
	12
61)21264(348 + $\frac{36}{61}$ *lb.* Ginger.	5316
183 . .	4
296	21264
244	
524	
488	
36	

Answer 348 = $\frac{36}{61}$ Pounds of Ginger must be delivered for the Pepper.

Another Example.

A has 100 pieces of silk, which are worth but 3 *l.* a-piece in ready money, yet he barters them with B at 4 *l.* *per* piece, and at that rate takes their value of B in wools at 7 *l.* 10 *s.* *per C.* which are worth but 6 *l.* *per C.* in ready money: the question will be to know what quantity of wool pays for the silks, and which of the two, A or B is the gainer, and how much?

To which I answer 53 *C* ⅓ of wool pay for the silk, and A gains 20 *l.* in money by the barter. Demonstrated thus:

1. If

	l.	*s.*		*l.*		*l.*
1. If	7	10	—————become	6,	what will	400?
					Facit	320

	l.		*lb.*		*l.*
2. If	6	ready money buys	1	of wool, what will	320

ready money?

Anſwer. 53 *C.* $\frac{1}{4}$ of wools.

So it is evident that the true weight of the wool which B. delivered was 320 *l.* for which he received only of A. the worth of 300 *l* in ſilks, and therefore B. looſes 20 *l.* by the *barter*.

Rebate, is alſo a very uſeful rule of *Arithmetic.* *Rebate* is the payment of ſo much ready money, in lieu of a ſum due at any time to come, which put forth at intereſt for any ſuch time, would become equal to that ſum, ſo due, at any time to come. For Example:

A merchant, who is to receive 1680 *l.* at 9 months end, deſires to have his money immediately paid him, for which courteſy he is willing to abate 8 *per cent. per Ann.* intereſt; the queſtion is to find how much preſent money is equivalent to 1680 *l.* rebating 8 *l.* *per Cent.* The rule is thus:

As 1 year or 12 months, or 365 days, is to the rate of intereſt propoſed, ſo is the time propoſed the third term, to find the fourth number ſought.

	Months	*l.*	Months.
So if	12———	8———	—9

makes 6 *l.*

	l.		*l.*		*l.*
Then if	106	*Rebate* come from	100,	what will	1680?
					100
					168000

l.

106)168000(1584 + $\frac{96}{106}$
106 ...

620
530

900
848

520
424

96

	l.	*s.*	*d.*
Anſwer	1584	18	6 $\frac{3}{4}$

	l.	*d.*
$\frac{96}{106}$ *Facit*	18	6 + $\frac{3}{4}$

Which ſaid 1584 *l.* 18 *s.* 6 *d.* $\frac{3}{4}$. which is the preſent money the merchant muſt receive, being deducted from 1680, there remains the money rebated, *viz.*

l.	*s.*	*d.*	
95	1	5 $\frac{1}{4}$	
l.	*s.*	*d.*	
1680	00	0	
1584	18	6 $\frac{3}{4}$	Subtract
95	1	5 $\frac{1}{4}$	Money rebated.

Queſt. 2. How much preſent money is equivalent to a rent or annuity of 100 *l.* a year to continue five years, *rebate* being made at the rate of 6 *l.* for 100 *l.* for one year ſimple intereſt?

1	106	100	100	*facit*	94	06	0
2	112	100	100	*facit*	89	05	6
3	118	100	100	*facit*	84	08	0
4	124	100	100	*facit*	80	12	2
5	130	100	100	*facit*	76	18	1 $\frac{1}{2}$
				very near	425	19	9 $\frac{1}{2}$

So that by this queſtion it is manifeſt there muſt be computed the preſent worth of 100 *l.* due at the firſt year's end; alſo the preſent worth of 100 *l.* due at the ſecond year's end; and in like manner, the third, fourth, and fifth years, all which preſent particular worth being added together, the ſum will be the total above propounded, *viz.*

	l.	*s.*	*d.*
very near	425	19	9 $\frac{1}{2}$

This Rule leads us naturally into what is called *Intereſt.*

Of Interest.

Interest is the premium or money paid for the loan or uſe of money; and is either *ſimple* or *compound.*

Simple Interest is that counted from the principal only. This is eaſily computed by the *Golden Rule*, either *ſimple* or *compound*, thus:

Let that which is the principal cauſe of the *Intereſt* be put in the firſt place, that which betokeneth time in the ſecond place, and the remaining in the third. Under this conditional part place the two other terms, each under its like, and there will be a blank to ſupply under one of thoſe above, either under the firſt, ſecond, or third.

	Months.	*l.*
100	12	6
50	3	

Here the blank will be under the third place, multiply the three last for a dividend, and the two first for a *divisor*, the *quotient* of these gives the sixth; that is, $6\times 50\times 3=900$, and $100\times 12=1200$, now $1200)90000(75=15s.$ required.

If the demand had been, in how many months would 50*l.* have gained 15*s.* or if 100*l.* in twelve months gains 6*l.* what shall the principal be that in three months would gain 15*s.* In these cases the blank would have been under the first or second term; then by another rule, multiply the first, second, and last for a dividend, and the third and fourth for a *divisor*; the *quotient* is the answer.

l.	Months	*l.*
100	12	6
	3	75=15*s.*

Then by the rule $100\times 12.\times .75=90000$ and $6\times 3=18)900.(50\,l.$ required.

This *Rule* shews *Simple Interest*, and all that belongs to it, with ease, and was thus found: put P for the Principal, T for the Time, and G for the Gain in the Conditions, and $p\ t\ g$ answering, it will be $P:G::t:p:\frac{GP}{P}$ and $T:Gp::t\ \frac{Gpt}{TP}=g$, which is the first rule; that is, multiply the three last for a dividend, and the two first for a divisor, and because $\frac{Gpt}{TP}=g$, therefore $Gtp=Tpg$, and consequently $t=\frac{TPg}{GP}$ and $p=\frac{TPg}{Gt}$, which is the second rule.

Compound Interest, is that which is counted both from the principal, and the *simple Interest* forborn, called also *Interest* upon *Interest*.

This sort of *Interest* is commonly worked by *decimal Arithmetick*; but for the better understanding of it I shall state a few questions, to be performed by *vulgar Arithmetick*. For example:

If 300*l.* be put out at 6*l. per Cent. per Ann.* reckoning interest upon interest, what money must I receive then?

l. *l.*
300 at 6 *per Cent.*
6
18|00

l.	*s.*	*d.*	
300	00	0	Principal
18	00	0	Interest
318	00	0	Increase the first Year.

l. *s.* *d.* *l.*
318 00 0 at 6
6
19|08 00 6
|20
1|00
|12
7|20
|4
0|80

l.	*s.*	*d.*	
318	00	0	
19	01	7	
337	01	7	Increase the 2d Year.

l. *s.* *d.* *l.*
337 1 7 at 6 *per Cent.*
6
20|22 9 6
|20
4|49
|12
5|94
|4
3|76

l.	*s.*	*d.*	
337	1	7	
20	4	6 ¾	
357	6	0 ¼	Increase Third.

l. *s.* *d.* *l.*
357 6 0 ¼ at 6 *per Cent.*
6
21|43 16 4 ½
|20
8|76
|12
9|16
|4
0|65

l.	*s.*	*d.*	
357	06	0 ¼	
21	08	9	
378	14	9 ¾	Fourth Year.

So that at the fourth year's end he must receive for principal and interest 378*l.* 14*s* 9*d.* ¾.

The

This way of operation is more compendious than by the *Rule of Three*.

First state your question as before. If 100*l.* gain 6*l.* what will 300*l.* your principal? Multiply first your principal by your interest; that done, cut off the two first figures towards your right hand of the pounds with a line. Then multiply them by 20, 12, and 4, and all above two figures towards your right hand, carry over the line to the left, as you see in the above-mentioned example.

Thus much for *Simple* and *Compound Interest* till we come to *Decimal Arithmetick*.

Of Exchange.

Exchange implies the trade of money carried on between one nation and another, by means of *Bills of Exchange*.

Example.

A merchant delivered 530*l.* *sterling* in *London*, at 20*s* *per l.* to receive the same, by a *Bill of Exchange*, at *Amsterdam*, the exchange at thirty-three shillings and four pence *Flemish*, for a pound *sterling*, I demand the same in *Flemish* money.

Note, That in the stating of your question, your first and third numbers must be both of one kind; if the first be *sterling* money, the third must be *sterling*; if the first be *Flemish*, the third must be *Flemish*. Therefore I ask

If 20*s* sterl. give 33*s*. 4*d*. what will 530*l*. sterl.?

```
    s.          s.  d.              l.
If 20 ———————— 33   4 ———————————— 530
               12                   20
             ————                 ——————
              400                 10600
             ————                   400
                                ———————
                                4240000
                                ———————

                12
20)4240000(212000(1766|6
   40 . . . . 12 . . . .  ————————
   ——         ——          883|6  8
   24         92          ————————
   20         84
   ——         ——
   40         80
   40         72
   ——         ——
    0         80
              72
              ——
              80
              72
              ——
               8
              ——
```

Answer *Flem.* 883 *l.* 6 *s.* 8 *d.*

Or thus shorter:

```
      l.      s.  d.
3)  530  at  33   4
     33
   —————
   1590
  1590
  ——————
  17490
    176     8
  ——————————
  1766|6    8
  ——————————
   883|6    8
```

I ask farther at what rate when the *Exchange* from *London* to *Rotterdam*, when I delivered 700 pounds *Sterling* in *London*; and received in *Rotterdam* 1010 *l. Flemish*?

If 700 *l. Sterling* make 1010 *l. Flemish*, what will 20 *s. Sterling*?

```
                                l.  s.  d.
Facit per Rule of Three         1   8   10 1/4

        l.    l.  s.  d.
Proof  700 at 1   8   10 3/4
        1
 2/5)700     0   0    0      8 s. 2/5 of a l. Sterling.
   8)140     0   0    0      6 d. 1/8 of 4 s.
   8)140     0   0    0      3 d. 1/2 of 6 d.
   2) 17     0   0    0      1 d. 1/2 1/2 of 3 d.
       8    15   0    0      1/4 1/5 of 1 d. 1/2.
       4     7   6    0
       0    14   7    0
  ———————————————————————
    1011     7   1    1 Small difference.
```

Of Alligation.

Alligation is the *Rule of Mixture*, teaching to compound several species of ingredients or commodities together, according to any intent or design proposed; and is either *medial* or *alternate*.

Medial *Alligation* shews the rule or price of mixtures, when the several quantities of the mixture and their several values are known.

To work this rule, multiply the ingredients severally by their own prices, and divide the sum of those *Products* by the sum of the ingredients, the *Quotient* answers the question.

Therefore repeating again the above-faid example, I demand how much that miftling is worth? Thus according to *rule*.

s.	*d.*	*s.*	*s.*	*d.*	
2	8	2	13	4	
5		9	18	0	add
13	4	18	31	4	
			12		
			376		Dividend.

5 Bufhels of Wheat
9 Bufhels of Rye
— add
14 Divifor

Then 376 divide by 14. *Anfwer*, 2 *s.* 2 *d.* $\frac{3}{4}$.

```
          12 s. d.
14)376(26| 2  2 + 12/14 or 6/7
    98 · 24
    ---  --
    96   2
    84   —
    --
    12
```

So that I conclude that a bufhel of that miftling may be afforded for 2 *s.* 2 *d* $\frac{6}{7}$, or $\frac{3}{4}$ *farth.* Which is the refolution of the queftion propofed.

In *Alligation medial*, the *proof* of the work is by comparing the total value of the feveral fimples, with the value of the whole mixture; and when thofe fums agree, the operation is perfect; fo as in this example.

	s.	*d.*	
5 Bufhels of Wheat at 2 *s.* 8 *d.* is	13	4	add
9 Bufhels of Rye at 2 *s.*	18	0	
all which amounts unto	31	4	

which is likewife the value of 14 bufhels of wheat at 2 *s.* 2 *d.* + $\frac{3}{4}$. For by the *Rule of Three*, if 1 bufhel coft 2 *s.* 2 *d.* + $\frac{3}{4}$ what will 14 bufhels? *Anfwer*, 31 *s.* 4 *d.* with the fraction $\frac{6}{7}$, or $\frac{3}{4}$ *farth.*

The nature, quality, &c. of the feveral ingredients of a mixture being given, to find the temperament, or degree of finenefs refulting from the whole. Place the feveral quantities of the mixture in rows; againft which, place the feveral qualities or finenefs; then as the fum of the quantities is to their product, fo is the unity to the quality or finenefs of the mixture. For example.

A Goldfmith has 8 ℔. weight of filver bullion of 7 *oz.* fine, 15 ℔. of 8 *oz.* $\frac{1}{2}$ fine, and 13 of 10 *oz.* fine, and he would melt altogether, and know what finenefs a pound weight of that mafs would come to?

℔. *oz.*	℔. *oz.*	℔. *oz.*
8 of 7	2)15 of 8 $\frac{1}{2}$	13 of 10
7	8	10
56	120	130
	7 $\frac{1}{2}$	
	127 $\frac{1}{2}$	

add	56		8
	127 $\frac{1}{2}$		15
	130		13
	313 $\frac{1}{2}$		36
	2		2
Dividend	627	Divifor	72

```
      oz.                           pwt. gr.
72)627(8 + 51/72 or 17/24 makes 14   4
   576
   ---
    51
```

Anfwer, the mafs muft be 8 *oz.* 14 *pwt.* 4 *gr.*

Given the total of a mixture with the whole value; and the value of the feveral ingredients, to find the feveral quantities mixed though unequally, Multiply the total of the mixture by the leaft value. fubtract the product from the total value; and the remainder is the firft dividend. Then take the faid leaft value from the greateft valued ingredient, and the remainder is the firft divifor. The quotient of this divifion fhews the quantity of the higheft priced ingredient, and the other is the compliment of the whole. And when more ingredients than two are in the compofition, the divifors are the feveral remains of the leaft value, taken from the other: The dividends are the remains left upon the divifions, till none remain there; which will be one fhort of the number of ingredients; and this defective ingredient is to be fupplied as a complement; and in divifion no more muft be taken in every quotient, than that there may remain enough for the other divifors; and the laft to leave nothing remaining.

ALLIGATION *Alternate*, is when the rates or qualities of feveral fimples are given; and the quantity of each is required neceffary to make a mixture of the given rate or quality. *Alligation Alternate*, fhews the due proportion of feveral ingredients; and counter-changes the places of fuch exceffes or differences as arife between the mean price and the extremes;

extremes; ascribing that to the greater extreme, which proceeds from the lesser; and contrarily.

The Rules which obtain in *Alligation Alternate* are these.

First, You must set down the numbers of which you will make the *Alligation*, orderly one under the other: and the common number whereinto you must reduce them, set on the left hand. Then note which of the said numbsrs are lesser than that common number, and which of them be greater, and with a draught of your pen link two numbers together; so that the least number may be still linked with the greatest, and the greatest with the smallest. Then add up all these differences into one total, which shall be the first number in the *Rule of Three*, and the second number the common number, then the third must be each difference done by itself. For example:

A Vintner has four sorts of low wine of four several prizes; the first at 8 *d. per* gallon, the second at 10 *d. per* gallon, the third at 15 *d. per* gallon, and the fourth at 18 *d. per* gallon: now he would mix all these sorts together, that a gallon of these (lower, decay'd) wines may be worth 12 *d.* the puncheon holding 84 gallons, Then:

$$12\left\{\begin{array}{l|r} 8 & —6 \\ 10 & —3 \\ 15 & —2 \\ 18 & —4 \\ & \overline{15} \end{array}\right.$$

Gall.
If 15——84——6
Makes $33 + \frac{3}{5}$ of the first sort.

Gall.
If 15——84——3
Makes $16 + \frac{4}{5}$ of the second sort.

Gall.
If 15 give——84——what will 2?
Makes $11 + \frac{1}{5}$ of the third sort.

Gall.
If 15 give——84——what will 4?
Makes $22 + \frac{2}{5}$ of the fourth sort.

which quantities added up make 84, *viz.*

		Fractions	
add	33	3	5)10(2 for *Fractions.*
	16	4	
	11	1	
	22	2	
	2	—	
	—	10	
for the Proof	84		

Further, A Goldsmith has divers sorts of gold, *viz.* some of 24 caracts, others of 22 caracts others of 18 caracts, and others of 16 caracts fine; is desirous to melt as much of all these four sorts together, as may make a mass of gold to contain 16 ounces of 21 caracts fine. Then he proceeds thus:

$$21\left\{\begin{array}{l|r} 24— & 5 \\ 22— & 3 \\ 18— & 1 \\ 16— & 3 \\ & \overline{12} \end{array}\right.$$

Oz.
If 12——60——5
Makes 25 *ounces* of the first.

Oz.
If 12——60——3
Makes 15 *ounces* of the second.

Oz.
If 12——60——1
Makes 5 *ounoes* of the third.

Oz.
If 12——60——3
Makes 15 *ounces* of the fourth.

which quantities so taken and mixed, make up the mass of 60 *ounces* of 21 caracts fine.

	Oz.	
viz.	25	of the first sort
	15	of the second sort
	5	of the third sort
	15	of the fourth sort
	—	
	60	of 21 caracts fine

Of Position.

When we calculate on several false numbers, taken at random, as if they were true ones; and from the differences found therein, determine the number sought; such rule is called in *Arithmetick* the rule of *False Position.*

Position is either *single* or *double*. *Single Position* is when there happens in the propositions some partition of numbers into parts proportional, in which case the question may be resolved at one operation by this rule. Imagine a number at pleasure, and work therewith, according to the tenor of the question, as if it was the true number; and what proportion there is between the false conclusion and the *false Position*, such proportion the given number has to the number sought, the number sought by argumentation, shall be the first term of the *Rule of Three*; the number supposed the second term, and the given number the third. For example:

Three men build a ship (which cost them 2700 *l.*) *viz. A*, *B*, and *C*, and they so agree that *B* is to pay double what *A* must pay, and *C* triple of what *B* pays: I would know how much every man ought to pay? To resolve this question, I suppose *A* paid 6 *l.* therefore *B* paid 12 *l.* and *C* must pay 36 *l.* But by this *Position* of 6 *l.* + 12 *l.* + 36 *l.* added, makes but

but 54*l.* which by the intent of the question ought to have been 2700*l.* nevertheless by those suppositional numbers I shall discover the true sums which the several parties ought to pay; for I say, by the *Rule of Three*:

```
       l            l.                l.
1st.  As 54 is to —— 6 —— what will 2700
                                       6
                                   -----
                                   16200

              l.
       54)16200(300 A must pay
          162··
          -----
           000

       l.          l.                 l.
2d.  As 54 is to —— 12 —— what will 2700
                                      12
                                   -----
                                   32400

              l.
       54)32400(600 B must pay
          324··
          -----
            00

       l.          l.                 l.
3d.  As 54 is to —— 36 —— what will 2700
                                      36
                                   -----
                                   16200
                                   8100
                                   -----
                                   97200

               l.
       54)97200(1800 C must pay
          54···
          -----
          432
          432
          -----
           00

                     l.
       Proof  A pays   300
              B pays   600
              C pays  1800
                      ----
       Total is       2700 the sum propounded.
```

Farther, A gentleman having about him a certain number of crowns, said, if a fourth, a third, and a sixth of them were added to what he had about him, they would make 45 crowns, what were the number of crowns he had about him? *Answer* 60 crowns. I suppose then he had 24 crowns.

```
                 Crowns.
      1/4 of 24 is 6
      1/3 of 24 is 8
      1/6 of 24 is 4
                   --
  all which make  18
But if 18 come of 24 what will 45 Crowns?
                                24
                               ----
                               180
                                90
                              -----
                         18) 1080 (60 Crowns.
              Crowns         108
  Proof 1/4 of 60 is 15      ---
        1/3 of 60 is 20       0
        1/6 of 60 is 10
                     --
        makes 45 Crowns.
```

The *Double Position* is, when there can be no partition in the numbers, to make a proportion. In this case therefore, you must make a supposition twice; proceeding therein according to the tenor of the question. If neither of the supposed numbers solve the proposition, observe the errors, and whether they be greater or lesser than the resolution requires; and mark the errors accordingly with the signs + and —

Multiply contrarywise, the one position by the other error; and if the errors be both too great, or both too little, *subtract* the one product from the other, and divide the difference of the products by the difference of the errors. But if the errors be unlike, *viz.* one great and the other little, add the products, and divide the sum thereof by the sums of the errors added to the greater; for the proportion of the errors is the same with the proportion of the excesses or defects of the numbers supposed, to the numbers sought. A few Examples will demonstrate this rule to be plain and easy.

Note, That this character — signifies that the lesser of the two numbers, betwixt which it is found, ought to be subtracted from the greater; and that this + intimates that the numbers betwixt which it is found, ought to be added together.

We

We muft obferve farther, that for the operation of this rule, we muft draw two lines a-crofs, and place the terms of the *falfe pofition*, (*viz.* thofe that have the fame denomination) at the uppermoft end of the crofs, and each error under its refpective pofition, at the lower end of the fame crofs.

EXAMPLE.

A certain man being demanded what was the age of his four fons? anfwered that his eldeft was four years older than the fecond; the fecond four years older than the third; the third four years older than the fourth; and the fourth was half the age of the eldeft; We demand then what was the age of each fon?

To anfwer which, fuppofe firft the age of the eldeft 16, then by the queftion, the fecond muft be 12, the third 8, and the fourth or youngeft 4: but it ought to have been 8; fo that it wants 4 of what it ought to be. Therefore make a fecond fup pofition, and take 20 for the age of the eldeft fon, then the age of the fecond will be 16, the age of the third 12, and the age of the fourth or youngeft 8, which fhould have been half 20, fo that it wants 2 of what it ought to have been; fo that in both thefe fuppofitions there are defects, and by confequence alike the fcheme follows:

16 20
48
(24 both defects work accordingly as per rule.
4 — 2
2

16 × 2 = 32

20 × 4 = 80
32 fubtract
48 Dividend

4
2
1 Divifor. 2)48(24 Years of age the eldeft.

Therefore the age of the eldeft is
24 eldeft fon.
20 fecond fon
16 third Son
12 youngeft fon.

Which anfwers the queftion; for 12, the youngeft fon, is half the age of the eldeft, *viz.* 24.

Farther, let it be required to divide 100 *l.* among three perfons, *viz.* A. B. C. in fuch a manner that the fhare of B. may be the triple of the fhare of A. and 4 *l.* over and above; alfo that the fhare of C. may be equal to the fum of the fhares of A. and B. and 6 *l.* over and above. Thus:

Let the firft pofition for the fhare of A. be 12, then B. muft have 40 *l.* and C. 58 *l.* but 12 *l.* 40 *l.* and 58 *l.* is 110 *l.* which is 10 *l.* too much.

12
40
58
110

Then for a fecond Pofition I fuppofe for the fhare of A. 8 *l.* then B. muft have 28 *l.* and C. 42 *l.*; but 8 + 28 + 42 = 78 *l.*; but this 78 *l.* is too little by 22; for if I fubtract 78 from 100, there will remain 22, which is too little; therefore this queftion, by the fuppofitions, proves one too little by 22, and the other fuppofition 10 *l.* too much.

l. 8
28
42
78

264 + 80
12 8
344
10 *l.* + ¾ *lb.* or 10 *l.* 15 *s.*
10 + 22
32

		l.	*s.*
Proof	A.	10	15
	B.	36	5
	C.	53	0
		100	0 Total.

Farther, A man gives away his eftate in this manner, to A. ½ and he gave back 10 *l.* to B. ⅓, and he gave back 6 *l.* and to C. ¼, and he gave back 4 *l.* Laft of all he had 16 *l.* remaining, what was his eftate?

For fuppofition, fuppofe 60, then
60 ½ 30—10=20
60 ⅓ 20— 6=14
60 ¼ 15— 4=11
45

45+16=61, therefore is 1 too much.

Second fuppofition; again, fuppofe 120 *l.* then,
120. ½ 60—10=50
120. ⅓ 40— 2=34
120. ¼ 30— 4=26
110

110+16=126, which is 6 too much.

His Eftate 48 *l.*

Proof.
48. ½ 24—10=14 A.
48. ⅓ 16— 6=10 B.
48. ¼ 12— 4= 8 C.
32+16=48 *l.*

5)240(48 360
20. 90 120
240
40
40
0
4
1 — 6
5

FRACTIONS.

FRACTION in *Arithmetick* is a part or division of an *unit* or *integer*; or a member; which stands to an *unit*, in the relation of a part to its whole.

Fractions are usually divided into *vulgar* and *decimal*.

VULGAR FRACTIONS, called also simply *Fractions*, are always expressed by two numbers, the one wrote over the other with a line between them.

The lower, called the *denominator* of the *Fraction*, denotes the *unit* or whole that is divided into parts; and the upper, called the *numerator of the Fraction*, expresses the parts given in the present cases. Thus two third parts of a line, or other things are wrote $\frac{2}{3}$; where the *denominator* 3 shews that the whole line is supposed to be divided into three equal parts; and the *numerator* 2 indicates or assigns two of such parts.

Again, twenty-nine sixtieths is wrote $\frac{29}{60}$, where the *numerator* 29 expresses 29 parts of an *integer* divided into 60; and the *denominator* 60 gives the denomination to these parts, which are called *sixtieths*.

The real design of adding the *denominator*, is to shew what *aliquot* part the broken number has in common with unity. In all *Fractions*, as the *numerator* is to the *denominator*, so is the *fraction* itself to the whole, whereof it is a *Fraction*. Thus supposing $\frac{3}{4}$ of a pound equal to 15 *s.* it is evident that 3 : 4 :: 15 : 20, whence it follows, That there may be *infinite Fractions* of the same value one with another; in as much as there may be infinite numbers found, which shall have the ratio of 3 : 4.

Fractions are either *propor* or *improper*. PROPER FRACTION, is that where the *numerator* is less than the whole or *integer*, as $\frac{25}{40}$. IMPROPER FRACTION, is where the *nnmerator* is either equal to or bigger than the *denominator*; and of course the *Fraction* equal to or greater than the whole, or *integer*, as $\frac{25}{25}$, or $\frac{25}{20}$, or $\frac{90}{22}$.

Fractions, again, are either *simple* or *compound*. SIMPLE FRACTIONS, are such as consist of only one *numerator*, and one *denominator*, as $\frac{2}{7}$, or $\frac{14}{350}$, &c. COMPOUND FRACTIONS, called also *Fractions of Fractions*, are such as consist of several *numerators* and *denominators*, as $\frac{4}{7}$ of $\frac{11}{12}$ of $\frac{5}{9}$ of $\frac{15}{30}$, &c.

Of *Fractions* those are equal to each other, whose *numerators* have the same ratio to their *denominators*. Those are greater, whose *numerators* have a greater ratio; and those less, which have less: Thus $\frac{3}{6} = \frac{4}{8} = \frac{5}{10} = \frac{25}{50} = \frac{1}{2}$. But $\frac{3}{24}$ is greater than $\frac{2}{6}$; and $\frac{4}{6}$ less than $\frac{10}{18}$. Hence if both the *numerator* and *denominator* of a *Fraction*, as $\frac{4}{6}$, be multiplied or divided by the same number 2; the fact in the former case, $\frac{8}{12}$, and the *quotients* in the latter $\frac{2}{3}$ will constitute *Fractions*, equal to the first *Fraction* given.

The *Arithmetick* of *Fractions* consists in the *Reduction*, *Addition*, *Subtraction*, and *Multiplication* thereof.

The REDUCTION OF FRACTIONS is to bring *integers* into *Fractions*, or contrarywise *Fractions* of divers denominations into one, or what you'll want or desire.

When three or more *Fractions*, which have unequal *denominators*, are given to be reduced, we must multiply the *numerator* of each *Fraction*, and all the *denominators*, except its own, continually one into another; so are the several products, arising from such continual *Multiplication*, a new *numerator*. And by multiplying all the *denominators* together continually, the product is a common *denominator* to all the new *numerators*. Thus are reduced *proper Fractions*. For Example:

Reduce $\frac{3}{4}$ $\frac{4}{5}$ into one common *denominator*. Thus:

$$\begin{matrix} \frac{3}{4} & \frac{4}{5} \\ \frac{15}{20} & \frac{16}{20} \end{matrix}$$

for three times 5 is 15, and 4 times 4 is 16, new *numerators*, and 4 times 5 is 20. So that $\frac{15}{20}$ $\frac{16}{20}$ are common *denominators*, and equal to $\frac{3}{4}$ and $\frac{4}{5}$.

Likewise reduce $\frac{2}{4}$, $\frac{3}{5}$, $\frac{10}{12}$, $\frac{4}{9}$, $\frac{17}{14}$, into one denomination, being reduced *per* our Rule are:

Numerator	15120	18144	25200	13440	36720
Denominator	30240	30240	30240	30240	30240

To reduce *Fractions of Fractions*, the Rule is to multiply all the *numerators* together, and take the product thereof for a numerator, and likewise to multiply all the *denominators* together, and make the total a new *denominator*. For Example:

Reduce $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ into a *single Fraction*; being reduced it makes $\frac{6}{24}$, and is a *single Fraction*.

$$\frac{6}{\overline{\tfrac{1}{2} \text{ of } \tfrac{2}{3} \text{ of } \tfrac{3}{4}}}\;$$
$$24$$

Again reduce $\frac{6}{8}$ of $\frac{4}{5}$ of $\frac{3}{4}$ of $\frac{5}{7}$ of $\frac{2}{6}$, into a *single Fraction*:

Numerator	720	720	720	720
Com. Denominator	6720			

$\frac{720}{6720}$

The *Reduction of improper Fractions* into whole numbers, is done in dividing the *numerator* by the *denominator*, so is the *quotient* the whole number, or mixed number sought. For Example:

 Reduce

Reduce $\frac{26}{5}$ into its equivalent mixed number, the number will be $5\,l.\,\frac{1}{5}$ or $5\,l.\,4\,s.$ for if 26 be divided by 5, the *quotient* is $5\frac{1}{5}$.

$$\begin{array}{l} 5)26(5\tfrac{1}{5} \\ \quad 25 \\ \quad\overline{\ \ 1\ \ } \end{array}$$

Reduce $\frac{10}{4}$ *facit* $2\,l.\,\frac{2}{4}$

$$\begin{array}{l} 4)10(2\tfrac{2}{4} \\ \quad 8 \\ \quad\overline{\ 2\ } \end{array}$$

Reduce $\frac{406}{12}$ *facit* $33.\frac{10}{12}$

$$\begin{array}{l} 12)406(33.\tfrac{10}{12} \\ \quad 36. \\ \quad\overline{\ 46\ } \\ \quad 36 \\ \quad\overline{\ 10\ } \end{array}$$

Also the improper *Fraction* $\frac{52}{4}$ will be reduced into the whole number 13.

$$\begin{array}{l} 4)52\ (13 \\ \quad 4 \\ \quad\overline{\ 12\ } \\ \quad 12 \\ \quad\overline{\ \ 0\ \ } \end{array}$$

To reduce a *mix'd number*, as $4\frac{11}{12}$ into an *improper Fraction* of the same value. Multiply the *integer* 4, by 12, the *denominator* of the *Fraction*; and to the product 48 add the *numerator*; the sum 59, set over the former *denominator* $\frac{59}{12}$, constitutes the *Fraction* required.

To reduce a *whole number* into an *improper Fraction*, multiply the given number by the intended *denominator*, and place the product for a *numerator* over it. For Example:

Reduce 15 into a *Fraction*, whose *denominator* shall be 12. *Facit.* $\frac{180}{12}$ for 15 multiplied by 12 *Facit* $\frac{180}{12}$.

$$\begin{array}{r} 15 \\ 12 \\ \hline 180 \end{array}$$

To find the value of a *Fraction* in the known parts of its *integer*. Suppose it were required to know what is $\frac{9}{16}$ of a *pound*; multiply the *numerator* 9 by 20, the number of known parts in a *pound*, and divide the product by the *denominator* 16, the *quotient* gives 11 *s.* Then multiply the remainder 4 by 12, the number of known parts in the next inferior denomination; and dividing the product by 16, as before, the *quotient* is 3*d.* So that $\frac{9}{16}$ of a *pound* = 11 *s.* 3 *d.*

Thus much for *Reduction of Fractions.* We'll proceed now to *Addition.*

ADDITION *of vulgar Fractions.* 1. If the given *Fractions* have different *denominators*, reduce them to the same; then add the *numerators* together, and under the sum write the common *denominator*. Thus, for Example.

$\frac{2}{3}+\frac{4}{5}=\frac{10}{15}+\frac{12}{15}=1\frac{07}{15}$. and $\frac{2}{3}+\frac{1}{6}+\frac{1}{4}+\frac{48}{72}+\frac{12}{72}+\frac{52}{74}=1\frac{42}{72}=1\frac{7}{12}$.

2. If *Compound Fractions* are given to be added; they must first be reduced to simple ones; and if the *Fractions* be of different denominations, as $\frac{6}{8}$ of a *pound*, and $\frac{2}{3}$ of a *shilling*, they must first be reduced to *Fractions* of the same denomination of *pounds.*

3. *To add mixed numbers:* The *integers* are first to be added; then the fractional parts; and if their sum be a *proper Fraction*, only annex it to the sum of *integers*. If it be an *improper Fraction* reduce it to a mixed number, adding the *integral* parts thereof to the sum of *integers*, and the *fractional* part after it. Thus, $5\frac{2}{3}+4\frac{1}{2}=10\frac{1}{6}$.

For the SUBTRACTION *of Fractions.* The Rule is — when the numbers given are both single *Fractions*, and have one and the same *denominator*, to subtract the lesser *denominator* from the greater, and place the remainder over the common *denominator*, so is such new *Fraction* the difference between the *Fractions* given. For Example:

Subtract $\frac{3}{8}$ from $\frac{7}{8}$, the difference is $\frac{4}{8}$, or $\frac{1}{2}$.

But when they have unequal *denominators*, they must be reduced into *Fractions* of the same value, which shall have a common *denominator*, and then find the difference. For Example:

Subtract $\frac{6}{7}$ from $\frac{7}{8}$ rest $\frac{1}{56}$, for $\frac{6}{7}$ and $\frac{7}{8}$, being reduced, will $\frac{48}{56}$ and $\frac{49}{56}$, so the difference you see to be $\frac{1}{56}$

When one of the numbers given is a whole number, or a mixt number, or if either of them are mixed numbers, reduce such whole or mixt numbers into an improper *Fraction*, or *Fractions*, and then work as before.

Subtract $7\frac{3}{5}$ from 12, the remainder is found $4\frac{2}{5}$, for these two *Fractions* will be found to be $\frac{38}{5}$, and $\frac{60}{5}$, whose difference is $\frac{22}{5}$ or $4\frac{2}{5}$.

In like manner $3\,l.\ \frac{2}{3}$, being to be ſubtracted from $5\,l.\ \frac{3}{4}$, the remainder will be found $_{25}$, or $2\,l.\ \frac{1}{12}$, as by the ſubſequent operation.

l.	*l.*	
$5\frac{3}{4}$	$3\frac{2}{3}$	
4	3	
$\frac{23}{4}$	$\frac{11}{3}$	
69	12 *Denom.*	So there is $\frac{25}{12}$, or $2\,l.\ \frac{1}{12}$, (as before.
44		
25 *Numerator.*		For 4 multiplied by 3 is 12 for (*Numerator.*

From 12 take $7\frac{3}{5}$ Thus:

$\frac{12}{1}$ $\frac{38}{5}$

12
5
60
38
22

Reſt $\frac{22}{5}$

For anſwer remains $\frac{22}{5}$, or $4\frac{2}{5}$.

When a whole number is given to be ſubtracted from a mixt number, ſubtract the ſaid whole number from the whole part of the mixt number; and unto the remainder annex the *fractional* part of the mixt number given, ſo is the mixt number ſo found the difference ſought. For Example:

Received 24 of a *pound*, laid out 7 *pounds*, what remains?

24
7 Subtract
$17\frac{5}{8}$ Remains.

When a *Fraction* is given to be ſubtracted from an *integer*, ſubtract the *numerator* from the *denominator*, and place that which remains over the *denominator*, which new *Fraction* is the difference ſought, So $\frac{3}{5}$ being ſubtracted from an *integer*, or 1, the remainder is .

When a *Fraction* is given to be ſubtracted from a whole number greater than 1, ſubtract the ſaid *Fraction* from one of the *integers* given by the laſt rule; the remaining *Fractions* being annexed to the number of *integers* leſſened by 1, will give the remainder. Thus $\frac{4}{9}$ being ſubtracted from 6, the remainder is $5\frac{5}{9}$.

To ſubtract a whole number and a *Fraction* from a whole number and a *Fraction*, the *Fractions* muſt be firſt reduced into one denomination, then one *numerator* ſubtracted from the other; and the *integers* ſubtracted, as in whole numbers. For Example:

Received $30\,l.\ \frac{3}{4}$, laid out $10\,l\ \frac{1}{2}$, firſt reduce $\frac{3}{4}$ and $\frac{1}{2}$ (into one denomination.

	$30.\ \frac{3}{4}$	$\frac{3}{4}$	$\frac{2}{8}$ or $\frac{1}{4}$
	$10.\ \frac{1}{2}$	$\frac{1}{2}$	
Reſt	$20.\ \frac{1}{4}$		

When *Fractions of Fractions* are to be ſubtracted, they are to be reduced into ſingle *Fractions*, then ſubtract as before.

Subtract $\frac{1}{2}$ of $\frac{2}{3}$ from $\frac{3}{4}$ of $\frac{4}{5}$. Being reduced they are ($\frac{1}{3}$ and $\frac{3}{5}$

4
5 5 Reſt $\frac{4}{15}$
$\frac{1}{3}$ $\frac{3}{5}$
15

Thoſe *Fractions* are always accounted the greateſt, whoſe *numerator* multiplied by the *denominator* of the other *Fraction* makes the greateſt number. Thus $\frac{7}{8}$ is greater than $\frac{3}{5}$; for 7 times 5 is greater than 8 times 3.

In *Multiplication of vulgar Fractions.* 1. If the *Fractions* propoſed be both ſimple, multiply the *numerators* one by another for a new *numerator*, and the *denominvtors* for a new *denominator*. Thus $\frac{3}{4}$ into $\frac{5}{8}$ produces $\frac{15}{32}$.

We muſt obſerve in this place, that as whole numbers multiplied by whole numbers increaſe the product; ſo proper *Fractions* multiplied by proper *Fractions* diminiſh the product. For as 1 multiplied by 1 makes but 1, ſo that which is leſs than 1 being multiplied by $\frac{2}{3}$ of a *pound* makes but $\frac{2}{1}$ a *pound*, $\frac{3}{4}$ by $\frac{2}{3} = \frac{6}{12}$ or $\frac{1}{2}$.

2. If one of them be a mixed or whole number, it muſt be reduced to an improper *Fraction*, and then proceed as in the laſt rule. Thus $7\frac{1}{2}$ being multiplied by $5\frac{3}{5}$, the product will be found 42.

$7\frac{1}{2}$ by	$5\frac{3}{5}$	$\frac{15}{2}$ by $\frac{28}{5}$	
2	5		
15	28	for 28 by	2
2	5	15	5
		1|0)42|0(42	10

Though there may be other rules for the Multiplication of mixed numbers, that uſed by joiners, carpenters, and bricklayers, commonly called *Croſs Multiplication*, is at preſent very much in uſe. Thus if it be required to multiply 120 feet $\frac{1}{4}$ by 48 feet $\frac{1}{2}$, firſt multiply the whole numbers continually; thus 120 by 48, and place the product orderly one under the other.

Thus

Thus the whole numbers make 5760, then multiply alternately, or croſs-ways, *viz.* take $\frac{1}{4}$ of 48, which is is 12, alſo take $\frac{1}{2}$ of 120, which is 60, orderly to be added to the former. *Laſtly*, add all together, and to the ſum add the product of the two *Fractions*, as in this Example, the product of the multiplication of $\frac{1}{4}$ by $\frac{1}{2}$, which is $\frac{1}{8}$, ſo the total product required will be $5832\frac{1}{8}$, as you ſee by the operation in the margent.

$120\frac{1}{4}$
$48\frac{1}{2}$
———
960
480
———
5760
12
60
$\frac{1}{8}$
———
$5832\frac{1}{8}$

In like manner multiply $4\frac{1}{2}$ by $4\frac{1}{2}$, or 4 *s.* 6 *d.* by (4 *s.* 6 *d.*

	s.	*d.*	
$4\frac{1}{2}$	4	6	by 4 *s.* 6 *d.*
$4\frac{1}{2}$	4	6	
16	16		
2	2		
$2\frac{1}{4}$	$2\frac{1}{4}$		
$20\frac{1}{4}$	20	3	

For by multiplying croſs-ways, ſaying 6 times 4 is 24 *d.* which is 2 *s.* and ſo alternately again it is 2 *s.* and the *Fraction* being $\frac{1}{4}$ of a *ſhilling* is 3 *d.* ſo that 4 *s.* 6 *d.* multiplied by 4 *s.* 6 *d.* is 20 *s.* 3 *d.*

In like manner multiply 3 feet 6 inches by 3 feet 6 inches.

Feet
$3\frac{1}{2}$
$3\frac{1}{2}$
———
9
$1\frac{1}{2}$
$1\frac{1}{2}$
$\frac{1}{4}$
———
$12\frac{1}{4}$

Facit 12 Feet $\frac{1}{4}$

Operation by *Fractions* by the laſt Rule.

l. *s.* *d.*
5 5 5 — 5 *d.* is $\frac{5}{12}$ of $\frac{1}{20}$ *viz.* + $\frac{5}{240}$.

5	$\frac{105}{20}$	$\frac{5}{240}$
20	105	20
105	240	5
20	4200	100
20	210	
400	25200	
12	100	
4800 New Den.	253|00 New Num.	
	48|00	

48 — $\frac{253}{48}$ by $\frac{253}{48}$ — 253
48 — 253
———
2304 — 759
1265
506
———
64009

Anſwer $\frac{64009}{2304}$ equal to 27 *l.* 15 *s.* 7 *d.* $\frac{1}{2}$ $\frac{5}{12}$.

The proof of this queſtion by the Rule of *Three* direct.

l.	*l.* *s.* *d.*	*l.* *s.* *d.*
1	5 5 5	5 5 5
20	20	20
20	105	105
12	12	12
240	1265	1265
		1265
		6325
		7590
		2530
		1265
		1600225

12
240)1600225(6667(55|5
1440··· 60
27|15:7 : $\frac{29}{48} = \frac{1}{2} + \frac{7}{12}$

1602 66
1440 60

1622 67
1440 60

1825 7
1680

145

$\frac{1}{2}\frac{4}{4}\frac{5}{6}|\frac{2}{4}\frac{9}{8}$

For the *Divifion of Fractions*. 1. If the *Fractions* propofed be both fimple, multiply the denominator of the divifor, by the numerator of the dividend; the product is the numerator of the quotient. Then multiply the numerator of the divifor by the denominator of the dividend, the product is the denominator of the quotient. Thus $\frac{3}{5})\frac{4}{9}(\frac{20}{27}$.

2. If either dividend, divifor, or both, be whole or mixed numbers, reduce them to improper *Fractions*; and if they be compound *Fractions*, reduce them to fimple ones; and proceed as in the firft rule.

In *Divifion* of *Fractions*, obferve that the quotient is always greater than the dividend; becaufe in all divifion, as the divifor is to the unity, fo is the dividend to the quotient; as if 3 divide 12, it will be as 3 : 1 :: 12 : 4. Now 3 is greater than 1; wherefore 12 muft be greater than 4: but in *fractions*, as $\frac{3}{5} : 1 :: \frac{4}{9} : \frac{20}{27}$; where $\frac{3}{5}$ is lefs than 1; wherefore $\frac{4}{9}$ muft alfo be lefs than $\frac{20}{27}$.

To work the *Rule of Three* in *Vulgar Fractions*, the denominator of the firft number muft be multiplied by the numerator of the fecond; then that product multiplied by the numerator of the third number, and the product referved for a new numerator. That done, the numerator of the firft number muft be multiplied by the denominator of the fecond; and the product multiplied by the denominator of the third, which product will become a new denominator. This new *Fraction* fo fought is the anfwer to the queftion, which faid *Fractions* whether proper, improper, or mixt *Fractions*, may be reduced into its equivalent *Fractions*, as before taught. For example:

If $\frac{3}{4}$ of a yard coft $\frac{5}{6}$ of a pound what will $\frac{7}{8}$ of a yard.

$\frac{3}{4}$ —— $\frac{5}{6}$ —— $\frac{7}{8}$

5 3

20 18
7 8

Num. 140 144 Denom. $\frac{140}{144}|\frac{70}{72}$

Anfwer $\frac{140}{144}$ or $\frac{70}{72}$

Further: If 3 yards of broad cloth coft 2 *l* $\frac{4}{5}$, what will 14 $\frac{3}{7}$ yards coft.

Yards.	*l.*	*Yards.*
$\frac{3}{4}$	$\frac{14}{5}$	$\frac{101}{7}$

3 101
5 14

15 404 $\frac{1405}{1414}$ of a pound equal
7 101 to 13 *l.* 9 *s.* 9 *d.*

105 1414

Thus proved by reducing your *Fraction* as before taught.

l. *s.* *d.*
105)1414(13 9 4
105·

364
315

49
20
s.
105)980(9
945

35
12
d.
105)420(4
420

0

By

By this operation 'tis evident, that $\frac{105}{1414}$ is equal to 13*l.* 9*s.* 4*d.*

Having thus clearly demonſtrated the *Arithmetick* of whole numbers and *Vulgar Fractions*, I proceed to that excellent invention called DECIMAL *Arithmetick*, firſt invented by *Johannes Regiomontanus*, and uſed by him in his tables of ſigns.

DECIMAL FRACTIONS, are thoſe whoſe denominator is 1, with one or more *cyphers*; as 10, 100, 1000, 10,000, *&c.* Thus $\frac{5}{10}$, $\frac{6}{100}$, $\frac{7}{1000}$, *&c.* are *Decimal Fractions*.

In the writing of *Decimal Fractions*, we uſually omit the denominator, as only conſiſting of unity with *cyphers* annexed; and in lieu thereof a point, or comma is prefixed to the numerator. Thus $\frac{5}{10}$ is wrote .5; $\frac{46}{100}$, .46; ſo .125 expreſſes an hundred twenty-five parts of any thing ſuppoſed to be divided into 1000 parts.

As *cyphers* on the right hand of integers do increaſe their value *Decimally*; as 2, 20, 200, *&c.* ſo when ſet on the left hand of *Decimal Fractions*, they decreaſe the value *Decimally*, as 5, 05, 005, *&c.* when ſet on the left hand of integers, or on the right hand of *Decimals*, they ſignify nothing but only to fill up places; thus 5000, or 0005, is but five units.

To reduce *Vulgar Fractions* into *Decimals*, add *cyphers* at pleaſure to the numerator, and divide by the denominator. Thus $\frac{5}{8}$, being propounded to be reduced to a *Decimal*, will be changed into .625, that is $\frac{625}{1000}$, for annexing *cyphers* unto the numerator 5, it will be 5000, which being divided by the denominator 8, the quotient will be 625, before which, prefixing a point, it will be .625, that is $\frac{625}{1000}$ the *Decimal* ſought; as it appears in the operation.

```
8)5000(625
  48..
  ----
   20
   16
  ----
    40
    40
    --
     0
```

The common operation in *Decimals*, are performed as in the vulgar rules, regard being had only to the particular notation, to diſtinguiſh the integral from the fractional part of a ſum.

In *Addition*, and *Subtraction* of *Decimal Fractions*; the points being all placed under each other, the figures are to be added; or ſubtracted as in common *Arithmetick*: and when the operation is done, ſo many figures of the ſum, or the remainder are to be noted for *Decimals*, as there are places of *Decimals* in the greateſt given number, an example will make this clear.

Addition of	*Decimals*	*Subtraction.*
.43791		from 67.9
.792	59.271	take 29.8754
.6124	15.040	Rem. 38.0246
.053	3.791	
.10	12.009	from 25.1462
.2	7.5	take 13.07
2.19531	97.062	Rem. 12.0762

For MULTIPLICATION of *Decimals*, the rule is, ſo often as two numbers are given to be multiplied, and are both mixt numbers, or both *Decimal Fractions*, or one of them a whole number, and the other a *Decimal* or mixt number, to write them down exactly one underneath the other, as is done in *Multiplication* of whole numbers; and when you have gotten the product, to ſee how many places of *Fractions* are found both in the *Multiplicand* and *Multiplicator* jointly, juſt ſo many places you muſt cut off from the product, by a point, comma, or line, towards the right-hand, as there are places of *Decimals* in both factors. Thus,

```
multiply  246.25      .87
      by      35       .9
          ------      ----
          123125      .783
          73875
          -------
          8618.75
```

When the *Multiplication* is finiſhed, if there ariſe not ſo many places in all, as ought to be cut off, (which may often happen when the product is a *Fraction*) in ſuch caſe as many places as are wanting, ſo many *cyphers* muſt be prefixed to the product, on the left hand thereof, to compleat the product. For example;

```
Multiply .0375 by .05
              .05
             -----
             1875
```

Now here being but four figures, I prefix two *cyphers* to compleat the product of

```
Multiply .0375 is .001875 Product
      by   .05
Product .001875 as by Rule.
```

In DIVISION of *Decimals*, proceed in all reſpects as in dividing of integers; and when the operation is done, mark as many places in the quotient for *Decimals*, as with the number of *Decimals* in the diviſor, are equal to the *Decimal* places of the dividend.

```
.22).8030(3.65        22)8.030(365
     66                  66
     ---                 ---
     143                 143
     132                 132
     ---                 ---
      110                 110
      110                 110
      ---                 ---
        0                   0

22).8030(.0365       72.2)8321.9(1.13
    66                    732
    ---                   ----
    143                   1002
    132                    732
    ---                   ----
    110                   2709
    110                   2196
    ---                   ----
      0                    513
```

But there are certain caſes in *Diviſion* of *Decimals*, which require ſome further management: as firſt, where the diviſor is a *Decimal Fraction*, and the dividend an integer; add or annex as many or rather more *cyphers* to the dividend, than there are places in the diviſor: Thus,

.365)22.000(60.2

For there being three places of *Decimals* in the diviſor, and four in the dividend, there will be but one in the quotient.

2. Where the diviſor is a mixt number, and the dividend a whole number, add, at leaſt, as many *cyphers* to the dividend, as there are places in the diviſor. Thus,

3.65)22.0000(6.02

3. Wherever the diviſor is bigger than the dividend, annex *cyphers* to the latter. Thus,

.365)22.0000(6.02

To work the RULE OF THREE in *Decimals*, the operations are the ſame as in whole numbers, only in *Decimals* reſpect muſt be had to the *Decimal* Rules before taught, eſpecially when you come to the anſwer in your quotient, by duly ſeparating the *Decimals* from the integers. For example,

If 9 ℔. ¼ of coffee coſt 3 *l.* 15 *s.* how much will 278 ℔. ½ coſt?

Note, When the fractional parts of the numbers in this queſtion are converted into *Decimals*, then they will ſtand thus.

If 9.25 ℔. of coffee coſt 3.75 *l.* what will 278.5 ℔. of coffee coſt.

```
                                   278.5
                                    3.75
                                 --------
                                   13925
                                  19495
                                  8355
                                 --------
                                 1044.375
                                 --------
9.25)1044.4375(112.9              50=1+
     925....                     --------
     ----                          9.25
     1193
      925
     ----
      268
     1850
     ----
     8375     Anſwer 112 l 9 s 1 d. +
     8325
     ----
       50
```

Further, If 9 *C. wt.* of ſugar coſt 25 *l.* 7 *s.* what will be the price of 17 *C. wt.*?

```
C.        l.           C.
9 ------ 25.35 ------- 17
           17
        -------
         17745
         2535
        -----------
        9)430.95(47.88
          36...
          ---
           70
           63
           --
           79     Anſwer 47 l. 17. 8 d.
           72
           --
           75
           72
           --
            3
```

Decimals are of a very great uſe in the menſuration of ſuperficies and ſolids, which is acompliſh'd in the following manner, *viz.*

There

There is a chamber whose floor is 22 feet 9 inches long, and 9 feet 6 inches broad, what is the content in feet and inches? Thus *decimally*,

Length 22.75 feet and breadth 9.5 feet what is the content?

$\frac{125}{1000} \Big| \frac{25}{200} \Big| \frac{1}{8}$

$$\begin{array}{r} 22.75 \\ 9.5 \\ \hline 11375 \\ 20475 \\ \hline 216.125 \end{array}$$

Answer 216 Feet and $\frac{1}{8}$ of an inch.

Further, How many yards of wainscot does that room require, whose height is 12 feet 3 inches, and compass 104 feet 6 inches?

3 Inches in *Decimals* is .25
6 Inches in *Decimals* is .5

Therefore multiply 104.5
by 12.25

$$\begin{array}{r} 5225 \\ 2090 \\ 2090 \\ 1045 \\ \hline \text{In feet } 1280.125 \end{array}$$

To answer the question in yards.

Divide by 9)1280125(142.236

$$\begin{array}{l} 9\,.\,.\,.\,.\,. \\ \hline 38 \\ 36 \\ \hline 20 \\ 18 \\ \hline 21 \\ 18 \\ \hline 32 \\ 27 \\ \hline 55 \\ 54 \\ \hline 1 \end{array}$$

Answer 142 yards, $\frac{236}{1000}$ or 142 yards, 2 feet, 3 inches.

To find the length of the circumference of a circle, the diameter being known. Let there be a circle whose diameter is 42, what is the length of the circumference?—Multiply always the diameter by 22, and divide the product by 7, your *quotient* is the answer. Thus

$$\begin{array}{r} 42 \\ 22 \\ \hline 84 \\ 84 \\ \hline 7)924(132 \\ .\,.\,. \\ \hline 0 \end{array}$$

Answer 132

The circumference being given, to find the diameter as in the former circle, the circumference being 132, and the diameter required.—The circumference must be multiplied by 7, and the product divided by 22, and the *quotient* is the diameter. Thus,

Circumference 132
7

22)924(42 the diameter required.

$$\begin{array}{r} 88\,. \\ \hline 44 \\ 44 \\ \hline 0 \end{array}$$

The diameter of a circle being given to find the *Area*, or content thereof. Multiply the diameter by itself; again, multiply by 11, and divide by 14, and your operation is perfect. Thus,

The diameter 42, the content of the circle required.

Diameter

```
        Diameter 42
   multiply'd by 42
                 ——
                 84
                168
                ———
               1764
   multiply'd by 11
               ————
               1764
              1764
             —————
Divide by 14)19404(1386 Content required.
             14...
             ——
              54
              42
              ——
              120
              112
              ———
               84
               84
               ——
                0
               ——
```

Having thus compleated our *Arithmetick*, either of *Integers* or *Fractions*, both *Vulgar* and *Decimal*, we must proceed to the extraction of *Square* and *Cube Roots*.

Square Root is a number considered, as the root of a second power or *square number*; or a number by whose multiplication, into itself, a square number is generated; which square number is the product of a number multiplied by itself. Thus 4 the product of 2 multiplied by 2; or 16 the product of 4 multiplied by 4, are square numbers; therefore the number 2, being that by whose multiplication by itself, the square number 4 is produced; is in respect hereof called a *Square Root*, or the *Square Root* of 4. Since as unity is to the *Square Root*, so is the *Root* to the square number.

For the extraction of *Square* and *Cube Roots*, they have the squares and cubes of all digits in readiness, as exhibited in the following Table.

Roots	1	2	3	4	5	6	7	8	9
Square	1	4	9	16	25	36	49	64	81
Cubick	1	8	27	64	125	216	343	512	729

To extract a *Square Root* out of a given number.

1. Divide the given number into classes of two figures a piece; and include each class between two dots, commencing with the place of units, or the right-hand figure; the root will consist of so many parts or figures as you have classes. By the way observe, it may happen that for the last class, on the left-hand there shall only be one figure left.

2. Then the left-hand class being the square of the first figure of the root sought; look in the table of roots for the square figure answering to that number: or if that square number be not precisely there, to the next lesser number: this root write down for this first figure of the quotient, and subtract its square from the left-hand class to the remainder, bring down the next class towards the right.

3. Write down the double of the quotient-figure, under the left-hand figure of the second class; and seek how oft the decuple is contained in the figure over it: the quotient gives the second figure of the root.

4. Write the same quotient under the right-hand figure of the same class; and subtract the product of the whole number underwritten, multiplied by the first figure of the *Root*, from the number over it, as in Division.

5. The operation being repeated according to the third and fourth steps, that is to say, the remainder being still divided by the double of the *Root* as far as *extracted*, and from the remainder, the square of the figure that last came out, with the decuple of that aforesaid divisor augmented thereby, being subtracted; you will have the *Root* required. For example:

Note, That by *Decuple* is understood a term of relation or proportion, implying a thing to be ten times as much as another.

To *extract* the *Root* of 99856, point it after this manner, $\dot{9}98\dot{5}6\dot{}$, then seek the number, whose square shall equal the first figure 9, *viz.* 3, and write it in the quotient; then having subtracted from 9, 3×3, or 9, there will remain 0; to which set down the figures as far as the next point, *viz.* 98 for the following operation.

```
 . . .
99865(316
9
——
098
 61
————
 3756
 3756
 ————
    0
   ——
```

Then

Then taking no notice of the laſt figure 8, ſay, How many times is the double of 3, or 6, contained in the firſt figure 9? Anſwer 1, wherefore having wrote one in the quotient, ſubtract the product of 1 × 61, or 61 from 98, and there will remain 37, to which connect the laſt figure 56, and you will have the number 3756 on which the work is next to be carried on. Wherefore alſo neglecting the laſt figure of this, *viz.* 6, ſay, How many times is the double of 31 or 62 contained in 375, (which may be gueſſed at from the initial figure 6, and 37, by taking notice how many times 6 is contained in 37:) Anſwer 6; and writing 6 in the quotient, ſubtract 6 × 626, or 3756, and there will remain 0; whence it appears that the buſineſs is done, the *Root* coming out 316.

Otherwiſe with the diviſors ſet down, will it ſtand thus:

```
        . . .
       99856(316
       9
       ---
    6) 98
       61
       ---
   62) 3756
       3756
       ----
         0  and ſo in others.
```

Again, if you was to extract the *Root* of 22178791: Firſt having pointed, ſeek a number, whoſe ſquare (if it cannot be exactly equalled) ſhall be the next leſs ſquare, (or neareſt) to 22, the figures to the firſt point, and you will find it to be 4, for 5 × 5, or 25, is greater than 22; and 4 × 4, or 16, is leſs; wherefore 4 will be the firſt figure of the *Root*. This therefore being writ in the quotient, from 22, take the ſquare 4 × 4, or 16; and to the remainder 6, adjoin the next figures 17, and you will have 617; from whoſe diviſion, by the double of 4, you are to obtain the ſecond figure of the *Root*, *viz.* neglecting the laſt figure 7, ſay, How many times 8 is contained in 61? Anſwer 7; wherefor write 7 in the quotient, and from 617 take the product of 7 into 87, or 609, and there will remain 8, to which join the two next figures 87, and you will have 887; by the diviſion whereof by the double of 47, or 94, you are to obtain the third figure; in order to which, ſay, How many times is 94 contained in 88? Anſwer 0; wherefore write 0 in the quotient, and adjoin the two laſt figures 91, and you will have 88791, by whoſe diviſion by the double of 470, 940, you are to obtain the laſt figure, *viz.* ſay, How many times 940 in 8879? Anſwer 9; wherefore write 9 in the quotient, and you will have the *Root* 4709. But ſince the product 9 × 9409, or 84681 ſubtracted from 88791 leaves 4110, the number 4709 is not the *Root* of the number 22178791 preciſely, but a little leſs.

```
  . . . .
22178791(4709,43637, &c.
16
---
 617
 609
 ----
   88791
   84681
   -----
    411000
    376736
    ------
     3426400
     2825649
     -------
      60075600
      56513199
      --------
       356190400
       282566169
       ---------
        73624231
```

If it then be required to have the *Root* approach nearer; carry on the operation in decimals, by adding to the remainder two *cyphers* in each operation; thus the remainder 4110, having but two *cyphers* added to it, becomes 411000; by the diviſion whereof, by the double of 4709, or 9418, you will have the firſt decimal figure 4; then having writ 4 in the quotient, ſubtract 4 × 94184, or 376736, from 411000, and there will remain 34264; and ſo having added two more *cyphers*, the work may be carried on at pleaſure, the *Root* at length coming out 4709.43637, &c.

But when the *Root* is carried on half way or above, the reſt of the figures may be obtained by diviſion alone: as in this example, if you had a mind to *extract* the *Root* to nine figures, after the five former 4709.4 are *extracted*, the four latter may be had, by dividing the remainder by the double of 4709.4.

Thus if the *Root* of 32076, were to be extracted to five places, in numbers: after the figures are pointed, write 1 in the quotient, as being the figure whoſe ſquare 1 × 1, or 1, is the greateſt that is contained in 3, the figure to the firſt point; and having taken the ſquare of 1 from 3, there will remain 2; then having ſet the next figures, *viz.* 20 to it, (*viz.* to 2,) ſeek how many times the double

12. Gg of

of 1, *viz.* 2 is contained in 22, and you will find indeed that it is contained more than ten times; but you are never to take your divifor 10 times, no, nor 9 times in this cafe; becaufe the product of 9×29, or 261, is greater than 229, from which it fhould be taken, or fubtracted: wherefore write only 8, and then having wrote 8 in the quotient, and fubtracted 8×28, or 224, there will remain 5, and having fet down to this the figures 76, feek how many times the double of 18, or 36, is contained in 57, and you will find 1, and fo write 1 in the quotient; and having fubtracted 1×361, or 361 from 576, there will remain 215. *Laftly*, To obtain the remaining figures, divide this number 215, by the double of 181, *viz.* 362, and you will have the figures 59, which being writ in the quotient, give the *Root* 181.59. Thus:

```
  . . .
 32976(181.59
 1
 ----
2)229
  224
  ----
36)576
   361
   ----
362)215(59, &c.
```

After the fame manner are *Roots* extracted out of decimal numbers. Thus the *Root* of 329.76 is 18.159; and the *Root* of 3.2976 is 81.159; and the *Root* of 0.032976, is 0.18159, and fo on. But the *Root* of 3297.6 is 57.4277; and the *Root* of 32.976 is 574247; and thus the *Root* of 9.9856 is 3.16.

Before we proceed to the *Extraction of Cube Roots*, we muft underftand what is a *Cube* or *Cubic Root.*

A CUBE ROOT, is the origin of a *Cubic Number*, which *Cubic Number* is a number arifing from the multiplication of a fquare number by its *Root*.

Thus, if the fquare number 4 be multiplied by its *Root* 2, the factum 8, is a *Cube*, or *Cubic Number*; and the number 2, with refpect thereto a *Cube Root*. Hence, fince, as unity is to the *Root*, fo is the *Root* to the *fquare*; and as unity is to the *Root*, fo is the *fquare* to the *Cube*; the *Root* will alfo be to the *fquare*, as the *fquare* to the *Cube*; that is, unity, the *Root*, the *fquare*, and the *Cube* are in continual proportion; and the *Cube Root* is the firft of two numbers that are mean proportionals between unity and the *Cube*.

A *Cube Number* is either fimple or compound. The fimple *Cube Numbers*, together with their refpective *Roots* are expreffed in the table at the beginning of extraction of *Square Roots*.

A COMPOUND CUBE NUMBER, is that which being produced by itfelf, it never lefs than 1000, fo 405224 is a *compound Cube Number*, being produced thus:

```
  74               5476
  74                 74
 ----              -----
 296              21904
518               38332
 ----             ------
5476 the Square   405224 Cube Number.
```

The *Extraction of a Cube Root*, and of all other *Roots* may be comprehended under one general rule, *viz.* every third figure beginning from unity, is firft to be pointed, if the *Root* to be extracted be a *Cubic one*; or every fifth, if it be a *Quadrato Cubic*, (or of the fifth *power*,) and then fuch a figure is to be writ in the quotient, whofe greateft *power*, (that is, whofe *Cube*, if it be a *cubic power*,) or whofe *Quadrato Cube*, if it be the fifth *power* fhall either be equal to the figure or figures, before the firft point, or next lefs under them; and then having fubtracted that *power*, the next figure will be found by dividing the remainder augmented by the next figure of the refolvend, by the next leaft *power* of the quotient, multiplied by the index of the *power* to be extracted, that is, by the triple *fquare*, if the *Root* be a *Cubic* one; or by the *Quintuple Biquadrate* (that is five times twice the *fquare*) if the *Root* be of the fifth *power*, &c. And having again fubtracted the *power* of the whole quotient from the firft refolvend, the third figure will be found by dividing that remainder, augmented by the next figure of the refolvend, by the next leffer *power* of the whole quotient, multiplied by the index of the *power* to be extracted.

But to leave nothing unobferved, before we proceed farther on this fubject, we muft let our pupils know what we mean by *powers*.

Power in *Arithmetick* is the produce of a number, or other quantity, multiplied into itfelf. Thus the produce of the number 3 multiplied by itfelf, *viz.* 9, is the fecond *power* of 3; the factum of 9 multiplied by 3, *viz.* 27, is the third *power*; and the product of 27 again multiplied by 3, *viz* 81, is the fourth *power*, and fo on to infinity. In refpect hereof, the firft number 3 is called the *root* or firft *power*. The fecond *power* is called the *fquare*, with refpect to which, 3 is the *fquare root*, (as is feen in the table.) The third *power* 27, is called the *Cube*

cube; with reſpect to which, the 3 is the *cube root*; to be ſeen likewiſe in the table. The fourth *power* 81, is called the *biquadrate*, or *quadrato quadratum*; with reſpect to which, 3 is the *biquadratic root*.

The number, which ſhews how often the *root* is multiplied into itſelf, to form the *power*; or how often the *power* is to be divided by its *root*, to come at the *root* is called the *exponent* of the *power*: thus the *exponent*, or *index* (for in this place they are two ſynonymous terms) of a *ſquare number* is 2, of a *cube* 3, *&c.*

Now to proceed on the *Extraction of Cube Roots.* To extract the *cube root* of 13312053, the number is firſt to be pointed after this manner, *viz.* 13312053, then you are to write the figure 2, whoſe *cube* is 8 in the firſt place of the quotient, as, that which is the next leſſer *cube* to the figures 13 (which is not a perfect *cube number*) or as far as the firſt point; and having ſubtracted the *cube*, there will remain 5; which being augmented by the next figure of the reſolvend 3, and divided by the triple ſquare of the quotient 2, by ſeeking how many times 3×4, or 12, is contained in 53, it gives 4 for the ſecond figure of the quotient. But ſince the *cube* of the quotient 24, *viz.* 13824, would come out too great to be ſubtracted from the figures 13312, that preceed the ſecond point, there muſt only 3 be writ in the quotient; then the quotient 23 being in a ſeparate place multiplied by 23, gives the ſquare 529, which again multiplied by 23, gives the *cube* 12167, and this taken from 13312, will leave 1145; which augmented by the next figure of the reſolvend 0, and divided by the triple ſquare of the quotient 23, *viz.* by ſeeking how many times 3×529, or 1587, is contained in 11450, it gives 7 for the third figure of the quotient. Then the quotient 237, multiplied by 237, gives the ſquare 56169, which again multiplied by 237, gives the *cube* 13312053, and this taken from the reſolvend, leaves 0. Whence it is evident that the *root* ſought is 237, as it appears in the following whole operation.

	13312053(237
Subtract the cube	8
12) remain.	54(4 or 3
Subtract cube	12167
1587) remain.	11450(7
	13312053
Remains	0

So to extract the *quadrato cubical root* of 364308203 it muſt be pointed over every fifth figure; and the figure 3, whoſe *quadrato cube*, or fifth *power* 243, is the next leſſer to 364, *viz.* to the firſt point, muſt be writ in the quotient. Then the *quadrato cube* 243 being ſubtracted from 364, there remains 121, which augmented by the next figure of the reſolvend, *viz.* 3, and divided by five times the *biquadrate* of the quotient, *viz.* by ſeeking how many times 5×81, or 405 is contained in 1213, it gives 2 for the ſecond figure. That quotient 32 being thrice multiplied by itſelf, makes the *biquadrate* 1048576; and this again multiplied by 32, makes the *quadrato cube*, 33554432, which, being ſubtracted from the reſolvend, leaves 2876388. Therefore 32 is the integer part of the *root*, but not the true *root*; wherefore if you have a mind to proſecute the work in decimals, the remainder, augmented by a cypher, muſt be divided by five times the aforeſaid biquadrate of the quotient by ſeeking how many times 5×1048576, or 5242880 is contained in 2876388.0, and there will come out the third figure, or the firſt decimal 5. And ſo by ſubtracting the *quadrato cube* of the quotient 32,5 from the reſolvend, and dividing the remainder by five times its biquadrate, the fourth figure may be obtained; and ſo on, *in infinitum.* This is the above mentioned operation at length:

	364308203(32.5
	243
405)	1213(2
	33554432
5242880)	2876388.0(5

In ſome caſes it is convenient only to indicate the extraction of a root, eſpecially where it cannot be had exactly. Now the ſign or character, whereby *roots* are denoted, is $\surd$: to which is added the exponent of the *power*, if it be above a ſquare, and even ſometimes if it be not. For example, $\surd^2$ denotes the *ſquare root*. $\surd^3$ the *cube root*, &c.

When a *biquadratic root* is to be extracted, you may extract twice the *ſquare root*, becauſe $\surd^4$ is as much as $\surd^2\times2$. And when the *cubo-cubic root* is to be extracted, you may firſt extract the *cube root*, and then the *ſquare root* of the *cube root*, becauſe the $\surd^6$ is the ſame as $\surd^2\times3$; whence ſome have called theſe *roots*, not *cubo-cubic* ones, but *quadrato-cubes*. And the ſame is to be obſerved in other *roots*, whoſe indexes are not prime numbers.

To prove the extraction of *roots*. 1. For a *ſquare root*: multiply the *root* found by itſelf, and to the product add the remainder, if there were any: if the ſum be equal to the number given, the operation is juſt.

2. For a *cube root*: multiply the root found by itſelf; and the product again by the ſame root, to the

the laſt product, add the remainder if there were any. If the ſum come out the number firſt given, the work is juſt.

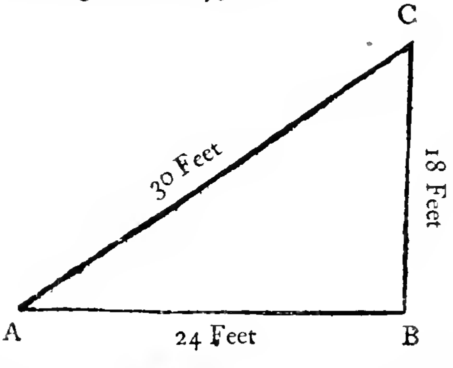
Now to reduce this into practice, eſpecially as to ſolving ſome *arithmetical* and *geometrical* queſtions; I proceed thus.

1. If I would find a mean proportional between two given numbers, I multiply the given numbers, the one by the other, and extract the *ſquare root* of the product. ſo ſhall that ſquare root be the mean proportional ſought. For example:

Let the given number be 16 and 64, according to my rule, I multiply 16 by 64, and the product is 1024, the *ſquare root* of which is 32, ſo that 32 is the mean proportional between 16 and 64. Thus:

```
 16 } multiply
 64 }
 ---
 64
96
----
1024(32 ſquare root
 9
----
62)124
   124
   ---
     0
```

Again, am I deſired to find a third ſide to two ſides of right-angled plain triangle given? For example in the triangle A, B, C, the baſe A, B, is 24, and the perpendicular B, C, is 18, now I am to find the length of the hypothenuſe.



To anſwer this propoſition, I muſt firſt ſquare the baſe A B 24, which is 576; then ſquare the perpendicular 18, which makes 324; then add theſe two ſums together, and the product is 900, and the ſquare root of 900 is 30, which gives the length of A C. This proportion is of great uſe in meaſuring of heights, diſtances, and other mathematical figures.

2. *As to Solid Meaſures.*—If the ſide of a *cube*, be 12 inches, how many *cubical* inches are contained in that *cube*? To anſwer which I multiply the length by the breadth, and that product by the depth; as in this example:

```
  12
  12
 ---
 144 ſquare inches
  12
 ----
1728 cubical inches.
```

In like manner, if the ſide of a *cube* of ſtone be 2.53 feet, the ſolid content of that *cube* will be 16.194277 feet. Thus:

```
      2.53
      2.53
      ----
       759
     1265
    506
    ------
    6.4009
      2.53
    ------
    192027
   320045
  128118
  ----------
  16.194277 feet.
```

Note, That Solid in Geometry, is the 3d ſpecies of magnitude, having three dimenſions, length, breadth and thickneſs.

To meaſure a pyramid. A Pyramid is a ſolid figure, whoſe baſe is a *polygon*, and whoſe ſides are plain triangles, their ſeveral tops meeting together in one point at the top. Now if the ſuperficial content or the baſe of a *pyramid* be 5.756 feet, and the height thereof 14.25, (which ſaid height is the length of the perpendicular line, that falls from the top of the *pyramid* to the baſe) what is the ſolid content of that pyramid? The operation muſt be thus:

If the *area* of the baſe of the *pyramid* be multiplied by $\frac{1}{3}$ of the height thereof, the product ſhall be the ſolid content of the *pyramid*, therefore $\frac{1}{3}$ of 14.25 is equal to 4.75, and 5.756, the baſe be multiplied by 4.75=27.341 feet, the ſolidity of the *pyramid* required.

5.756

```
 5.756
  4.75
------
 28780
40292
23024
----------
27.34100 solid feet
```

```
3)14.25(4.75
  12
  --
   22
   21
   --
    15
    15
    --
     0
```

To measure a globe. A GLOBE, is a perfect round body contained under one plain; in the middle of the *globe* there is a point, called the center, from whence all strait lines drawn to the out side, are of equal length, and called semi-diameters, the double of any one of which, is equal to the diameter of the globe. Now if the diameter of the globe of stone be 1 75 feet, how many feet solid are contained in that globe? The operation must be conducted by multiplying first the diameter 1.75, by itself, the product will be 3.0625, which multiplied again by the said 1.75, gives for the product 5.359375, to wit, the cube of the diameter; which being multiplied by .5238, the product thence arising will be 2.807+, which is the solidity of the globe propounded. Thus:

```
   1.75
   1.75
   ----
    875
  1225
  175
 ------
 3.0625
   1.75
 ------
 153125
214375
30625
---------
5.359375 cube.
  .5238
---------
  428-5000
 16078125
10718750
2679687 5
------------
2.8072406250 the solidity of the globe.
```

Of SURDS.

SURDS in *Arithmetick* are called an *irrational* and *incommensurable number*: or a number that cannot be expressed, or is incommensurate with unity. See *Surds* in *Algebra*. p. 14.

When any number or quantity has its root proposed to be extracted, and yet is not a true figurate number of that kind; that is, if its *square root* be demanded, and it is not a true square; if its *cube root* be required, and itself be not a true cube, *&c.* then it is impossible to assign, either in whole numbers or in fractions, any exact root of such number proposed. And whenever this happens, it is usual in *Arithmetick*, to mark the required root of such numbers or quantities, by prefixing before it the proper mark of *radicality*, which is $\surd$: Thus $\surd : 2$ signifies the *square* root of 2, and $\sqrt[3]{} : 16$, or $\surd : (3)\ 16$, signifies the *cubick* root of 16; which roots, because they cannot be expressed in numbers exactly, (for no effable number, either integer or fraction, multiplied into itself, can ever produce 2; or being multiplied cubically, can ever produce 16) are properly called *surd roots.*

There is also another way of notation now much in use, whereby roots are expressed without a radical sign, by their indexes: thus, as x^2, x^3, x^5, *&c.* signifies the square, cube, and fifth power of x; so $x^{\frac{1}{2}}$, $x^{\frac{1}{3}}$, $x^{\frac{1}{5}}$, signify the square root, cube, *&c.* of x. The reason of which is plain enough; for since $\surd : x$ is a geometrical mean proportional, between 1 and x, so $\frac{1}{2}$ is an Arithmetical mean proportional between 0 and 1; and therefore as 2 is the index of the square of x, $\frac{1}{2}$ will be the proper index of its square root, *&c.*

We must observe also, that for convenience or brevity's sake, quantities or numbers, which are not *surds*, are often expressed in the form of *surd roots*. Thus $\surd : 4$, $\surd : \frac{9}{4}$, $\sqrt[3]{} : 27$, *&c.* signify 2, $\frac{3}{2}$, 3, *&c.*

But though these *surd roots* (when truly such) are inexpressible in numbers, they are yet capable of *Arithmetical* operations, (such as *Addition*, *Subtraction*, *Multiplication* and *Division*, &c.

Surds are either *simple* or *compound*.

Simple surds are those which are expressed by one single term, as $\sqrt[3]{}\ c$.

Compound surds are those formed by the *Addition* or *Subtraction* of *simple Surds*: as $\surd : 5 + \surd : 2$ $\surd : 5 - \surd : 2$, or $\sqrt[3]{\ } : 7 + \surd . 2$: which last is called

called an univerſal root, and ſignifies the cubick root of that number, which is the reſult of adding 7 to the ſquare root of 2.

To reduce rational quantities to the form of any *ſurd root* aſſigned. For example, if 3 were to be brought to the form of $\sqrt[4]{}$: 12, you muſt raiſe 3 up to its fourth power, and then prefixing the note of radicality to it, it will $\sqrt[4]{}$: 81, or 81 $\frac{1}{4}$, which is the ſame form with $\sqrt[4]{}$: 12. And this way may a ſimple *ſurd* fraction, whoſe radical ſign refers only to one of its terms, be changed into another, which ſhall reſpect both *numerator* and *denominator*. Thus $\frac{\sqrt{}:2}{25}$ is reduced to $\sqrt{}$: $\frac{2}{25}$ and $\frac{5}{3}$, to $\sqrt[3]{}$: $\frac{125}{4}$; where the radical ſign affects both *numerator* and *denominator*.

To reduce *Surds* to the loweſt term poſſible. Divide the *ſurd* by the greateſt *ſquare*, *cube*, *biquadrate*, &c. or any other higher power which you can diſcover, is contained in it, and will meaſure it without any remainder; and then prefix the root of that power before the *quotient*, or *ſurd*, ſo divided; this will produce a new *ſurd* of the ſame value with the former, but in more ſimple terms.

This reduction is of great uſe, whenever it can be performed; but if no ſuch *ſquare*, *cube*, *biquadrate*, &c. can be found for a diviſor, find out all the diviſors of the powers of the *ſurd* propoſed; and then ſee if any of them be a ſquare, cube, &c or ſuch a power as the radical ſign denotes; and if any ſuch can be found, let that be uſed in the ſame manner as above, to free the ſurd quantity in part from the radical ſign. Thus if $\sqrt{}$: 288 be propoſed; amongſt its diviſors will be found the ſquares, 4, 9, 16, 36, and 144; by which, if 288 be divided, there will ariſe the *quotients* 72, 32, 18, 8, and 2; wherefore inſtead of $\sqrt{}$: 288, you may put 2 $\sqrt{}$: 72, or 3 $\sqrt{}$: 32, or 4 $\sqrt{}$: 18, or 6 $\sqrt{}$: 8, or laſtly, 12 $\sqrt{}$: 2, and the ſame may be done in *ſpecies*.

A R M Y.

UNDER this general name may be included all bodies of men that *carry arms* under commiſſioned officers. So that, tho' it is moſt commonly confined in diſcourſe to a large body of land forces; we ſhall here treat of it in its general ſenſe, including a naval armament of ſhips, ſailors and marines, under proper officers. But ſhall begin with the *Land Army*.

A *land army* is a large body of ſoldiers conſiſting of horſe and foot; and a *naval army* is a number of ſhips of war, equipped and manned with ſailors and marines, under the command of an admiral, with other inferior officers under him.

A *land army* is compoſed, as I have already obſerved, of both horſe and foot, the horſe being called *cavalry*, and the foot *infantry*.

The CAVALRY (from the *French cavalerie*, and from the corrupt *Latin*, *caballus*, horſe) is a body of ſoldiers, who fight or march on horſeback.

The *cavalry* is divided into *horſe* and *dragoons*. The *horſe* are either regimental or independent troops, to which latter ſort belong the horſe-guards, and in *France*, the great *gendarmes*, properly called the *gendarmerie*, the *mouſquetaires*, the *chevaux legers*, and *horſe-grenadiers*.

The *horſe-guards*, by the *Spaniards* called *guardas a cavallo*, by the *French*, *gardes de corps*, or *du corps*, and by the *Engliſh*, uſually *life-guards*; are the guards of the king's perſon and body. They are divided into four troops; to which are now added, by eſtabliſhment, two troops of grenadiers, conſiſting of 80 men, all under the command of a captain.

Each troop of horſe-guards is divided into four diviſions or ſquadrons; two of which conſiſting of 100 men, commanded by a principal commiſſion'd officer, two brigadiers, and two ſub-brigadiers, with two trumpets, mount the guard one day in ſix, and are relieved in their turns.

Their duty is, by parties from the guard, to attend the king's perſon, when he goes out near home.——When he goes out of town, he is attended by detachments out of all the three troops.

One of the three captains of the *horſe-guards* attend on the king when he walks on foot, immediately next his perſon; carrying in his hand an ebony ſtaff, or truncheon with a gold head.

One diviſion of the *grenadiers* mounts with a diviſion of the troop, to which they belong; and go out on ſmall parties from the guard, perform centinel duty on foot, attend the king alſo on foot, &c.

The *gardes de corps*, or *life-guards* in *France*, conſiſt of four companies of horſe. The firſt was antiently *Scotch*, and ſtill retains the name; tho' it now conſiſts wholly of *Frenchmen*. Not only the name, but they alſo retain the antient phraſe or formula of anſwering when called upon, *I am here.*

The

The *Scotch guard* was first established in *France* by *Charles* VII. who chose himself a guard out of such *Scots* as were sent by the earls of *Bucan*, *Douglas*, and other *Scotch* lords, to drive out the *English*.

The *grand gens d'armes*, are also a troop of gentlemen, to the number of about 250, who guard the king's person. The king himself is their captain, and one of the prime peers the captain-lieutenant. When the king marches with all his houshold troops, the *gens d'armes* close the march. Their device is a thunder-bolt falling from heaven, with the motto, QUO JUBET IRATUS JUPITER.

The MUSQUETEERS are also of the king of *France*'s horse-guards; there are two troops of *musqueteers*, distinguished into the grey and black *musquetcers*, from the colour of their horses. These are young gentlemen of distinction, instructed at the king's expence in all the rules of the military art of discipline.

These three bodies of cavalry of the king of *France*'s houshold, *viz.* the *gardes du corps*, the *grand gens d'armes*, and the *musqueteers*, are composed of none but of persons of distinction.

That body of horse called by the *French*, *gendarmerie*, is also of the king's houshold, and consists of sixteen companies, *viz.* the *Scotch gens d'armes*; the *English gens d'armes*; the *Burgundy gens d'armes*, and the *Flemish gens d'armes*, which four companies compose the king's *gens d'armes*.

The other companies take their names from the princes who command them, as captains, *viz.* the queen's *gens d'armes*; the queen's *light horse*: the dauphin's *gens d'armes*; the dauphin's *light horse*: the duke of *Burgundy*'s *gens d'armes*; the duke of *Burgundy*'s *light horse*: the duke of *Orleans*'s *gens d'armes*, &c. Each troop at a medium, consists of seventy-six *gens d'armes* or *light horse*.

Light horse in *England* includes all the horse, except those of the life guard.—The denomination arose hence, that anciently they were lightly armed, in comparison of the royal guards, which were armed at all points.

The regimental cavalry is composed of what we call here *troopers*, and in *France*, *cavaliers*.

The best qualities for a TROOPER is to be bold and resolute, strong and healthy, of a daring and sprightly temper, ambitious of honour, and fearful of nothing but shame and disgrace.

The troopers are formed into *troops*, each troop consisting commonly of 50 private troopers, besides a *captain*, a *lieutenant*, a *cornet*, and a *quarter-master*.

A CAPTAIN should be endued with a great and generous soul, preferring his honour above all things, life not excepted. When he first appears at the head of his *troop*, he is to salute the subalterns, and having produced his commission, assure them of his friendship; and then invite them to his quarters.

A *captain* must chuse a trumpeter who understands how to sound well, and particularly one who has been trained up in the war, and in whom he can confide. A man thus qualified, when sent to the enemies camp, or any of their garrisons, may give an account how the enemy is posted, the nature of their entrenchments, ditches, out-works, and of their guards and the avenues to their camp.

The LIEUTENANT of a *troop*, ought to be a person trained up in the cavalry, and well experienced in that part of the *military art*. When they engage the enemy as by squadron, his post is on the right or left, according to the seniority of his commission. When the captain is commanded upon the grand guard, or any other guard, as soon as he comes to his post, the *lieutenant* having drawn up the *troop*, shall continue at the head of it on horseback, while the *captain* receives orders, and goes with the *quarter master* to place the vedettes or out-posts, on horseback, and to view their posts, and instruct them how they are to behave themselves, till the *captain* returns to give the other necessary orders for his guard.

The duty of a CORNET consists principally in carrying the standard upon a review, or other public appearance, or to bear it in the day of battle, and in an engagement to defend it; to salute the prince, and in his absence the general, and his post is in the centre of the *squadron*, about half a horse's length behind the field-officer.

A QUARTER-MASTER, ought to be a man of good parts, activity and experience, since the œconomy of the subsistence, and service of the troops, depend upon him. He is to receive orders and the word, which he should commit to writing, and then carry them to his officers He is to shew his orders to the magistrate, and acquaint him with the captain and other officers of his retinue, and to view their quarters, that they may have no cause to complain The quarters being timely provided, he shall mount and meet the troop as it draws near; and if the billets be delivered to him, he is to conduct the *captain* and the *troop* to his quarters, and drawing up the troop in one single rank, cause the billets to be drawn out of his hat, and admonish the *troopers* to be civil to their landlords. He is to keep an exact list of the quarters, that he may visit their horses; and if any of them have received any damage, he is to take care to have them speedily cured.

When the trumpet sounds to horse, he is to mount first and hasten the troopers, and repair to the *captain*'s quarters. Upon a march, his post is u, on the flank of the *troop* or ſquadron, and he is to ride from the front to the rear, and from the rear to the front, to view the ranks, and make them keep their due diſtance. In time of action he is to be upon the flank, with his ſword drawn, to prevent the men falling into diſorder, and to kill the firſt who ſhall offer to fly.

Troops are formed into ſquadrons; three troops to each ſquadron: and thoſe ſquadrons into regiments; three ſquadrons to each regiment, which commonly conſiſts of 300 men: tho' there are ſome in *Germany* of 2000 men.

Among us a regiment of men is commanded by a *colonel*; and in *France* by a *meſtre de camp*.

There are *colonels*, *colonel-lieutenants*, and *lieutenant colonels*. A *colonel* is an officer, who has the command in chief of the regiment. A *colonel-lieutenant*, is he who commands a regiment of guards, whereof the king, prince, or other perſon of the firſt eminence is colonel. And a *lieutenant-colonel*, is the ſecond officer in a regiment; who is at the head of the *captains*, and commands in the abſence of the *colonel*. In the horſe, the *lieutenant colonel* is the firſt captain of the regiment.

The Dragoons are alſo ranked in the *cavalry*. The *dragoons* are a body of ſoldiers, who march on horſeback, and fight on foot; tho' moſt commonly on horſeback.

The *dragoons* are uſually poſted in the front of the camp, and march firſt to the charge, like a kind of *enfans perdus*. They are by ſome reputed as belonging to the infantry, and in that quality have colonels and ſerjeants; but they have cornets too, like cavalry.

The Cuirassiers belong alſo to the cavalry, ſo called from wearing a *cuiraſs*, which is a piece of defenſive armour, made of an iron plate well hammered; ſerving to cover the body from the neck to the girdle, both before and behind. The *cuiraſs* was not brought in uſe till about the year 1300. Good part of the *German* cavalry are *Cuiraſſiers*.

The *Ottoman cavalry* are called Spahis, chiefly raiſed in *Aſia*, and the aga or commander of the *Spahis*, *Spahi Agaſi*.

The moſt conſiderable part of an army conſiſts in the foot, or Infantry, divided alſo into companies, battalions and regiments.

A Company is a little body of infantry, commanded by a captain. The number of men in a company is uncertain; in the ordinary regiments it is fifty centinels, beſides three ſerjeants, three corporals, two drums, &c. A company in the guards is eighty private men. In the *French* guards, the company is 120, in the *Swiſs* guards 200. Companies not imbodied into regiments are called *independent companies*.

The officers of a *company of infantry* are a *captain*, a *lieutenant*, an *enſign*, and a *ſerjeant*.

A Captain *of infantry* muſt underſtand perfectly the duties of a *lieutenant*, *enſign*, and *ſerjeant*. He muſt at leaſt know the lines of defence, and how to gain a flank'd angle, to carry up a trench to it, to make a good lodgement upon it, and to flank it well; to order his place of arms and batteries conveniently: to begin the ſap at the foot of the *glacis*, on the edge of the ditch; to make a deſcent into a place that is eaſy to be defended; to carry a gallery acroſs a ditch, after he has made a good lodgement to ſupport it, well empaled and flank'd; ſo that the enemy may not attack it without danger; and in fine to know how to lodge himſelf on a breach; for though there are engineers who are to order theſe things, yet they are generally tedious, and many eyes can ſee more than two. Beſides as a *captain* is ſometimes obliged to do the duty of a *major*, or *major of brigade*, he muſt therefore be laborious and vigilant, and underſtand their duties, rights, privileges and prerogatives. Moreover he is to know all the other duties of thoſe poſts to perfection; the articles of war; how caſes have been decided upon controverſies formerly ſtarted; the poſts of all regiments, and what is due to his own.

A Lieutenant of *infantry* ought to know the duty of a ſoldier to perfection; and, allowing him to have the qualifications of an *enſign*, he is farther to know how to diſcourſe pertinently of the methods of war; as how to gain an advantage in all places and exigencies; of making a good encampment; of intrenching in all ſorts of places; of cantoning without noiſe or confuſion, becauſe he commands the company in the abſence of the *captain*. He muſt know all the ſoldiers of the company, and hold intelligence with ſome of them, to take care that they keep their arms clean, to ſend their ſick to the hoſpital, and to ſee that they be diligently attended.

An Ensign ſhould be perfect in all the duties of a ſoldier, and be expert in handling his arms, and he ſhould teach and cauſe them to be taught before him.

A Serjeant ſhould be perfect in the exerciſe of the fire-lock, and the uſual evolutions, that he may inſtruct raw and ignorant ſoldiers; and he is to ſee that the word of command, when given to the battalion, be punctually obeyed.

A *Serjeant* is to be diligent in his duty, both upon a march, and in garriſon. He muſt ſee all his ſoldiers quartered before he quarters himſelf.

The Companies of Infantry are formed into *battalions*.

A BATTALION, is a little body of *infantry*, rang'd in form of battle, and ready to engage. A *battalion* usually contains from 5 to 800 men: but the number of men it consists of is not determined: tho' in *England* it is generally understood to consist of 700 affective men. *Battalions* are usually drawn up with six men in a file, or one before another.

A REGIMENT usually consists of several *battalions*; though some consist but of one, which is too few; others of four, or five, which are too many. The *French regiments* consist commonly of three *battalions*, or fifteen *companies*.

A *Regiment* is commanded by a *colonel*, a *lieutenant-colonel* and a *major*.

The COLONEL of a regiment of *infantry* should be a man of credit and authority; grave in his behaviour; lofty in his deportment; yet without vanity and haughtiness; courteous to all men, particularly, to the officers of his own regiment. He must frequently view and examine all the companies in his regiment, commending those captains who have good ones, and privately reprimanding those who have bad; and he is to be frequently present, when the regiment performs their exercise, and to encourage such who do better than the rest.

The duty of a LIEUTENANT COLONEL is much the same with that of a *colonel*.——In the absence of the *colonel* he is to command the regiment, and then the *major* is to receive orders from him.

A MAJOR of a regiment of *infantry* should have a profound experience in war; especially in the foot service. —— He is to understand how to attack a place; and when the regiment marches into the field, he is to give notice of the effective strength of it, and is to acquaint the *general*, or his *sovereign*, if he discovers any evil design among the officers.——Besides the knowledge of drawing up the forces, forming battalions, and exercising them, the *major* of a regiment is to see, that in marching they observe their distances, that they carry their arms well, that the ranks be strait, and every thing done with decency, and a good grace. — In the field he should have two or three horses, war-horses, and pads; because it is his business to carry orders, and to be every where upon occasion. — The *major* must also have an *adjutant*, who ought to be well mounted, and be a person of experience, ability, courage, and judgment; because he is the *major*'s right-hand, to ease him of part of the great burden of his employment, and upon all occasions in his absence, whether from wounds, sickness, or any other occasion to perform all the duty of a *major*. —— Care is to be taken that there be a good *drum-major* to the regiment, who is to teach the others how to behave on all publick occasions.

The SQUADRONS of *cavalry*, and the *battalions* of *infantry* are formed into *brigades*.

The BRIGADE of an *army*, consists of ten or twelve squadrons, or of five or six battalions, and in this manner, an *army* is sometimes divided into eight *brigades*; four of horse and four of foot. Each *brigade* is commanded by an officer called *brigadier-general*, who has under him an officer called *brigadier-major*, or *major* of a *brigade*, to assist him in the management, and ordering his *brigades*, in which he acts as a *major-general* does in an army.

An ARMY is commanded by a *general*, who has under him *lieutenant-generals*, *majors-general*, *brigadiers*, &c.

A GENERAL is an officer whose command is not limitted to a single regiment, but extends to a body of forces, composed of several regiments.

A Prince can never be too cautious in the choice of his *generals*, since the preservation or loss of kingdoms often depends upon the conduct of those intrusted with the command of *armies*.

The principal qualities requisite in a GENERAL, are courage, conduct, and zeal; and if a natural inclination to war attends these qualities, there are scarce any difficulties which may not be surmounted.

The duties of a *general* are to order an encampment, to post the camp-guard, to march an army, to draw it up, to give battle, to attack enemy's quarters or towns, to form a blockade, and lay siege to any place. He must understand what train of artillery is requisite in proportion to the strength of his army, and what he is capable of attempting; and also from whence he is to have his provisions and ammunition; what money will be allowed to pay his men to defray the charge of works, for his provisions, artillery, and hospitals, and for secret services; upon which matters of the greatest importance frequently depend.

A LIEUTENANT-GENERAL is next in rank to the *general*; he commands in battle one of the lines or wings; a detachment in a march, or a flying camp, also a quarter at a siege, or one of the attacks, when it is his day of duty.

MAJOR-GENERAL, is a general officer, who receives the *general*'s orders, and delivers them out to the *majors* of *brigades*, with whom he concerts what troops are to mount the guard, what to go on parties, what to form detachments, or to be sent on convoys, &c.

There are other general officers attending an army, as *general* of the artillery, *engineer-general*, *muster-master*, or *commissary-general*, &c.

General of Artillery, more properly called *maſter of the artillery*, is an officer, who has under his command and direction the train of *artillery*, which follows an army, and all the batteries at a ſiege. He has under him a great number of ſubaltern officers.

Muster-Master, or *commiſſary-general*, is an officer in the army, who takes account of every regiment, their number, horſes, arms, &c.

Having thus formed an Army, both of *cavalry* and *infantry*, appointed and commiſſioned all the officers both general and private, inſtructed them in their ſeveral duties; we muſt not keep it idle in its quarters; therefore we will order to beat the *generale*, in order for an *encampment*. To order which, I'll ſend the *major-general* of the day, to mark out the camp; for if my army was to continue long in it, it would be my duty, as a *General* to mark the camp myſelf ——For the well ordering of this, I ſuppoſe my *major-general* to know the number and poſt of the troops, which compoſe the army, what train of artillery there is, and what proviſions.——He'll take with him the *quarter-maſter general* of the army, the *quarter-maſter general* of the horſe, the *quarter-maſters* of each regiment of horſe, the *majors* of foot regiments and their *quarter-maſters*, a *commiſſary* of the artillery, and a *commiſſary* of the proviſions.——The head officers of the *army* muſt each of them ſend one of their guard, to take up their quarters; and the *provoſt-marſhal* or his *lieutenant*, with part of their men, muſt attend the *major-general*, to be the firſt upon the quarters to prevent any body from foraging.

The *provoſt-marſhal* of an army is an officer appointed to ſeize and ſecure deſerters, and all other criminals. The *provoſt-marſhal* is to go often abroad round the army to hinder the ſoldiers from pillaging; it is his office to indict offenders, and to ſee the ſentence, paſſed upon them, executed. He likewiſe regulates the weights and meaſures, and the price of all proviſions, &c. in the army. for the diſcharge of his office, he has a *lieutenant*, a *clerk*, and a troop of *provoſts*, or *marſhalmen* on horſe-back; as alſo an executioner.

The *major-general* muſt alſo take a guard ſufficient to conduct him ſafe to the ground, on which he deſigns to encamp, and carry horſe and foot enough with him, if he is apprehenſive he ſhall meet with any oppoſition from the enemy; and if he is not, he then may leave the army a league, or three miles diſtant from the place he deſigns for the camp; but if he is, then he muſt not leave them above a quarter of a league, or little more than a mile behind him. If he is not acquainted with the way, he muſt take guides with him, and ſome officers of the train of artillery, with pioneers, and cart-loads of tools, to make the way eaſy for the army to march; and if there be much work to be done, a guard muſt be left to ſecure the pioneers. He muſt detach a party before him to go and view the ground, and on the right and left to prevent ambuſcades, and to appoint them a place of rendezvous, which is generally on a riſing ground, the way he comes to them, if he has not a particular reaſon for not ſhewing himſelf. If the detachments are not returned, when he comes up to the place of rendezvous, he muſt halt there till he has intelligence of them, and ſend out parties the way they ſhould come; and he muſt not take the ground till he has heard of them, or at leaſt till the ground has been nicely viewed. He is to regard the conveniency of forage, of ſprings, brooks, marſhes, of woods, the goodneſs of the way, the conveniency of filing off to march the next day, and the diſtance of the place from whence the army ſets out, that the march may not be too long or too ſhort.

If the *major-general* has more troops than are neceſſary for the guard of the quarters, he ſhall order them to diſmount, and let their horſes graze. He ſhall leave a ſmall guard on that ſide by which he came; and if from an eminency he cannot diſcover all round the quarters, he then ſhall ride over all the ground, and in the mean time the *quarter-maſter general* ſhall mark out the ground, and divide it among the *quarter-maſters*; and if there remains any after the general officers have their ground, it muſt be given to officers of regiments for their baggage, they being obliged to encamp with their corps; and the *quarter-maſter-general* is to make his report to the *major-general*, that he may lodge the *general's* guard by his quarters, and the others who are to be about him. He ſhall ſhew to the *majors* of *brigades* the ground that is allotted to each of them, and the *quarter-maſter general* of the horſe where he is to encamp. He ſhall alſo appoint the place for the cannon, and the park for the train and proviſions.

A *quarter-maſter-general* is a general officer, whoſe buſineſs is to provide good quarters for a whole army. A *quarter-maſter* of horſe, quarters for a troop of horſe. And a *quarter-maſter* of foot, for a regiment of foot.

The park of the *train of artillery* is generally near the cannon; but in caſe of danger the ſafeſt place is about the camp; becauſe an army may be routed by loſing its ammunition. The horſes of the *artillery* are to encamp, or graze, near the park. The proviſions are for the moſt part near the *artillery*, and the bread carts are drawn up in a ring to incloſe their horſes; but it is better to incloſe the ammunition with them, if you fear the enemy.

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The *cavalry* is to encamp the nearest to water, and to orchards, or hedges, if there are any, that they may have time to mount, and not be surprized in case of an alarm; and ways should be cut a-cross them towards the general's side, to receive orders, and towards the open plain, to march out to the field of battle. The camp of the horse is covered with that of the foot, leaving the space of fifty foot between them; but if the foot are so weak that they cannot cover the camp of the horse, then they are to encamp on that side that is most exposed to the enemy. The troops are to have their back towards the quarters, and to face outwards; and their file, or rows of huts, being three paces from their arms, which are always in the front. The *serjeants* have the front hut, and the officers encamp in the rear.

In an encampment for a night, fifty paces in depth, of three foot to a pace, and four paces in breadth are allowed for every company, for the soldiers huts; and if the company exceed not seventy men, ground is to be allowed only for one row, or file of huts. The *subalterns* are next behind the huts, the *captains* behind them, the field officers behind the *captains*, and a convenient interval for a large street is left, clear between every two regiments. But the horse have fifty paces in depth for sixty horse, and fourteen paces in breadth for three rows of huts; and if there are hedges, they have as much space allowed them as is requisite to tie their horses. If the enemy be stronger in horse, and the *major-general* apprehends that the camp may be attacked, he must order ditches and trenches to be cut in their way, to prevent their charging in good order, to gain an opportunity for the foot to engage upon an advantage; but if the enemy be stronger in foot, then the *major-general* should encamp on the edge of a plain, that the horse may draw up there, and the enemy's foot be afraid to engage where they can have no advantage against the horse.

A convenient place must be chosen by the *major-general*, to draw up the army in case of an alarm, and there the forces are to rendezvous: and besides the general field of battle, every regiment must have its particular ground to draw up on, from whence it must not march, 'till it has formed the battalion, or squadron; otherwise a small number of the enemy's forces, having gained the field of battle, would defeat a great *army*, should they be divided into small bodies, and those ill formed. It is dangerous to appoint but one field of battle for all the forces; because, should all the avenues to the camp be left unguarded, the enemy might give an alarm in one place to draw the *army* thither, and then attack it in another. It would therefore be convenient to appoint the best field of battle for half the *army*, and two or three others for the rest of the forces, there to expect the *general's* orders. If the safety of the troops only be regarded, it is best to have but one field of battle, but if we consider the loss of the baggage, something may be hazarded to save the whole. When there is cause to fear such an attempt, the best way is to encamp in battle, so that every battalion and squadron drawing up before their own tents, will there be in order; and if the enemy is near, and has no defile to pass, the troops are to continue loose, and shall rest upon their arms, being drawn up. If there be the least danger to be apprehended, the eldest regiment in the *army*, the artillery, the provisions, and a great part of the foot, must encamp near the *general's* quarters. Those troops, which are to have the van next day, must encamp on the most advanced part of the camp, on the way they are to march, and so likewise if the quarters are divided.

But when an *army* is to encamp for any time, the *general* for the most part orders the encampment. He is then to consider what provisions are in or near the place, and what conveniency of securing and bringing them to the *army*; and if there be corn how it may be made into meal. If there be no provisions, he must consider how to get them, and take care that they be not cut off by the enemy. The conveniency of forage, water, shelter, wood, and wholesomeness of the air, to prevent diseases, are also to be considered: if he must entrench, a convenient ground must be sought out. In this case the manner of encamping shall be according to the method of entrenchment; and the head of the camp shall be at least a hundred paces from it, without extending the camp too far: and the intrenchment is to be made as near as can be on the highest ground all about the camp, provided it be not at too great a distance; and though it seems, when of the greatest extent, to require the greatest guard, yet fewer men will maintain it, than when it is smaller, and the enemy has the advantage of the ground.

The ditch of the entrenchment must be at least nine feet over at the top, and three or four at the bottom, and six in the depth: but experience has taught us, that there may be more hopes in fighting in an open field, than behind a less intrenchment than we represent, even though our *army* be weaker than the enemy: for the soldiers placing most of their hopes in the strength of the intrenchment, if one part be forced they abandon the rest, and the assailants, being persuaded that all the difficulty consists in forcing the intrenchment, think nothing can stand before them, and with this confidence they increase their courage.

However this intrenchment is good, when the ditch is 12 feet wide at the top, four at the bottom, and eight in depth; and when the earth is thrown up out of it, makes a proportion l *parapet*, with a *banket* behind it or the muſketeers to ſtand on. At every eight feet diſtance there muſt be *redans*, or indented works; and it is obſervable that twenty ſhots flanking do more execution, than ſixty right forwards. No redoubts are to be made there, becauſe if the enemy ſhould once poſſeſs them, it would be hard to diſlodge them. It is alſo dangerous to make any forts, becauſe the loſs of one of them would open a way for the enemy into the intrenchment; but if there be any higher ground that might command the camp, or advantagious place within it, which might facilitate the rallying the forces, in caſe they were routed; three forts may be made, provided there may be no fear of loſing them. The ditch of them muſt be fourteen or ſixteen feet over at the top, and five or ſix at the bottom, and nine or ten in depth: Palliſadoes and ſtockades muſt alſo be fixed on the edge of the ditch faced with ſods, and *fraiſed* where there are no ſods; the earth muſt be held together with faſcines, and well beaten down, and *chevaux de friſe* placed in the intervals. Men vary in their opinion concerning the placing palliſadoes. If they are placed in the ditch, they may ſerve to help up planks to come at the parapet, and there may be *ponts volans*, or flying bridges, laid on, ſo that the ditch will be uſeleſs: but as it has this diſadvantage, it has alſo an advantage, which is, that the enemy cannot break in with their cannon, as they can on the edge of the ditch; and therefore where there is more danger of a ſurprize, than a regular attack, I would adviſe to place it on the edge of a ditch; and in the bottom, where they apprehend being attacked in form.

When the *army* is encamped, and the enemy is not very near, an eighth part of the *army* is generally upon guard, and diſpoſed according to the eaſineſs, difficulty, or the conſequence of the avenues, for the guard of horſe. During the day time, if the enemy be feared but one way, one half or two thirds of thoſe that mount the guard ſhall be poſted on that ſide, about a quarter of a league from the camp, or ſomewhat further if it be a champaign country. About an eighth part is detached from that guard, ſeven or eight hundred paces further upon ſome eminence, if there be any, which ſmall guard detaches one or two vedets to be poſted on the moſt advantageous ground for diſcovery. All guards are to be poſted that the main guard may not be cut off from the camp, nor the ſmall guards from the greater.

Note, There are ſeveral kinds of guards, as, 1. *Advanced Guard*, a party of horſe or foot, which marches before a corps, to give notice of approaching danger. When an army is upon the march, the *grand guard* which ſhould mount that day, ſerves as an *advanced guard* to the army. That a ſmall body alſo of fifteen or twenty horſe, commanded by a lieutenant beyond, but within ſight of the *main*, or before the *grand guard* of a camp, are called the *advanced guard*. 2. The *Grand Guard*, which conſiſts of three or four ſquadrons of horſe, commanded by a field-officer, and poſted before the camp on the right and left-wing towards the enemy, for the ſecurity of the camp. 3. The *Quarter Guard*, which is a ſmall *guard*, commanded by a ſubaltern officer, and poſted by every battalion of a camp 100 yards before its front. 4. The *Standard Guard*, a ſmall guard of foot, which a regiment of horſe mounts in their front under a corporal. 5. The *Main guard*, from whence all the other *guards* are detached. Thoſe who are to mount the *main guard*, meet at the reſpective captain's quarters, and from thence go to the parade; where after the whole *guard* is drawn up, the ſmall *guards* are detached for the poſts and magazines; and then the ſubaltern officers draw lots for their guards, and are commanded by the captain of the *main guard*. 6. The *Picquet Guard*, which is a number of horſe and foot, who keep themſelves always in a readineſs in caſe of an alarm; the horſes being ſaddled, and the riders booted all the while: the foot draw up at the head of the battalion at the beating of the tattoo, but afterwards return to their tents, where they remain in a readineſs to march on any ſudden alarm. This *guard* is to make reſiſtance in caſe of an attack 'till the army can get ready: A *Vedette* is a centinel on horſeback, detached from the main body of the army, to diſcover and give notice of the enemy's deſigns.

If the country be incloſed, the *main-guard* muſt be ſo near the camp that it cannot be cut off, but yet at ſuch a diſtance, that if the enemy appears, they may give timely notice; and to prevent the army being ſurprized, they muſt ſend out little *guards* of two or three hundred horſe on the right and left, who ſhall poſt *vedettes* for their ſecurity. The commander ſhall from time to time viſit the *advanced guard* and *vedettes*; and the time of the *guard* be ſo divided in relieving them, that every man in his turn may be upon the *advanced-guard*, who are not to diſmount, except in a very open place, and then the horſes muſt not be unbridled. The *main-guard* may unbridle half the horſes, the other remaining in readineſs. If the country be incloſed, ſcouts muſt be ſent from time to to time, ſome going ſtrait forward, others a-croſs from one ſmall *guard* to another, to take care that the enemy do not ſlip in between. When the *main-guard* is ordered, the reſt of the *cavalry* ſhall be divided into two or three other *guards*, to be diſpoſed about the camp; and they may be ſtronger or weaker, as there is occaſion.

The *guards of foot* are generally at the head of their own battalions, but if there be a ſteeple, tower, or ſtrong houſe near the camp, a *guard* of foot ſhall be ſent to it: ſo likewiſe, if there be any paſs upon a river, or any deep valley, about half a quarter of a league from the camp, and the country be not much encloſed, a *guard* of foot ſhall be ſent there at night only. If the paſs be at a diſtance, ſome foot may be ſent, ſupported by a *guard* of horſe; but if the place be too dangerous for the foot, a few horſe may be ſent to inform of the enemy, or ſcouts may be ſent thither often. Every regiment ought to ſend 50 men, according to its ſtrength, every night upon the *guard*, at the head of the camp, commanded by a *captain* and *lieutenant*, or one of them, if there be cauſe to fear any thing.

When the *major general* appoints the *guard* for the day, he ſhews the place where they are to retire at night, which is generally within two or three hundred yards of the camp. He is to viſit them once in a night, to ſee if they are poſted according to his orders; that is, whether the officers are there, and their number complete; whether the detached *guards* are on horſeback, and half the *main-guard*, and the reſt in their rank, and horſes bridled; whether the neceſſary number of *vedettes* be poſted for the ſecurity of the camp, and whether from time to time they ſend out their ſcouts, who are to be ſent from one *vedette* to another, when there is a poſſibility that the enemy may ſtep between them and the *vedettes*; or elſe the *vedettes* being coupled, as they ought to be at night, one of them goes as far as the others on the right; and when he returns, his comrade goes as far as the *vedettes* on the left, and thus they continue all night. Scouts are alſo going continually about the camp from one guard to another.

The *guard* of an intrenched camp is quite different; the intrenchment is divided among all the foot, who poſt centinels on it, ſo that there can be no paſſing between any two of them; and the *guard* of horſe is weaker than when the camp is open. It is poſted within the intrenchment in two or three bodies, near the barriers that are upon the great avenues, and only ſend a ſmall *guard* 50 paces without the lines, who continually patrol, and ſend out ſcouts on the right and left, and ſtrait forwards.

Now we ſhall order the *major-general* of the day to make the diſpoſitions for the *march*; which he learns from the number of the battalions and ſquadrons of which the *army* is compoſed; what enemies may be met in the march, and whether in front, on the right or on the left; whether the way be plain or woody, or incumbred with hedges, ditches, marſhes, or rivers; whether there be one or ſeveral roads or defiles; how many men, horſes, or waggons can march in front; and which is the ſoundeſt and eveneſt way for the artillery.

If the enemy be in front, and the army in a champaign ground, he muſt march in order of battle, with the cannon in front, the horſe on the wing, and the foot in the center; then the ſecond line, and after the two lines the train of artillery, thro' as many defiles * as he can, that they may be the leſs time in paſſing. Next the train of artillery, the proviſions, and all the beggage of the *army* oppoſite to its regiments upon the ſame line with the train of artillery; that is, the baggage of the firſt line foremoſt, and in the rear the baggage of the ſecond line, then the baggage of the *rear-guard*, or *corps de reſerve*, which *rear-guard* ſhall march after the baggage, leaving only one ſquadron in the rear of them to prevent any diſorder, or running away; but upon expedition the artillery and baggage march in two or more columns.

If the enemy be in front, and the country be woody, or encloſed with hedges or ditches, advanced parties of ſcouts muſt march before, ſupported by ſome *platoons* † of muſqueteers, and thoſe by ſquadrons or detachments of horſe, if the country will prove fit for the horſe. If the country be en-

* A DEFILE is a narrow paſs or way through which a company of horſe or foot can paſs only in *file*; by making a ſmall front, ſo that the enemy may take an opportunity to ſtop their march, and to charge them with ſo much the more advantage, in regard that the front and rear cannot reciprocally come to the relief of one another. The word is derived from the *French*, *Deffile*, to unthread or unſtring.

† PLATOON is a ſmall ſquare body of 40 or 50 men drawn out of a battalion of foot, and placed between the ſquadrons of horſe to ſuſtain them; or in ambuſcades, ſtreights and defiles, where there is not room for whole battalions or regiments. The grenadiers are generally poſted in *platoons*. The word is formed by corruption of the *French*, *Pilaton*, a bottom or clue of thread.

cloſed,

cloſed, ſo that the horſe cannot come to do ſervice, a battalion is to march after the firſt ſquadron, and ſo all the horſe and foot are mixed; and as there are generally more ſquadrons than battalions, the ſquadrons ſhall be equally divided among the battalions, and each ſquadron have platoons of muſqueteers; and in this manner the *van-guard* and main body ſhall march, then the heavy cannon, the ammunition, proviſions and baggage.

The field-pieces are to march with the * *van-guard*, and the heavier pieces with the main battle, and many *Platoons* in the intervals between the baggage, for fear the enemy ſhould cut it off in the wood; then the *rear-guard* ſhall march. It is dangerous to place the heavy cannon between the battalions and ſquadrons in a country that is encloſed; becauſe, if they were drawn up in order of battle on a ſudden, and the *van-guard*, ſhould be attacked, it might hinder the march of the troops, and can do them no great ſervice. However, if the country be encloſed in ſome places, and open in others, they muſt draw up in battle when they come into the plain, if the enemy be at hand, and turn to their former order when they have paſſed it. If there are ſeveral roads, they muſt draw up in two or three columns ‡, and at the head of every one of them a cart loaded with tools, and a number of pioneers and ſoldiers.

The better to regulate the *march*, ſome *general officers* ſhould keep in the *rear* of the baggage, each according to his poſt, except among the foot, where the baggage of the *rear-guard* march according to the ſeniority of the regiment, and thoſe of the elder regiments march foremoſt, though they make a retreat. The ſutlers and other trades, who do not belong to any particular regiment, march after the baggage of the main battle. Every regiment of foot ſends a man out of each company to guard its baggage, under the command of a *ſerjeant*; and each troop of horſe one trooper. The *provoſt-marſhal*, and all the other provoſts are to march with their men, to ſee that the ſoldiers keep their ranks, and to prevent diſorder.

A *captain*, or conductor of the baggage, is appointed, who puts the baggage into the marching order, and makes the *guards* obſerve it as they march; and every regiment puts up a flag of the ſame colour and ſhape, that their baggage may the better be kept together; and ſome of them are carried to the *major-general* of the day, who orders them to be placed at the head of every column of troops and baggage.

If the enemy be on the right wing, and the country plain, they muſt march thus. Thoſe who are to compoſe the *van-guard* in the order of battle, are to be on the right of thoſe who are to compoſe the *main battle*; the *main battle* on the left of the *van-guard*, and the *corps de reſerve* on the left of the *main battle*; each of thoſe bodies making a file, with the horſe at the head and in the rear, and the foot in the center, ſo that when the army halts, and each line faces to the right, the order of battle will be formed, provided the *van-guard* obſerves its due diſtance in marching, and the troops of the *main-battle* keep oppoſite to the intervals of the *van guard*. The troops that guard the baggage are to be on the left of all the reſt, making the largeſt front they can, that their files may extend almoſt as far as thoſe of the *army*, and they are to have but one ſquadron on the left. In this order of marching, all the cannon muſt march on the right of the *van-guard*, that it may be at the head of the *army* in caſe of battle.

If the country be encloſed or cut with trenches, and the enemy on the right, the *army* muſt march almoſt in the ſame order as in the plain, provided the roads will admit it, or can be made without much labour, as in the ſummer when all lands are encloſed; and all that is altered at that time is, that a column on the right, which compoſes the *van-guard*, ſhall be ſtronger in foot, than that which compoſes the *main battle*, and each ſquadron of the *van guard*, ſhall have *platoons* of muſqueteers. The cannon muſt march between two columns, becauſe it cannot do great ſervice in a country that is encloſed: and if it were upon the right of all, the enemy might take it, or nail it, before it could be relieved.

If there be two defiles, all the troops are to march through that on the right, and the baggage

* The Van, or *van-guard* of an *army* is the firſt line, and is the ſame with the front of an *army*, and gives the firſt charge upon the enemy. Every *army* being compoſed of three parts, a *van-guard*, *rear-guard*, and *main body*. The *rear-guard* is that part which march laſt, following the *main body* to ſtop deſerters. The *main body* marches between both, and is ordinarily the *general*'s poſt. The *corps de reſerve*, are the forces diſpoſed in the third or laſt line of an *army*, and deſtined to ſuſtain the reſt, as occaſion requires, and are not to engage but in caſe of neceſſity.

‡ A Column in war denotes a deep *file*, or row of troops; or a diviſion of an *army*, which marches at the ſame time, and towards the ſame place, at intervals large enough to avoid confuſion. An *army* marches in one, two, three, or more *columns*, according as the ground will allow, and the *general* ſees expedient.

through

through that on the left; part of the field pieces in the intervals of the *van guard* part with the *main battle*, and some few with the *rear guard*. The heavy cannon is to march in the column of the baggage, but not quite at the head of it, lest the enemy send some troops to attack it, but after the baggage of the *van-guard*, that it may be the better covered by troops.

The *van-guard* files off first, then the *main body*, and next the *corps de reserve*. If there should happen to be one *defile*, then all the *van-guard* marches off first; the artillery, the provisions, and the *general*'s baggage next, then the *main-battle*, and all the other baggage, and then the *corps de reserve*. But this is a very dangerous way of marching if the enemy be near, because the line being divided by the baggage, they cannot come to succour one another: and on the other hand, should all the troops march together, and the baggage after them, it would be too much exposed, and the loss of it be as detrimental to the *army*. as the defeat of a considerable part of the troops; therefore to avoid this inconvenience, the baggage should in this case march through another defile, than that the troops march through, tho' it were a league distant; and so they ought to have a guard of a sixth or fourth part of the *army*, according to the force which it may be expected, that the enemy would send to attack it. In such a march it should have many small parties of horse if they can be had; if not, of foot, to scour on the right, and discover if the enemy comes to attack it, at which time surprizes are most dangerous, because it is difficult for troops when they are put into disorder in a *defile*, to rally. Parties should be frequently sent out towards the enemy, that if one should happen to be cut off, the other might give notice of it.

If the enemy be in the rear, the order prescribed must be inverted; and when there are *defiles* in the way. great care must be taken to make them easy, that the troops may come to each others succour, if the *rear* should be attacked. The field-pieces must be lodged on the edge of the *defile*, to favour the retreat of the hindmost troops, unless it be woody; if not, then many field-pieces are more necessary than at another time.

When there is little cause to suspect the enemy, and the country is champain, the *van-guard* marches in two columns, then the *main battle*, and the *corps de reserve* after it; in the same order, the baggage between the two columns, with the artillery and provisions in the front; or else the *van-guard* may march in three columns, the *main battle* in the same manner, and the artillery, provisions, and baggage after it, and last of all the *rear-guard*, or *corps de reserve*.

If the country be inclosed, and there is but one *defile*, then let the *van-guard* and *main battle* march next the artillery, provisions and baggage, and then the *rear-guard*. If there are many *defiles*, the *van-guard* and *main battle* may march in as many columns, then the baggage after them, and the *rear-guard* last; or else the troops and baggage may pass through several *defiles*. When the order of marching is resolved, the *major-general* is to acquaint the *general* with it, to know whether it meets with his approbation.

The enemy is in sight, and I must prepare for a battle. Let all my officers be called to receive the orders for a general emgagement. First let me instruct them how they are to behave themselves in fight. Every respective officer ought to encourage and animate the soldiers in the combat, more by their courage, intrepidity and valour, than by their discourses; since a good example makes a stronger impression on their mind than a studied and florid discourse. The horse-officers should be well mounted, and have horses with good mouths.

An officer should not ride a fleet horse on the day of battle, except he rides him usually at other times, lest he gives occasion to have it said, that he chose that horse to run away the faster. He must take care to have his horse's buttocks within the front rank, and the ranks so close, that they may not be broke; for the strength of a squadron consists in being kept close. In pursuit of the enemy the squadron must be kept in order of battle, and if they come to a defile, make a halt, till all are past, and then form again. When a battalion or squadron is formed in the face of an enemy, the best way is to form them by ranks, and not by files. Where there are ditches or hedges, an officer of horse must take care not to get too far from the foot, lest he should want their assistance; and therefore platoons should be always placed between the squadrons. When the enemy is routed, the men must not stay for plunder, for by that means the enemy will gain ground and get off safe: or the enemy might rally, and change the face of affairs. There are rules for plundering as well as for every thing else, and detachments are generally appointed for it. Prisoners taken in battle are to be put into the hands of men detached to secure them. If soldiers will not refrain from plunder when they are ordered another way, one of them should be shot, as an example to the rest.

A Battle, is an action which passes between two *armies* ranged in order of *battle*, and who engage in a country sufficiently open for them to encounter in front, and at the same time; or at least for the greater part of the line to engage, while

while the remainder is in ſight, by reaſon of ſome difficulty, which hinders it from entering ſo readily into an action, with a front equal to that which may be oppoſed to it by the enemy.

Other great actions, tho' generally of a longer duration, and even frequently attended with great ſlaughter, are only called *ſkirmiſhes*.

A *battle* loſt, almoſt always draws with it the loſs of the artillery of the army, and frequently alſo that of the baggage: conſequently as the *army* beaten cannot again look the enemy in the face, till it have repaired thoſe loſſes, it is forced to leave the enemy a long time maſter of the country, and at liberty to execute all its ſchemes. Whereas a great fight loſt is rarely attended with a loſs of all the artillery, and ſcarce ever of the baggage, becauſe the two armies not meeting in front, they can only have ſuffered in the part that has been engaged.

The hiſtory of *battles* are only the hiſtory of the faults and overſights of *generals*.

Therefore we muſt ſo contrive the order of *battle*, that all the troops may ſupport one another without confuſion, that when one body is broke it may not bear down another; and they ſhould make the largeſt front, as well to prevent being out flanked by the enemy, if they are in more open order, as to encloſe them if they are in a narrow compaſs. And yet they muſt not be extended ſo much, that when one body is broken, there may be none left to ſupport it, and to oppoſe them that have routed it; or that the battalions and ſquadrons ſhould be ſo diſtant, that if two of the enemies ſhould happen to join one of ours, thoſe on the right or left of it, could not come to its relief before the enemy had broke it.

To keep a due proportion, we muſt draw our army in two lines, *viz.* the firſt and ſecond line, which muſt be of equal force, and the *corps de reſerve*. The foot ſhall be placed in the center, and the horſe on the wings. The ſquadrons from one hundred and fifty men each, at leaſt, to two hundred at moſt, and but three deep. The battalions of five, ſix, or ſeven hundred at moſt, and drawn up three deep. If our *army* conſiſt of forty ſquadrons, and eighteen battalions, we ſhould place ſixteen ſquadrons, and eight battalions in the firſt line; ſixteen ſquadrons and ſeven battalions in the ſecond, and eight ſquadrons and three battalions in the rear-guard, or *corps de reſerve*. Or elſe in the firſt line place fourteen ſquadrons and nine battalions; in the ſecond, ſixteen ſquadrons and five battalions; and in the *rear guard*, ten ſquadrons and four battalions. Or elſe in the firſt line, let there be ſixteen ſquadrons and ten battalions; in the ſecond, ſeventeen ſquadrons and ſix battalions, and for the *rear-guard*, ſeven ſquadrons and two battalions.

The eldeſt corps has the right, the next the left, and ſo on according to ſeniority, till the youngeſt meet in the center. The firſt line is more honourable than the ſecond, and the ſecond than the *rear-guard*. The guards are always in the line of battle, and the *carabineers* * and *fuſileers* are on the wings, ſomewhat advanced before the other troops. The ſpace of two hundred paces is allowed for the diſtance between the firſt and ſecond line, and one hundred between the ſecond and the rear-guard.

The battalions and ſquadrons of the ſecond line are placed oppoſite to the intervals between thoſe of the firſt line, that they may march through the enemy; and thoſe of the firſt line, if broken, may paſs through the intervals of the ſecond without diſorder to either. The intervals are to be half the breadth of the front of the battalion or ſquadron that it fuſtains, when doubled from three to ſix. It has been found of ſervice to place all the foot almoſt in the two firſt lines, as being very near uſeleſs in the *corps de reſerve*, becauſe they cannot come time enough to relieve the troops that are bore down. More foot ſhould be placed in the firſt line than the ſecond, and their place be ſupplied in the ſecond by ſome ſquadrons, which would do great execution, coming up to charge between the two battalions, after they had ſpent their fire: beſides, the foot would be greatly encouraged, who love to be ſuſtained by the horſe, and the horſe would charge with more alacrity, after the foot have given their firſt volleys; and the fire of the battalions has more effect when the firſt troops have the onſet, than when they are mixed, and in confuſion; and it often happens that the battalion of the ſecond line do not ſpend half their fire, being come up to puſh of bayonet before they make their diſcharge.

The cannon muſt be placed in brigades before the firſt line, reſerving ſome few pieces an hundred paces behind the *corps de reſerve*, guarded by a ſmall number of men to favour a retreat, or prevent being attacked in the rear. If there be any riſing ground, either in the front, or on the right or left, the utmoſt efforts muſt be made to gain it, in order to plant the cannon there, and prevent the enemy taking the ſame advantage of it; and ſome-

* The CARABINEERS are a ſort of light horſe, carrying longer *carabines* than the reſt; and uſed ſometimes on foot: The *French* of late have formed entire corps of theſe *carabineers*, which cannot but have good effect: this being a ſort of ſoldiery choſen out of the whole cavalry, and better paid than the reſt. FUSILEERS are foot-ſoldiers, armed with firelocks which are generally ſlung. There is a regiment of fuſileers for the guard of the artillery.

I time

times a general battle has been changed into an engagement of regiments againſt regiments to poſſeſs an advantageous ground; and the time being ſpent till night, both parties are obliged to draw off, each finding their troops much weakened, not knowing the damage on either ſide.

The *army* being drawn up, 'tis beſt to charge the enemy before they are in order of battle; but if their ground be more advantageous than ours, as being to mount a riſing ground, or to paſs a brook, ditch, or hollow way, it is better to expect their coming than to attack them, except we be much ſuperior to them in number, and our cannon be poſted to advantage.

When the firſt line or *van-guard* advances, let the ſecond move alſo, keeping equal pace with the firſt, and leaving a ſmall interval between them, leſt the firſt ſhould be broke before the ſecond can march up to relieve it; or if it ſhould break the firſt line of the enemy, leſt their ſecond line may relieve it before ours can march up to ſuſtain our *van-guard*.

The *corps de reſerve* muſt advance gently towards the enemy, that the broken troops may have time to rally, and they muſt engage all at once, and it muſt be always obſerved to give them time to recover their ſpirits.

While there remains any hope of getting the battle, the rally'd forces muſt charge again; but if their number be ſo ſmall in compariſon of the conquerors, that all hopes are loſt, then retreat in the beſt order, and rally again as near the field of battle as you can, that you may be in a condition to oppoſe any ſmall bodies of the enemy that ſhall purſue you, and with the remains of your troops throw yourſelf into the next conſiderable town, which in all probability they will firſt attack.

A *general*'s conduct is as often commended in a *retreat*, as in a *battle*, and his intrepidity and courage as much ſignalized. As it cannot be reaſonably expected he ſhould fight in too great a diſadvantage, proceeding either from the too ſmall number of his forces, when compared with thoſe of the enemy, or from the ſituation of his army, or from his proviſions being cut off, or from the imminent danger of being ſurrounded by the enemy, ſo as to be forced to ſurrender, or to be cut to pieces, *&c.* and that the reputation of a *general* is almoſt always loſt by a flight; he muſt have ſome means left to extricate himſelf from thoſe difficulties with honour, which cannot be done otherwiſe than by what is called an honourable retreat, which, under the above mentioned diſadvantages, muſt be made with all poſſible expedition, even tho' the *army* ſhould loſe ſome ſoldiers that could not keep up with it, and a *general* muſt not quit all, or any part of his cannon, except the utmoſt neceſſity compels him to it: but for the baggage, if the retreat be not eaſy, he muſt incumber himſelf with as little as may be; and if he is ſo hard preſſed that he muſt unavoidably come to a battle, he muſt chuſe an advantageous opportunity for himſelf, endeavouring to draw up behind a wood or hill, that he may fall upon the enemy's flank; or elſe as they purſue him, making a quick countermarch, after paſſing a defile, that he may engage one part of the enemy's *army* before it can all join together. In ſuch caſes of compulſion there is no counting the number of men; for, though you are but half, or the third part of their number, yet you may lay hold of ſuch an opportunity, and with ſuch reſolution, that you may defeat them.

If you are ſo weak that nothing can be done by fighting, or ſpeedy marching; or, if a too powerful number of the enemy have got before, and hinder your paſſing; then the laſt reſolution to be taken, is to preſerve what may be ſaved, dividing the army into four or five bodies, which muſt march ſeveral ways to make their eſcape.

All orders of battle for a retreat differ according to the diverſity of circumſtances that occur; the uſual method of retreating is in columns, except a ſmall body in the rear. And in an army of 15,000 or 20,000 men, it uſually conſiſts of eight or ten ſquadrons, and two or three battalions, which are to march in a line in an open country, only keeping two ſquadrons behind to amuſe the enemy. In an encloſed country the battalions and ſquadrons muſt be intermix'd, and detached muſqueteers muſt bring up the rear. Secrecy in ſetting forwards, diligence in marching, care in mending the ways, and cunning in fighting, are all the advantages in this part of war; and a *general* who manages a retreat, in the different manners here preſcribed, is always commended and admired for his prudence and conduct.

But, as we ſuppoſe our *Army* to have gained a *compleat victory*, which has inſpired our forces with new courage, we'll not quit the field 'till we have attempted ſomething farther; therefore we'll march to the SIEGE of the next town of the enemy, where they could rally and recruit their routed forces; which the better to effect, we'll view the ground round about it, eſpecially on that ſide the enemy may come, and we'll order parties abroad to give intelligence of their march; and according to the information we receive, we'll either expect their coming, in an advantageous poſt, or go to meet them, which laſt is the ſureſt way; for if we wait for them in one certain place, we give them an opportunity of relieving the town ſome other way, which is not to be done, ſince we are not ſo weak, as to expect to fight to a great diſadvantage, for if we were, we ought to ſecure ourſelves by a ſtrong line of circumvallation.

The order of battle behind a line is quite different from the others; for a third part, or thereabouts, are poſted to man the line, and ſome are to be poſted for the moſt part in *redans*, or angles ſalīant, they being the moſt conſiderable places for defence of the line. The reſt of the forces muſt be drawn up in two lines, the firſt thirty paces from the entrenchment, and the ſecond one hundred paces from the firſt line; and we muſt intermix the battalions and the ſquadrons. It would be convenient that every ſquadron had four or five files, ſomewhat detached from the reſt, to be ready to charge any that begin to paſs the line, if we had not numbers ſufficient to oblige the whole ſquadron to charge them, unleſs we ſhould detach ſmall parties of fifteen or twenty men for this purpoſe.

All the forces muſt never be poſted to guard any one part of the line, unleſs we be thoroughly aſſured that the enemy's troops are in one body, and have not detached any number to attempt another place. The defence of a camp that is intrenched is the ſame with that of a circumvallation, (ſee *Fortification)* and the chief care is that the enemy do not fortify themſelves within the intrenchments; to prevent which, they muſt be continually charged as faſt as they enter, and not be allowed time to draw up in order of battle.

A ſufficient number of workmen muſt be ready to repair the line, when the enemies have thrown it down, and are repulſed, leſt they make a freſh attack; or elſe in order to throw down the line to ſally after them if they are much weakened, and diſcouraged. Many cannon are of great uſe for the defence of the lines; and to be planted in thoſe parts which command moſt of the plain, and in the *redans*, from whence they ſweep the length of the intrenchment.

If the enemy attempts to make us *raiſe* the Siege; and our trenches are opened, and no lines of circumvallation drawn, which, ſhould have been done, then if we are not much ſuperiour to them, we muſt draw off all our men to bend our united force againſt theirs; but if we are much ſtronger, we'll leave then as many men as may ſecure the trenches, and meet the enemy with the reſt; marching not too far, leſt they ſhould throw ſuccours into the town, who, joining with the garriſon, could gain our trenches.

But perhaps we march to raiſe a Siege, and deſign to take the advantage of the circumvallation being not finiſhed, to fight the enemy; then we muſt march directly up to the place, having firſt ſent parties to bring advice whether they come to meet us, taking particular care that they do not fight us when we are half paſſed a deſile, and that we do not attack them in an advantageous poſt — In ſuch a caſe we muſt turn to the right or left, and march another way to the place.—We muſt not march ſo cloſe that they may attack our flank or rear, but keep at a due diſtance; that if they quit their poſt, they may find us in a poſture to receive them.——If we have no mind to fight, we'll keep ourſelves in an advantageous poſt, and at night detach two or three conſiderable parties to relieve the place, and order them to take the greateſt compaſs we think fit, and while they are endeavouring to throw themſelves into the place, we'll make a ſhew of intending to fight, that the enemies may not divide their forces.

If our parties ſhould happen to be defeated, and we obliged ſoon to retire, either for want of proviſions, or for any other reaſon, or the circumvallation finiſhed before our return, then we'll hazard a battle, if the place be worth it.——To this purpoſe we'll ſend a party or two to alarm the enemy in the night, and oblige the enemy to divide their forces, then march with our army the way we think we are leaſt expected.———If the enemies have taken up their quarters and are not intrenched, we'll endeavour to ſurprize one of them, and throw in our ſuccours that way; and ſo weakening their *army*, we may be in a condition to fight them. ——But if their quarters be intrenched, we'll endeavour to chop in between them, and throw in our ſuccours that way.——If we are much their ſuperiors, then we'll attack one of their quarters; or if they all get into one, and we have put ſuccours into the place we'll encamp between them and their country to ſtarve them; or if they come out, to fight them in their retreat.

If the line of circumvallation be finiſhed, and we deſign to force it, in order to throw ſuccours into the town, we muſt encamp as cloſe as we can, that is, out of cannon-ſhot, and at night divide the *army* into one main body, and ſeveral ſmall ones, ſo to make two attacks; but they muſt not be ſo far aſunder, that if the enemy ſallies out upon one body and beats it, the other cannot come to its relief; and we'll march in the night. that the enemy may not diſcover our deſign.

The propereſt time for attacking is half an hour before day-break; for then the enemy not being able to diſtinguiſh between a true and falſe attack, will not know how to uſe their cannon, and the fire of their ſmall arms will do leſs execution by night.

In attacking the lines, feveral platoons, each commanded by a ferjeant, muft march before, who are to be followed by two or three hundred men, each carrying a fafcine and his arms, who, when they have caft their fafcines into the ditch, endeavour to mount the line.——After this a hundred men muft go with pick-axes and other tools, to throw down the line that the horfe may enter; and in cafe of a repulfe, other attacks may be made with eafe the fame way.——The men muft be fuftained by battalions always firing while the others work.—Two or three thoufand men may be employed in every attack, and ordered to fall on near one another, or at a fmall diftance, and the horfe to be divided to fuftain them: and a ftrong *Corps de Referve* is to ftand ready out of cannon fhot, but the nearer the better, if a place can be found under covert.——The battalions, which fuftain that which falls on, muft not be directly in the rear of it, but on the right and left, and at a greater diftance: by this means they will fee how thofe, who attack proceed, and the better judge what they are to do themfelves, and cannot be difordered by fuch as run away, or the wounded men, who retire.

It would be proper to fend a fquadron to fuftain them near at hand, and the reft are to be kept juft out of mufquet fhot, caufing them to advance, as the foot make themfelves mafters of the line.—The regiments, which fuftain fhould have fome tools; becaufe if the enemy in a confternation quit any other place than that which was attacked, thofe regiments may poffefs themfelves of it.

But perhaps after a *victory*, or without a *victory*, we enter the enemy's country, or to ravage it, or to put it under *contribution*, or to hinder the junction of an army defigned to rendezvous there, or to fight one already joined.

If to ravage the country: we muft divide our *army* into feveral bodies, but not fo fmall as that either of them may be beaten.——If to take a poft, to lay it under contribution; we muft chufe one commodious for forage, that has good air, and fo feated, that we may have provifions from our own country, in cafe the place where we are cannot furnifh our forces; and we muft take care to fecure a retreat, if the enemy fhould come upon us with ftronger force; and it is fafeft to intrench.—If to hinder the junction of an *army*; we muft haften into our quarters, to furprize thofe who fhall not be quick enough to retire, and then purfue the reft as far as can be.—If to fight an *army* already formed; we muft be cautious, and know the ftrength of it, and the place where it lies, left in our march we meet with it, in a difadvantageous place.

When we enter an enemy's country, we muft confider the nature of the rivers we pafs; as whether a great fhower of rain, or the fun melting the fnows, may not prevent us from repaffing. Or if we would force any confiderable pafs into it, as one on the mountains, or over a river, or an intrenchment, all depend on expedition, efpecially in gaining paffes on mountains, from whence it is not an eafy matter to drive thofe, who have once lodged themfelves.

If the enemy are there before us, and are not numerous, we muft endeavour to furprize them; but if we fail herein, and are obliged to do it by open force, we muft ftrive to gain an eminence above them, or if they are not very ftrong, and are fhut up with batteries, we muft attack them with *petards*, *fcaling ladders*, and *hand granades*.——If a tower or caftle fecures a *pafs*, we muft ufe the *petard*, or fix the *miner* to it: and remember that in all difficult places we muft forecaft to fecure a retreat; and if we leave a *pafs* behind us, to place a fufficient guard there.

If we are to force a *pafs* upon a river, we muft chufe a convenient place for a paffage on our fide, and if there be any rifing ground, place our cannon upon it, to prevent the enemy's troops from drawing up.—Having viewed the place, we muft make a fhew of paffing in feveral places; and when our cannon is planted, throw up a *parapet* on the bank of the river, about a thoufand fathoms in length, placing mufqueteers behind it, then launch our tin boats, and fend over fome men, part foldiers and part workmen, to throw up a half moon.—This being done, we are to fend more to defend it, in cafe we be attacked, and other workmen to make another half moon, on the right, or on the left of the firft.—If we are not preffed by the enemy while we are making the firft half moon, we may carry on a horn-work, the wings of it to be flanked by the firft *parapet*, and the cannon lodged there.—But if the river be fo broad that a mufquet cannot defend the wings of the horn-work, it muft be defended by half moons made beyond the water. In the mean time we muft labour hard at the bridge, and when finifhed caufe the troops to pafs, if the enemy be not on the fpot; if they are, the horn-work muft be finifhed, that they may not fall upon the troops as they pafs.—When it is finifhed as ftrong as it fhall be thought neceffary, we muft put as many foot in it, as it will conveniently hold, and fome field pieces; then the cannon upon the hill keeping the enemy at a diftance; the cavalry may alfo pafs.—But yet this is not to be done, but when their *army* is much weaker than our own, for if they were as ftrong as we, then when half our men were over they would fall in with them, and our cannon or mufquets would do them no harm; and though they could not force our intrenchment, yet they would cut off all without it.——Therefore if their *army* be near as ftrong as ours, we muft finifh the horn-work, and at the fame time making another bridge and another horn-work, at fome diftance from the firft, draw a line from one to the other. The laft and fureft way is to fecure a pafs at fome diftance from the place where we lie, that the enemy may not prefently have notice of it; and to keep part of our forces, as long as we can before them, to give them the leaft occafion to fufpect we have detached any troops.

If there be any brook, morafs, ditch, hollow way, rifing ground, or other difficult *pafs*, or any eminence at hand, on which the enemy may conveniently lodge themfelves, and plant cannon on the other fide the river, where we defign to pafs; it will be requifite to make fome redoubts on the *paffes*, if the enemy are not there already; for if they are much weaker than we, they may come and intrench themfelves there, and by fecuring the fecond *pafs*, make the firft ufelefs.

But perhaps we are to guard fuch a *pafs*: therefore we muft view all places along the river, which are fit for that purpofe, and throw up forts and redoubts before them. if we can, and caufe the country people to be upon guard, if we are afraid to divide our *army* too much, that we may have notice of the approach of the enemy, and be ready to receive them, and by our fpies and other means get intelligence, when they make a detachment to furprife an ther *pafs*.

If they draw up their field pieces on the edge of the water, and have planted their heavy cannon on higher ground, determined to pafs, without any intrenchment, under the fire of their cannon and fmall arms, which they fuppofe will keep us at a diftance; then, if we have not an advantageous place to plant our cannon, we muft poft ourfelves a mufket-fhot from their paffage, either above or below it, that fo making an empalement, to cover us from their artillery, we may fire upon the *pafs* without being expofed. If there are any hedges or trees, we fhould take the advantage of that covert, for it is dangerous to lodge cannon in the fight of great batteries If there be a hollow way, ditch, ridge of ground, or hedge, we'll lodge as many foot as we can there, and ftrengthen our lodgement the beft we can. Yet if all our efforts cannot prevent the enemy from paffing, as foon as a part which is weaker than our *army* is over, we'll rufh in upon them, that in the confufion the remainder on the other fide may not fire upon us, left they kill their own men. If they make a parapet on the edge of the water on their fide, and detach fome men to make a half moon, and their bridge, and our cannon and fmall fhot cannot hinder them, then if the place be convenient for horfe, we muft fend fome fmall parties, ftronger than thofe that are pafs'd; for if we fend great bodies, they will receive more damage from the enemies beyond the water than we can receive by thofe that are pafs'd.

If there be any likelihood of carrying the half-moon the enemies have made at the pafs, we muft attack it with vigour, and if we are repulfed, endeavour then to prevent their throwing up other works, by pofting our cannon and fmall fhot advantageoufly for that purpofe. But if they have got a good fafe half-moon, and are not over-hafty, it will be difficult to obftruct their paffage; becaufe their workmen whom they fend to make other intrenchments, will retire to the ditch of the half-moon, if we prefs upon them, and they that fuftain them will force us with their volleys, and the affiftance of thofe beyond the water to retire, and then the men will return to their work; and as often as we attack them they will kill more of our men than we can of theirs However though thefe little attacks coft us fome men, yet if by that means we can retard the work 'till night, it will be a great advantage to us; for then being out of fight of their fire, we may make lodgments for mufqueteers, and raife batteries as near their works as poffible, fo that they who are lodged in them, will, by their fire in the morning, hinder the enemies from extending their works; and in order to prevent their working by night, we muft make frequent fallies, as often as they go about it, which will not be very dangerous, or keep a continual firing from our fmall arms, charged with partridge fhot; but if we cannot hinder their paffing, it will be eafier to retire by night than by day. If we find the pafs well fecured with works, then if there be a morafs, ditch, or ridge, or any other advantageous ground, we'll entrench ourfelves upon the ridges of it, to obftruct their fecond paffage.

When both armies have a defign to poffefs themfelves of an advantageous poft, it often occafions a battle. The precaution to be ufed, in that cafe, is to fend our fcouts towards them, and not to march without a good number of fmall parties out before us, to prevent meeting the enemy in a dangerous place. A ftrong detachment is to be fent from the *Army* to take poffeffion of the poft, and expect the enemy there, provided our detachment be ftrong enough, to maintain it 'till the whole

army

army come up. If we know that the enemy muſt paſs a difficult defile, we muſt ſend ſome parties thither to ſpoil the ways, and to ſkirmiſh with them.

When we find ourſelves inveſted by an *army* ſtronger than ours, whereby our *proviſions* are cut off, and no hope of getting any, without hazarding a battle, we muſt then make an attempt, either in order, to get clear out of our poſt, or elſe to bring in the *convoy*; though it has happened ſometimes, that by a too great confidence, or rather preſumption in a *general*, an *army* has been ſo well hedged in, that it was impoſſible to ſally out, without its being expoſed to be cut to pieces, as it happened to the *Czar*, *Peter* I. upon the *Pruth*, where his whole *army* muſt have periſhed for want of proviſions, or fallen by the ſwords of the *Turks*, if the *Czarina Catherine*, his wife, had not found the ſecret of amuſing the *Grand Vizir* with advantageous propoſals, to give time to the *Czar* to extricate himſelf out of that great dilemma, as he did, to the diſappointment of *Charles* XII. King of *Sweden*, who came one day too late to make the advantage he expected, from the diſtreſs of his moſt formidable enemy; which diſappointment ſo enraged the hero, that he could not help reproaching the *Grand Vizir* with perfidy and cowardice.

If we deſign to bring in the *convoy*,* we muſt order it to come with the greateſt ſecreſy, through ſuch a road, as we'll judge more proper for us to meet it, without hazarding a diſadvantageous battle. To effect which we muſt march out with all our forces; for though we ventured but little before the coming of the convoy, yet the loſs of it would loſe all, if our ſafety depended on its coming ſafe. But if we think there is as much difficulty to bring in the convoy ſafe as in leaving our poſt; or though it ſhould come ſafe it would ſubſiſt our *army* but for a few days, and that there might be the ſame hazard ſoon after in bringing another, ſo that the delay would be no advantage to us, then it would be more prudent to make an effort at firſt than to ſtay any longer; becauſe an army always declines, and for the moſt part loſes courage and ſtrength.

In order to force our way, we muſt either leave our baggage, in the place we quit, with a guard; or, if the place cannot be defended without leaving a conſiderable part of the *army*, take all with us, for fear of weakening ourſelves, and if we apprehend that our baggage may incumber us, and hinder the retreat we hope to make without it, we muſt ſave the beſt, and burn the reſt. Having firſt viewed the eaſieſt way, we muſt ſet forward towards the evening, and at the ſame time ſend parties to alarm the enemy in ſeveral other places, that they may be doubtful which way we draw off. If we carry our baggage with us, then we muſt keep between it and the enemy, that is, when the enemy is in the rear, and the baggage before us; and on the left if they are on the right; and ſo on the right if they are on the left. If the enemy be before us, we muſt march on, fighting courageouſly, and the ſame if they attack us briſkly in the rear, or on the flank; but if they come on but ſlowly, to retard us 'till all their forces come up, then we muſt not ſtop at all, but defend ourſelves, retreating, never loſing time to ſuſtain the troops that are attacked, though ſome of them be loſt: Nay, it is ſometimes abſolutely neceſſary to loſe a ſmall part to ſave a greater; but this reſolution is never to be taken unleſs the greateſt extremity compels us to it.

If we would prevent the *army* of the enemy croſſing our country, we muſt endeavour to cut it off in the van at ſome paſs, or fall upon its rear, when half paſſed ſome *defile*, giving it a check by this means, till the country is in arms, and all our forces are joined: and we muſt endeavour as much as poſſible to avoid coming to a battle, unleſs we have a great advantage, becauſe by fighting in our own country, the loſs of one battle may loſe all.

The judgment, prudence, and conduct of a *general*, are alſo evidenced in the ſurprize of an *army*, or of *quarters*. To ſurprize an *army*, he muſt underſtand the ſituation of the camp, whether it is intrenched or not; its ſtrength in horſe, foot, and cannon; how poſted; the manner of the encampment; what guard is kept within and without; where the guards, centinels, and vedets are poſted, and care muſt be taken to avoid or ſurprize them. As ſoon as the enemy has taken the alarm, he muſt fall on with the greateſt fury imaginable, that they may not have time to form themſelves. If the

* A CONVOY, in this place, is a body of forces ſent to guard a ſupply of proviſions, arms, or ammunition, going to a camp, to an *army*, or to a beſieged town. There are two ſorts of *convoy*, *viz*, a *ſmall* and a *grand convoy*; a *ſmall convoy* conſiſts only in a few waggons, or horſes loaded with ammunition or proviſions, and is eſcorted with a ſmall detachment of infantry. A *grand convoy* conſiſts of a very conſiderable number of waggons and horſes loaded with ammunition, proviſions, and often with money for the payment of the *army*, accompanied ſometimes with a train of artillery, and eſcorted with ſtrong detachments of both cavalry, and infantry, the cavalry on the right and left, and the infantry in the front and on the rear.

camp is intrenched, there muſt be carried *faſcines* * to fill up the ditches, pont volans, hand-granades and hatchets.

If he will ſurprize any particular quarters of horſe or foot, if they are in a place that is encloſed, he muſt uſe the ſame method practiſed to ſurprize garriſons, but if in an open place, he muſt act according to their ſtrength, guard, and ſituation.

In order to *break a bridge* which is advantageous to the enemy, we muſt ſtrive to make ourſelves maſters of one or both ends, if they are not well fortified. If we dare not attempt the lodgments the enemies have made, we are to endeavour to burn the bridge with fireſhips, if it be a bridge of boats, or ſend ſome good ſwimmers to cut the ropes, or drive down a ſtrong veſſel, heavy laden, to break them. If it be a wooden bridge upon piles, men may be ſent in cover'd boats to ſaw them, or elſe to daub them with pitch and other combuſtible matter, and then ſet fire to it. We may alſo build a ſmall body of ſtone-work upon boats, in the midſt whereof there ſhall be a mine, loaded at top with the largeſt ſtones we can get, and over that a piece of timber to bear under the upper part of the bridge, or upon the piles, and ſo open a trunk to give fire to the mine, which ſhall ſpring while the boats are under the bridge. If we cannot make ſure of the trunk for firing, a good ſwimmer may carry a boat, and tie or hook it to one of the main pillars; and having ſet fire to a *ſauciſſe*, ſwim away as faſt as he can. The boats which have the mines, may be conducted by other boats; and ſo the men in them, having faſtened the boats that have the mines, and giving fire, may get off without danger.

We would not ſend our *army* into quarters, before having *beſieged* a town in form, were we not to conſider, that *ſieges* and the *manner* of *beſieging* belong properly to *Fortification*, and conſequently is to be included in our treatiſe on that ſubject, under the letter *F*. Therefore we'll conclude this with ſome *general remarks* on *armies*.

The author of the *Conſiderations ſur les Cauſes de la Grandeur des Romains*. c. 3. p. 24. is of opinion, that a prince with a million of ſubjects, cannot keep an army of 10000 men, without ruining himſelf. It was otherwiſe, ſay they, in the antient republicks: The proportion of ſoldiers to the reſt of the people, which is now about one to an hundred, might then be as about one to eight. The reaſon ſeems owing to equal partition of lands, which the antient founders of commonwealths made among their ſubjects; ſo that every man had a conſiderable property to defend, and means to defend it with. Whereas amongſt us the *lands* and *riches* of a nation being ſhared among a few, the reſt have no way of ſubſiſting, but by *trades*, *arts*, and the like; and have neither any free property to defend, nor means to enable them to go to war in defence of it, without ſtarving their families. A large part of our people are either *artizans* or *ſervants*, and ſo only miniſter to the luxury and effeminacy of the *great*. While the equality of land ſubſiſted. *Rome*, though only a little ſtate, being refuſed the ſuccours, which the *Latins* were obliged to furniſh after the taking of the city, in the conſulate of *Camillus*, preſently raiſed *ten legions* within their own walls: which was more, *Livy* aſſures us, than they were able to do in his time, though maſters of the greateſt part of the world. A full proof, adds the hiſtorian, we are not grown ſtronger; and that what ſwells our city, is only luxury, and the means and effects of it.

A Legion was a kind of regiment or body of forces, of a number whereof the *Roman* armies were chiefly compoſed. The number of ſoldiers and officers whereof the *legion* was compoſed, was different at different times. In the time of *Romulus* each *legion* contained 3000 foot, and 300 *equites* or horſe: theſe were divided into three bodies, which made as many orders of battle. Each order conſiſted of ten companies or *maniples*, ranged at ſome diſtance from each other, though in the ſame front. Each body had two general officers to command it, called *Tribunes*, and each *maniple* two *centurions*.

The Tribunes were in the *Roman armies*, much the ſame with our *colonels*.

A Centurion was an officer of infantry who commanded a *century*, or hundred men. The firſt centurion of the firſt cohort of each *legion*, was not under the command of any tribune, as all the reſt were; and had four *centuries* under his direction. He guarded the ſtandard and the eagle of the *legion*.

* Fascines are ſmall branches of trees, or bavins bound up in bundles, which being mixed with earth, ſerve to fill up ditches, to ſcreen the men, make the parapets of trenches, &c. ſome of them are dipt in melted pitch or tar, and being ſet on fire, ſerve to burn the enemies lodgments or other works. A pitch'd *faſcine* is a foot and a half about; a *faſcine* for defence, two or three foot. *Pont volans*, or *flying-bridge*, is a kind of bridge made of two ſmall bridges laid one over another, and ſo contrived by means of cords and pullies placed along the ſide of the under bridge, that the upper may be puſhed forwards, till it join the place where it is deſigned to be fixed: the whole length of both not to be above five fathom, leſt they ſhould break with the weight of the men.

In the time of *Marcus*, theſe four diviſions of the *legions* were united into one, and augmented; and *cohorts* were appointed from five to ſix hundred men, each under the command of a tribune. Each *cohort* conſiſted of three *maniples*, each *maniple* of two centuries; and the *legion* was divided into ten *cohorts*, who made as many diſtinct battalions, diſpoſed in three lines; ſo that the *legion* then conſiſted of five or ſix thouſand men.

When the *army* was ranged in order of battle, the *cohorts*, or battalions were diſpoſed in the following manner. The firſt *cohort* took up the right of the firſt line, as the companies of grenadiers do in our regiments; the reſt followed in their natural order; ſo that the third was in the center of the firſt line of the *legion*, and the fifth on the left. The ſecond between the firſt and third; and the fourth between the third and fifth. The five remaining *cohorts* formed a ſecond line in their natural order; thus the ſixth was behind the firſt, and ſo of the reſt.

The firſt, third, and fifth *cohorts* were eſteemed the beſt, at leaſt it appeared ſo from the poſt they took up, which were looked on by the *Romans* as the moſt important.

The *cohorts*, called *Prætorian*, from their place or ſtation, in the palace called *Prætorium*, were the ſoldiers of the Emperor's guards. Their inſtitution was owing to *Scipio Africanus*, who firſt eſtabliſhed a company of the braveſt men in his *army*, pick'd out for the purpoſe, to be his guard, and never to ſtir from his ſide in battle. *Dion* tells us, that their number was at length increaſed to ten thouſand. They were commanded by an officer, created by *Auguſtus*, called *Præfectus Prætorii*, the prefect of the palace.

The STANDARD bore by the *legions* was various. At firſt a *wolf*, in honour of that, which ſuckled *Romulus*; afterwards a *hog*, by reaſon, ſays *Feſtus*, war is only undertaken with a view to peace, which was concluded by *ſacrificing a hog*. Sometimes they bore the *Minotaur*, to remind their *general* that their deſigns were to be kept ſecret and inacceſſible as the *Minotaur* in the labyrinth. They alſo bore a *horſe*, a *boar*, &c. *Pliny* tells us, that *Marius* was the firſt, who changed all thoſe *ſtandards* into *eagles*.

The ARMS of the antient *Roman Armies*, were a launce or javelin, a ſword and a ſmall argian buckler, which *Romulus*, during his wars with the *Sabines*, a bold and warlike nation, changed into a broad buckler; and what contributed moſt to render the *Romans* maſters of the world, was, that having ſucceſſively warred againſt all nations, they renounced their own methods, arms, &c. whenever they met with better.

The *armies* of the Grand Signior conſiſt chiefly of *Janizaries*, *Spahis*, and *Timariots*.

The JANIZARIES, reputed the Grand Seignior's foot guards, are the beſt *infantry* in the *Turkiſh armies*; firſt inſtituted by *Amurath* I. called the *conqueror*, who chuſing out one fifth part of the *chriſtian* priſoners taken from the *Greeks*, and inſtructing them in the diſcipline of war, and the doctrine of their religion, he ſent them to *Hagi Bektaſche* (a perſon whoſe pretended piety rendered him much revered among the *Turks*) to the end that he might confer his bleſſing on them, and at the ſame time give them ſome marks to diſtinguiſh them from the reſt of the troops. *Bektaſche*, after bleſſing them in his manner, cut off one of the ſleeves of his fur gown, and put it on the head of the leader of this new militia; from which time, *viz.* the year of CHRIST 1361, they have retained the name of *Jenitcheri*, and the *fur cap*.

As in the *Turkiſh armies* the *European* troops are diſtinguiſhed from thoſe of *Aſia*; the *Janizaries* are alſo diſtinguiſhed into *Janizaries* of *Conſtantinople* and of *Damaſcus*. Their dreſs conſiſts of a *dolyman*, or *long gown*, with ſhort ſleeves, which is given them annually by the *Grand Signior*, on the firſt day of *Ramazan*. They wear no turban, but in lieu thereof a kind of cap which they call *zarcola*, and a long hood of the ſame ſtuff, hanging on their ſhoulders. On ſolemn days they are adorned with feathers, which are ſtuck in a little caſe in the forepart of the bonnet.

Their arms in *Europe*, in a time of war, are a ſabre, a carabine, or muſquet, and a cartouch-box hanging on the left ſide. At *Conſtantinople*, in a time of peace, they wear only a long ſtaff in their hand. In *Aſia*, where powder and fire-arms are leſs common, they wear a bow and arrow, with a poniard, which they call *baniare*.

The *Janizaries* are children of tribute levied by the *Turks* among the chriſtians, and bred up to the military life. They are taken at the age of twelve years, to the end that forgetting their country and religion, they may know no other parent but the *Sultan*. However, generally ſpeaking, they are not at preſent raiſed by way of tribute; for the *carach* or *tau*, which the *Turks* impoſe on the chriſtians, for allowing them the liberty of their religion, is now paid in money, excepting in ſome places where money being ſcarce, the people are unable to pay in ſpecie, as in *Mingrelia*, and other provinces near the *Black Sea*.

The officer who commands the whole body of the *Janizaries*, is called *Janizar Agaſi*; *Aga* of the *Janizaries*; who is one of the chief officers of the empire.

The

The Spahis, as we have observed already, compose part of the cavalry of the *Ottoman army*; their commandant is called *Spahi Agasi.*

The Timariots, are those who enjoy lands on the footing and tenure of *Timar*, which is a tract or portion of land which the *Grand Signior* grants to a person on condition of serving him in war on horseback.

The *Timariots* are obliged to serve in war personally with as many men and horses for service as their *Timar*, by the estimation made thereof, contains 2500 *aspers*, or about six pounds sterling; and to maintain them constantly mounted and armed after their manner, to be ready to march at all hours when commanded, and that on pain of death, nothing, not even sickness itself, being allowed to excuse them.

Besides this service, they likewise pay an acknowledgment of one tenth of their revenue. If they have any children of age to bear arms, and fit for the service after their decease, or in defect thereof, if they have any relations that have the least interest, the *Timar* is used to be continued to them on the same conditions; otherwise it is transferred to others.

If the revenue thus held of the *Grand Seignior* exceed 15000 *aspers*, or 36 *l.* sterling, they who hold it are not called *Timariots*, but *Subassi* or *Zaims*, and have the administration of justice in the place.

The *Timariots* have different appointments from 4 or 5000 *aspers*, equal to about 12 *l.* sterling, to 20,000 *aspers*: but unless their *Timar* exceed 8000 *aspers*, they are never obliged to march, except when the *Grand Seignior* goes to the *army* in person, on which occasion none are exempted.

The origin of the *Timariots* is referred to the first Sultans, who being masters of the fiefs or lands of the empire, erected them into baronies or commanderies, to reward the service of their bravest soldiers; and especially to raise and keep on foot a number of troops without disbursing any money. But it was *Soliman* II. that first established the order and discipline among these barons or knights of the empire; but avarice, the ordinary fault of the orientals, has occasioned their declension of late years. The vice-roys and governors of provinces manage their matters so at court, that *Timars*, even out of their jurisdiction, are given to their domesticks, or to such as will give the most money for them.

There are two kinds of *Timariots*, the one appointed by the *Porte*, the other by the Viceroy of the country; but the revenues of both are less than those of the *Zaims*. Those who receive their patents from the Viceroys, have from 3 to 6000 *aspers* * *per Ann.*

This *cavalry* is better disciplined than that properly called the *Spahis*, though the *Spahis* be the neatest and briskest, These last only fight in platoons; whereas the *Zaims* and *Timariots* are divided into regiments, and commanded by colonels, under the direction of Bashaws. The Bashaw of *Aleppo*, when in the *army*, is *colonel-general* of this militia.

Shepherds, water-carriers, and other such undisciplined mob, compose the rest of the *Ottoman* forces or *armies*.

The *armies* of the Empire consist of divers bodies of troops furnished by the several circles.

The gross of the *French armies* under the *Merovingian*, or first race of their Kings, consisted of infantry. Under *Pepin* and *Charlemaign*, the *armies* consisted almost equally of cavalry and foot; but since the declension of the *Carlovingian* or second line, the fees being become hereditary, the national *armies*, says *Le Gendre*, are chiefly cavalry. The late King of *France*, *Lewis* XIV. has often brought twelve *armies* into the field, making up in all 500,000 men.

In England the *land forces* anciently consisted of a kind of Militia composed chiefly of tenants to the crown and vassals of lands, which were held *in capite* from their sovereign. But when our Kings were engaged in the conquests upon the continent, we find them hiring *mercenary troops* to enable them to meet the enemy abroad, without exposing this island, by drawing off the *militia*, its *natural strength*. And since the Revolution in 1688 this nation has been obliged by its connections with the powers in *Germany*, to maintain a *standing army*, not only at home, but also of *German mercenary auxiliaries*, for the most part of the time.

These measures so eclipsed the *militia*, with their discipline and service, that it was reduced almost to a state of annihilation; till the present ministry, (convinced of the necessity of an internal defence by a *regular and well-disciplined militia* to guard the nation from the invasions of our enemies, and to deliver us from the expence and hazard of hiring *foreign*

* The *aspers* is a little *Turkish* silver coin, worth something more than an *English* halfpenny. The only impression it bears is that of the Prince's name under whom it was struck. The pay of the *Janizaries* is from two to twelve *aspers per diem.* Most of the *Grand Seignior*'s revenues are paid in *aspers*.

troops to guard our coasts, in certain cases) are endeavouring, under the sanction of the parliament, to re-establish that force, which was once the glory of the nation and the terror of *Europe*. For, tho' our greatest strength consists in our *naval forces* or *armies*; yet this is only to be considered in regard to our quarrels with maritime states; and our defence by sea Our *land-forces* have always maintained a dignity beyond those of other nations in the wars of *Europe*, both for their equipment, courage and conduct.

However, it must be confessed, that our greatest strength consists in its *naval forces* or *armies*; which NAVAL ARMIES are a number of ships of war, equipped and manned with sailors and marines, under the command of an *admiral*, with other inferior officers under him.

An ADMIRAL is a great officer, who commands the *naval forces* of a kingdom or state, and takes cognizance by himself, or officers appointed by him, of all maritime causes.

Du Cange assures us, that the *Sicilians* were the first, and the *Genoese* the next after them, who gave the denomination of *admiral* to the commanders of their *naval* armaments, and that they took it from the *Saracen* or *Arabic Amir*, a general name for any commanding officer; though there are no instances of *admirals* in this part of *Europe*, before the year 1284; when *Philip* of *France*, who had attended St. *Louis* to the wars against the *Saracens*, created an *admiral*.

The *French* have at present an *admiral* in chief, called the *great admiral of France*, who is always a person of the first rank, and of an illustrious birth; and *two vice-admirals*, one of the *Levant*; the other of the *Ponant*. The two *vice-admirals* have also under them *rear-admirals*, *lieutenant-generals*, and chief *descadres*. When the *grand* or *high-admiral* commands in person, the *vice-admirals* command each his division.

A *French* fleet is commonly divided into three divisions; the white division; the blue division; and the white and blue division. But when the *high* or *grand-admiral* does not command in person, it is always the *vice admiral* of the *Levant* who commands in the *Mediterranean*, and that of the *Ponant* on the Ocean. The *grand-admiral* carries a squared flag, at the main top-mast, of blue silk, embroidered with a golden *sun*, with the late king's *device* or *motto*, *nec pluribus impar*. The *vice-admiral*, when the admiral commands in person, carries his *flag* at the mizen top-mast. The king of *France* has always 50000 seamen registered, who are obliged to pass in review before the commissary of the marine appointed for that purpose in each department or district of the marine provinces, *viz. Britanny*, *Normandy*, *Poitou*, *Aunis*, *Provence*, *Guienne*, *Languedoc*, &c. on the first notice given them by the said commissary; who chuses from among those who appear before him, as many boatswains, gunners, carpenters, caulkers, and common sailors as he wants, without being obliged to press vagrants or men unacquainted with sea affairs, into that service. Each man of war, besides its complement of sailors, has on board one or two companies of marines, which are independent companies always kept in pay, and exercised for that purpose; besides a detachment or brigade of *guards marines*, who are young noblemen, brought up to the sea at the king's expence, and commanded by a *brigadier*. Out of that body of the *guards marines*, are taken all the officers of the navy, and they are promoted according to the report made by their superior officer to the king, of their courage, knowledge, and experience.

In every sea-port there is a commandant of the marine, who is commonly called a captain of *haut bord*, as they call it, or of a first-rate man of war, and who commands all the marines of that department or district; an intendant of the marines, who is judge of the court of *admiralty* in that place; and a commissary of the marine, who has under him a comptroller, a treasurer, and several *commis* or clerks of his office, which they call *le bureau des classes*, because there is kept the register of all the sailors of that department, wherein every sailor is registered according to his rank and employment.

The LORD HIGH ADMIRAL of *England*, in some antient records called *Capitaneus mariniorum*, is judge or president of the court of admiralty.

He takes cognizance by himself, his lieutenant, or deputies, of all crimes committed on the sea, or the coast thereof, and all the civil and marine transactions relating thereto: as also of what is done in all great ships riding in any river, beneath the bridges thereof next the sea. We have had no high-admiral for some years; the office being put in commission, or under the administration of the *lords commissioners of the admiralty*.

Admiral is also used here, for the commander in chief of a single fleet or squadron. Thus we say, the *admiral* of the red, the *admiral* of the white, and the *admiral* of the blue. The term *admiral*, is also applied to all flag-officers: in which sense it includes *vice-admirals*, and *rear-admirals*. No nation in the whole world has ever produced a greater number of braver *admirals*, and other sea-officers than *England*. Their heroic actions have been admired and applauded under both hemiſpheres; and their ſingle appearance has always alarmed the coaſts of the moſt formidable enemies of the *Engliſh* name; and no doubt but our poſterity will remember with as much pleaſure and gratitude, *Jenning*, *Norris*, *Hoſier*, *Wager*, *Vernon*, *Haddock*, *Shovel*, &c. as we do *Drake*, *Cavendiſh* *Blake*, *Rooke*, *Matthews*, *Warren*, *Anſon*, *Boſcawen*, &c. For whoſe expeditions and actions, and what elſe relates to the *Britiſh navy*, ſee Entick's Naval History.

ASTROLOGY.

ASTROLOGY (*Gr.* αστηρ, *a ſtar*, and λογος, *a diſcourſe*) is defined the art of prognoſticating or foretelling events by the aſpects, poſitions and influences of the *heavenly bodies*.

Where, by *aſpect* is to be underſtood an angle formed by the rays of two planets meeting on earth, able to execute ſome natural power or influence. All which will be better explained by the inſpection of the following table: where you have

The Characters *of the*

Six Northern Signs	Six Southern Signs	Planets	Aspects
♈ Aries	♎ Libra	♄ Saturn	☌ Conjunction
♉ Taurus	♏ Scorpio	♃ Jupiter	⚹ Sextile
♊ Gemini	♐ Sagittarius	♂ Mars	△ Trine
♋ Cancer	♑ Capricorn	☉ Sun	□ Quartile
♌ Leo	♒ Aquarius	⊖ Earth	☍ Oppoſition
♍ Virgo	♓ Piſces	♀ Venus	
		☿ Mercury	
		☽ Luna	

This *art*, or conjectural *ſcience*, is principally divided into *natural* and *judiciary*.

Natural Astrology confines its ſtudy to explore natural effects; as, change of weather, winds, ſtorms, hurricanes, thunder, floods, earthquakes, and the like.

In this ſenſe, Astrology is admitted to be a part of *natural philoſophy*. Mr Goad, Mr. Boyle, and Dr. Mead plead for its uſe in this light. The former endeavours to account for the diverſity of ſeaſons from the ſituations, habitudes and motions of the planets; and to explain an infinity of *phænomena* by the contemplation of the ſtars. The honourable Mr. Boyle admits that all phyſical bodies are influenced by the heavenly bodies: and the doctor's opinion, in his treatiſe concerning the *Power of the Sun and Moon*, &c. is in favour of this doctrine.

But theſe predictions and influences are ridiculed and entirely exploded by the moſt admired modern philoſophers, of which the reader has a learned ſpecimen in Rohault's *Tract. Phyſic.* Par. 2. c. 27.

Judicial or Judiciary Astrology is a further pretence to diſcover or foretel *moral* events, or ſuch as have a dependance on the *freedom of the will.*

In this part of *Aſtrology* we meet with all the idle conceits about the horary reign of planets, the doctrine of horoſcopes, the diſtribution of the houſes, the calculation of nativities, fortunes, lucky and unlucky hours, and other fatalities.

The profeſſors hereof maintain, 'that the heavens are one great volume or book, wherein God has wrote the hiſtory of the world; and in which every man may read his own fortune, and the tranſactions of his time. This art, ſay they, had its riſe from the ſame hands as *aſtronomy* itſelf: while the antient *Aſſyrians*, whoſe ſerene unclouded ſky favoured their celeſtial obſervations, were intent on tracing the paths and periods of the heavenly bodies; they diſcovered a conſtant ſettled relation or analogy between them and things below; and hence were led to conclude theſe to be the *parcæ*, the *deſtinies*, ſo much talk'd of, which preſide at our births, and diſpoſe of our future ſtate.'

This ſtudy is ſo flattering to human curioſity, that it got early admiſſion into the favour of mankind, eſpecially of the weak, ignorant and effeminate: and their foibles induced the avaritious, crafty, and deſigning knaves to recommend and promote it for their private intereſts and advantage.

We

We first meet with an account of ASTROLOGY in *Chaldea*; and therefore at *Rome* it was known by the name of the *Babylonish calculation:* against which, *Horace* very wisely cautioned his readers, in Lib. 1. Ode XI. where he writes,

——nec Babylonios
Tentaris numeros.

i. e. consult not the tables or planetary calculations used by *Astrologers* of a *Babylonish* origin. This was the opinion of the *Romans*. But others ascribe the invention of this deception to the *Arabs*.

Be that as it will; *judiciary astronomy* has been too much used by the priests of all nations, to encrease their own authority. The *Egyptians*, the *Chaldæans*, the *Greeks* and *Romans* furnish us with innumerable instances to confirm the assertion. The *Bramins* amongst the *Indians*, who take upon them to be the arbiters of good and evil hours, and set an extravagant price upon their pretended knowledge of planetary predictions, maintain their authority by the same means. And if one had time to unveil the attempts made in this art by Christians, it would be found that *Astrology* has yet its admirers and advocates almost in every society or family; as you will see in the sequel of this treatise. For, tho' they have not all pursued or adopted the same tecnical method; it is certain that whoever pretends to discover futurity by any other means than divine revelation, may be properly reduced under the name of *judiciary Astrologers*.

They who pretend to reduce this practice into a system, present the world with certain schemes formed upon the *aspects* of the planets: and attribute certain qualities or powers to each sign.

Thus to discover the influence of the heavens over the life of a person, they erect a *theme*, at the given time of the moment he or she was born; whereby the *Astrologers* pretend to discover the *star* that presided, or in what part of the hemisphere it was placed when such person was born into the world.

This erection of their *theme*, they pretend to perform with the assistance of the *celestial globe*, or of the *planisphere*, with regard to the *fixed stars*; but as to the planets, they do it with *astronomical tables*. To accomplish which, they have recourse to a *semi-circle*, which they call *position*, by which they represent the six great circles passing through the intersection of the *meridian* and *horizon*, and dividing the *equator* into twelve equal parts. The spaces included between these circles, are what they call the *twelve houses*: which they refer to the twelve triangles marked in their *theme*; placing six of those houses above the *horizon*, and six underneath the *horizon*.

The first of the *houses* under the horizon toward the east, they call the *horoscope*, or *house of life*; the second, the *house of wealth*; the third, the *house of brothers*; the fourth, the *house of parents*, &c. as is clearly explained in the two following verses.

Vita, lucrum, fratres, genitor, natique, valetud',
Uxor, mors, pietas, & munia, amici, inimici.

Thus turned into *English* metre by some *students in Astrology*,

The first house shews life, the second wealth doth give;
The third how brethren, fourth how parents live;
Issue the fifth; the sixth diseases bring;
The seventh wedlock, and the eighth death's sting;
The ninth religion; the tenth honour shews;
Friendship the eleventh, and the twelfth our woes.

The *Astrologers* draw their table of the *twelve houses*, into a triple *quadrangle* prepared for the purpose, of which there are four principal angles, two of which fall equally upon the *horizon*, the other upon the *meridian*, which angles are subdivided into twelve triangles for the *twelve houses*, and in those houses they place the *twelve signs* of the *Zodiac*, attributing to each of them their particular quality, *viz.*

ARIES, denoted by this figure, ♈, is in their extravagant opinion, a masculine, diurnal, cardinal, equinoctial, easterly sign, hot and dry, the day-house of *Mars*.

TAURUS, ♉, is a feminine, nocturnal, melancholy, bestial, furious sign, cold and dry.

GEMINI, ♊, is a masculine sign, hot and moist, diurnal, aerial, human, double bodied, &c.

CANCER, ♋, is a feminine, nocturnal, phlegmatick sign, by nature cold and moist, the only house of *Luna*.

LEO, ♌, is a sign, masculine, diurnal, bestial, choleric and barren; a commanding, kingly sign, hot and dry, the only house of the *sun*.

VIRGO, ♍, is a feminine, nocturnal, melancholy, and barren sign.

LIBRA, ♎, is a sign masculine, cardinal, equinoctial, diurnal, sanguine and human, hot and moist.

SCORPIO, ♏, is a feminine, nocturnal, cold and phlegmetic northern sign.

SAGITTARIUS, ♐, is a sign, masculine, choleric and diurnal, by nature hot and dry.

CAPRICORN, ♑, is a feminine, nocturnal, melancholy, solstitial, moveable, cardinal and southern sign.

AQUARIUS, ♒, is a masculine, diurnal, fixed, sanguine, and human sign.

Pisces, ♓, is a feminine, nocturnal, phlegmatic, northerly, double-bodied ſign, the laſt of the twelve.

Having thus houſed their ſigns, and directed them in their operations, they afterwards come to enquire of their *tenants*, what planet, and fixed ſtar they have for *lodgers*, at the moment of the nativity of ſuch perſon; from whence they draw concluſions with regard to the future incidents of that perſon's life. For example, if at the time of that perſon's nativity they find *Mercury* in 27 degrees, 52 minutes of *Aquarius*, and in the *ſextile aſpect* of the *horoſcope*; they pretend to foretel that infant will be a perſon of great ſagacity, genius and underſtanding, and therefore capable to learn the moſt ſublime ſciences.

Aſtrologers imagine alſo, for the ſame ridiculous purpoſe, to be in the ſame houſes, different poſitions of the ſigns and planets, and from their different aſpects, oppoſition and conjunction, and according to the rules and axioms they have preſcribed to themſelves and invented, have the ſacrilegious preſumption to judge, in *dernier reſort*, of the fate of mankind, though their pretended art or ſcience is quite ſterile or barren in proofs and demonſtrations.

The Planets have allowed them, every one, except *Sol* and *Luna*, two ſigns for their houſes; to Saturn, the *Capricorn* and *Aquarius*; to Jupiter, *Sagittarius* and *Piſces*; to Mars, *Aries* and *Scorpio*; to Sol, *Leo*; to Venus, *Taurus* and *Libra*; to Mercury, *Gemini* and *Virgo*; and to Luna, *Cancer*.

The *Planets* by their continual mutation through the twelve *ſigns*, make ſeveral angles or aſpects, the moſt forcible of which are theſe five.

☌ *Conjunction*, △ *Trine*, □ *Quadrate*, ✱ *Sextile*, ☍ *Oppoſition*.

A Conjunction is when two *planets* are in one and the ſame degree and minute of a ſign; and this is, ſay our jugglers, either good or bad, as the *Planets* are either friends or enemies.

A Trine is when any two *planets* are four ſigns, or 120 degrees diſtant, as *Mars* in 12 degrees of *Aries*, and *Sol* in 12 degrees of *Leo*. Here *Sol* and *Mars* are ſaid to be in trine aſpect. And this is an aſpect of perfect love and friendſhip.

A Quadrate *aſpect* is when two *planets* are three ſigns, or 90 degrees diſtant, as *Mars* in 10 degrees of *Taurus*, and *Venus* in 10 degrees of *Leo*. This particular aſpect is of imperfect enmity, and *Aſtrologers* ſay, that perſons ſignified thereby, may have jars at ſome time, but ſuch as may be reconciled again.

A Sextile *aſpect* is when two *planets* are two ſigns, or 60 degrees diſtant, as *Jupiter*, in 15 degrees of *Aries*; and *Saturn*, in 15 degrees of *Gemini*; here *Jupiter* is in a *ſextile* aſpect to *Saturn*. This is an aſpect of friendſhip.

An Opposition, is when two *planets* are diametrically oppoſite, which is, when they are ſix ſigns, or 180 degrees (which is one half of the circle) aſunder, and this is an aſpect of perfect hatred.

A Partile *aſpect*, is when two *planets* are in a perfect aſpect to the very ſame degree and minute.

Dexter *aſpects*, are thoſe which are contrary to the ſucceſſion of ſigns, as a *planet* in *Aries* caſts its *ſextile dexter* to *Aquarius*.

Sinister *aſpect* is with the ſucceſſion of ſigns, as a *planet* in *Aries* caſts its *ſextile ſiniſter* in *Gemini*.

Aſtrologers play a great many other diverting tricks, hence we read of the application, prohibition, ſeparation, tranſlation, refrenation, combuſtion, exception, retrogradation &c. of *planets*.

The Applcation of *planets* is performed by them, three ways. 1. When a light *planet* being direct and ſwift in motion, applies to a *planet* more ponderous, and ſlow in motion, as *Mercury* in 8 degrees of *Aries*, and *Jupiter* in 12 degrees of *Gemini*, and both direct; here *Mercury* applies to a *ſextile* of *Jupiter*, by direct *application*. 2. When they are both retrograde, as *Mercury* in 20 degrees of *Aries*, and *Jupiter* in 15 degrees of *Gemini*; here *Mercury*, the lighter *planet*, applies to the *ſextile aſpect* of *Jupiter*; and this is by *retrogradation*. 3. When one of the *planets* are direct, and the other retrograde; as ſuppoſe *Mercury* were retrograde in 18 degrees of *Aries*, and *Jupiter* direct in 14 degrees of *Gemini*; here *Mercury* applies to a *ſextile* of *Jupiter*, by a retrogade motion.

Prohibition, is when two *planets* are applying either by body or aſpect; and before they come to their *partile* aſpect, another *planet* meets with the aſpect of the former, and ſo prohibits it.

Separation, is when two *planets* have been lately in *conjunction*, or *aſpect*, and are ſeparated from it.

Translation of light and virtue, is when a lighter *planet* ſeparates from the body or aſpect of a more weighty one, and immediately applies to another ſuperior *planet*, and ſo tranſlates the light and virtue of the firſt *planet* to that which it applies to.

Refrenation, is when a *planet* is applied to the body or aſpect of another; and before it comes to it, falls retrograde, and ſo refrains by its retrograde motion.

Combustion. A *planet* is ſaid to be combuſt of *Sol*, when it is within 8 degrees 30 minutes of his body, either before or after their conjunction; but *Aſtrologers* complain, that a *planet* is more afflicted

flicted when it is applying to the body of *Sol*, than when it is separaring from *combustion*.

RECEPTION, is when two planets are in each others dignities, and it may be either by house, exaltation, triplicity, or term.

RETROGRADATION, is when a planet moves backward from 20 degrees to 9, 8, 7, and so out of *Taurus* into *Aries*.

FRUSTRATION is when a swift planet applies to the body or aspect of a superior planet; and before it comes to it, the superior planet meets with the body or aspect of some other planet.

To the seven *planets*, viz *Saturn*, *Jupiter*, *Mars*, *Sol*, *Venus*, *Mercury* and *Luna*, *Astrologers* add two certain nodes or points, called the *Dragon's-Head*, distinguished by this *sign* ☊, and the *Dragon's-tail* by this other ☋. In those two extremities of the beast, our students in *Astrology* place such virtues, that they can draw from thence wealth, honours, preferments, &c. enough to flatter the avarice, ambition, vanity, &c. of the fools who follow them.

I am sensible that the admirers of this art support their principles and defend their doctrine by examples founded upon their own experience, and upon the authority of history. But the weakness of their arguments have been so often exposed, that it can't be required here to refute them. Let *Tully*'s reproof suffice; who during the darkest clouds, and greatest obscurity of Paganism, while religion itself seemed to countenance *Astrology*, inveighs severely against it. *Quam multa*, says he, *lib.* 2 *de divinat. ego Pompeio, quam multa Crasso, quam multa huic ipsi Cæsari a Chaldæis dicta memini, neminem eorum nisi senectute, nisi domi, nisi cum claritate esse moriturum? Ut mihi per Mirum videatur quemquam extare, qui etiam nunc credatis, quorum prædicta quotidie videat re & eventis refelli.* i. e. "I so well remember the *Chaldæans* predictions to *Pompey*, to *Crassus*, and to this same *Cæsar*, that none of them should die, but full of years and glory, and in his house, that I am surprized, that there are yet some persons capable to believe those, whose predictions are every day contradicted and refuted by the event."

Instead of *astrological calculations*, we find certain vain, ridiculous, and insignificant figures, invented by the *Chaldæans*, *Persians*, *Ægyptians*, and *Arabs*, called in the *Arabic* language TALISMANS; which are the seal, figure, *character* or *image* of a heavenly sign, constellation or planet, engraven on a *sympathetick stone*, or on a metal *corresponding* to the star, &c. in order to receive its influences; and to which *Astrologers* attribute some ridiculous, marvellous effects; as those of curing distempers; of rendering persons invulnerable, &c. So that a figure of lead, called *Saturn* by the *alchemists*, and impressed with the character of *Saturn*, being tied to the neck of a person, who has the plague, which, say they, is a *Saturnian* distemper, will effectually cure him.

The TALISMANS of the *Samothracians*, so famous of old, were pieces of *iron* formed into certain *images*, and set in rings, &c. They were held preservatives against all kinds of evils. There were other *Talismans* taken from vegetables, and others from minerals. Are not the *amulets* still in vogue amongst us the remains of this superstition?

In general we use to distinguish three kinds of *Talismans*: *Astronomical*, which are known by the signs or constellations of the heavens engraven thereon, with other figures and some intelligible characters: *Magical*, which bear very extraordinary figure, with superstitious words, and names of angels unheard of; and *mixt*, which consist of signs and barbarous words, but have no superstitious ones, or names of angels.

All the miraculous things wrought by *Apollonius Tyanæus*, are attributed to the virtue and influence of *Talisman*; and he is even said to have been the inventor of *Talismans*.

Astrologers have also made use of all their best artifices, and employed all the rules of their pretended art, to render those years of our age, which they call *climactericks*, dangerous and formidable.

CLIMACTERICK, from the *Greek*, κλιμακτης, *q.d.* by a scale or ladder, is a critical year, or a period in a man's age, wherein, according to those jugglers, there is some notable alteration to arise in the body; and a person stands in great danger of death.

The first *climacterick*, say they, is the seventh year of a man's life; the rest are multiplies of the first, as 21, 49, 56, 63, and 84; which two last are called the *grand climactericks*, and the dangers here supposed more certain.

Marc Ficinus gives us the foundation of this opinion: he tells us there is a year assigned for each *planet* to rule over the body of a man, each in his turn; now *Saturn* being the most maleficent *planet* of all, every seventh year, which falls to its lot, becomes very dangerous; especially those of 63 and 84, when the person is already advanced in years.

Some hold, according to this doctrine, every seventh year an established *climacterick*; but others only allow the title to those produced by the multiplication of the climacterical space by an odd number, 3, 5, 7, 9, &c. Others observe every ninth year as a *climacterick*.

Hevelius has a volume under the title of *Annus Climactericus*, describing the loss he sustained in the burning of his observatory, &c. which it seems happened in his first *grand climacterick*. *Suetonius* says, *Augustus* congratulated his nephew upon his having passed

passed his first *grand climacterick*, whereof he was very apprehensive.

Some pretend that the *climacterick* years are also fatal to political bodies; which perhaps may be granted, when it is proved that they are so to natural ones; for I must confess that I cannot discover the reason of such danger, nor what relation it can have with the number above-mentioned. Though this opinion has a great deal of antiquity on its side. *Aulus Gellius* says, it was borrowed from the *Chaldeans*, who might probably receive it from *Pythagoras*, whose philosophy turned much on numbers, and who imagined an extraordinary virtue in the number 7.

Authors on the subject, are *Plato*, *Cicero*, *Macrobius*, *Aulus Gellius*, among the antients; *Argol*, *Magirus*, and *Salmatius* under the moderns. St *Augustin*, St. *Ambrose*, *Beda*, and *Boetius* countenance the opinion.

Astrologers have also brought under their inspection the days of the years, which they have the presumption to divide into lucky and unlucky days, calling even the sacred text, and the common belief of christians, in former ages, to their assistance on this occasion. They pretend that the fourteenth day of the first month was a blessed day among the *Israelites*, authorised therein, as they pretend, by the several passages out of *Exod.* xii. 18, 40, 41, 42, 51. *Levit.* xxiii. 5. *Numb.* xxviii. 16. *Four hundred and thirty years being expir d of their dwelling in* Egypt, *even in the self same day departed they thence.*

As to evil days and times, they refer to *Amos* v. 13. *and* vi. 3. *Eccles.* ix. 12. *Psal.* xxxvii. 19. *Obad.* xii. *Jer.* xlvi. 21.—and to *Job* cursing his birth day, *chap.* iii. *ver.* 1 to 11. In confirmation thereof, they also quote a *calendar*, extracted out of several antient *Roman Catholick* prayer books, written upon vellum before the invention of printing, wherein were inserted the *unfortunate days* of each month, as in the following verses.

JANUARY. *Prima dies mensis, & septima truncat ut ensis.*

FEBRUARY. *Quarta subit mortem, prosternit tertia fortem.*

MARCH. *Primus mandentem, disrumpit quarta bibentem.*

APRIL. *Denus & undenus est mortis vulnere plenus.*

MAY. *Tertius occidit, & septimus ora relidit.*

JUNE. *Denus pallescit, quindenus fœdera nescit.*

JULY. *Ter denus mactat, Julii denus labefactat.*

AUGUST. *Prima necat fortem, perditque secunda cohortem.*

SEPTEMBER. *Tertia Septembris, & denus fert mala membris.*

OCTOBER. *Tertius & denus, est sicut mors alienus.*

NOVEMBER. *Scorpius est quintus, & tertius est vita tinctus.*

DECEMBER. *Septimus exanguis, virosus denus ut anguis.*

This poetry tastes much of the rusticity and ignorance of those times, and is a convincing proof that *Christianity* had yet a very strong tincture of the *Pagan* superstitions, which the purity of the Gospel has not been capable yet to blot out among us.

That such ridiculous notion of lucky and unlucky days, owes its origin to *Pagan* superstition, may be proved from the *Roman* historians, who mention that that very day four years, the *civil wars* were begun by *Pompey* the Father; *Cæsar* made an end of them with his sons, *Cneius Pompeius* being then slain; and that the *Romans* accounted *February* the 13th an unlucky day, because on that day they were overthrown by the *Gauls* at *Allia*, and the *Fabii* attacking the city of the *Reii*, were all slain save one: from the calendar of *Ovid's Fastorum. Aprilis erat Mensis Græcis auspicatissimus*; and from *Horace*, *Lib.* 2. *Ode* 13. Cursing the tree that had like to have fallen upon him.

Ille nefasto te posuit Die.

What has contributed much to confirm the *Pagans* as well as the Christians in their opinion on this subject, are the several remarkable events that happened at some particular days. As, *Alexander the Great*, being born the 6th of *April*, conquered *Darius*, and died the same day. The emperor *Bassianus Caracalla*, being born the 6th of *April*, and died the same day. *Augustus* having been adopted the 19th of *August*, began his *consulate*, conquered the *Triumviri*, and died the same day.

As for the Christians; they have observed that the 24th of *February* was four times fortunate to *Charles* V. emperor. That *Wednesday* was a fortunate day to pope *Sextus* V. for on a *Wednesday* he was born; on that day made a monk; on the same day made a general of his order; on that day created cardinal; on that day elected pope; and also on that day inaugurated That *Thursday* was a fatal day to *Henry* VIII. king of *England*, and his posterity, for he died on *Thursday*; king *Edward* VI. on *Thursday*; queen *Mary* on *Thursday*; and queen *Elizabeth* on *Thursday*. The *French* have observed that the feast of Pentecost had been lucky to *Henry* III. King of *France*, for on that day he was born; on that day elected king of *Poland*, and that day he succeeded his brother *Charles* IX. on the throne of *France*.

Here

Here, among ourselves are too many *Astrologers*; especially of the female kind, who are more careful to observe a *lucky* or *unlucky day*, than to keep their family in good order; who study a stranger on the fire-grate, the motions of a cat, the howling of a dog, the death-watch, the itching of their elbow, knee, feet, or of something else, with great attention; who are two or three hours poring over an empty tea-cup, to see if they can discover in it a husband, who shall keep a coach and six, or if a secret intrigue is to succeed according to expectation, or a love-letter to be answered, and an infinity of other ignorant, stupid, scandalous, ridiculous, and unchristian-like observations; when they should be otherwise employed. These errors and scandalous practices proceed from a vitiated education; and in some families this sort of *Astrology*, divination, or what you'll be pleased to call it, is a kind of hereditary distemper, which circulates with the blood throughout whole generations, and has its first origin from the *auguries* of the *pagans*. which were presages taken concerning futurity, from birds, beasts, and the appearances of the heavens.

Varro distinguishes four species of AUGURY according to the four elements. *Pyromancy*, or *augury* by the *fire*; *Aëromancy*, or *augury* by the *air*; *Hydromancy*, or *augury* by the *water*; and *Geomancy*, or *augury* by the *earth*.

PYROMANCY. The antients imagined they could foretel futurity by inspecting fire and flame; to this end they considered its direction, or which way it turned, (which answers very well to the prognostications we draw from the manner our fire burns.) Sometimes they add other matters to the fire, *e. gr.* a vessel full of urine, with its neck bound about with wool, watching narrowly on which side it bursts, and thence taking their *augury*. Sometimes they throw pitch on it, and if it took fire immediately, esteemed it a good *augury*.

HYDROMANCY. *Varro* mentions the *Persians* as the first inventors of *hydromancy*, or divination by throwing of water; adding, that *Numa Pompilius* and *Pythagoras* made use thereof.

GEOMANCY, is performed by means of a number of little points or dots made on paper at random; and considering the various lines and figures, which those points present; and thence forming a judgment of futurity, or deciding any question proposed.

Polydore Virgil, lib. I. *c.* 23. *de Invent. Rer.* defines *Geomancy* a kind of divination performed by means of clefts or chinks made in the ground, and takes the *Persian Magi* to have been the inventors.

The particular branches of *augury*, are *Alectoromancy*, *Anthropomancy*, *Belomancy*, *Catoptromancy*, *Capnomancy*, *Gastromancy*, *Aruspicina*, *Libanomancy*, *Lecanomancy*, &c.

ALECTOROMANCY, from ἀλέκτωρ, a cock, and μαντεια, divination, is an antient kind of *divination*, performed by means of a cock.

This art was in use among the *Greeks*, and the usual manner of it was this. A circle was made on the ground, and divided into twenty-four equal portions or spaces; in each of which spaces was written one of the letters of the alphabet, and upon each of these letters was laid a grain of wheat. This done, a cock was turned loose in the circle, and careful observation made of the grains he pecked. The letters corresponding to those grains were afterwards formed into a word; which word was to be the answer desired.

It was thus that *Libanus* and *Jamblichus* sought who should succeed the emperor *Valens*; and the cock answering to the spaces ΘΕΟΔ, they concluded upon *Theodore*, by a mistake instead of *Theodosius*.

ANTHROPOMANCY, from ἀνθρωπος, man, and μαντεια, divination, is a method of divination performed by inspecting the *viscera* of a person deceased.

BELOMANCY, from βελος, arrow, and μαντεια, divination, is a kind of divination, by means of arrows practised in the east, but chiefly among the *Arabians*.

Belomancy has been performed in different manners: one was to mark a parcel of arrows, and put eleven or more of them into a bag; these were afterwards drawn out, and according as they were marked, or not, they judged of future events.

Another way was to have three arrows, upon one of which was wrote *God orders it me*; upon another, *God forbids it me*; and upon the third, nothing at all. These were put into a quiver out of which they drew one of the three at random; if it happened to be that with the first inscription, the thing they consulted about was to be done; if it chanced to be that with the second inscription, it was let alone; but if it proved that without inscription, they drew over again.

Belomancy is an ancient practice, and probably that which *Ezekiel* mentions, *c.* xxi. 21. at least St. *Jerom* understands it so, and observes that the practice was frequent among the *Assyrians* and *Babylonians*. Something like it is also mentioned in *Hosea*, *c.* iv. only that *staves* are there mentioned instead of arrows, which is rather *rhabdomancy* than *belomancy*. *Grotius*, as well as St. *Jerom*, confounds the two together, and shews that it prevailed

vailed much among the *Magi*, *Chaldæans*, and *Scythians*; whence it paſſed to the *Sclavonians*, and thence to the *Germans*, whom *Tacitus* obſerves to make uſe of it.

Catoptromancy, from κατοπτρον, *ſpeculum*, and μαντεια, *divination*, is a kind of divination among the antients; ſo called, becauſe conſiſting in the application of a mirrour.

Pauſanias ſays, it was in uſe among the *Achaians*, where thoſe who were ſick, and in danger of death, let down a mirrour, or looking glaſs, faſtened by a thread into a fountain before the temple of *Ceres*; then looking in the glaſs, if they ſaw a ghaſtly, disfigured face, they took it as a ſure ſign of death: on the contrary, if the face appeared freſh and healthy, it was a token of recovery. Sometimes glaſſes were uſed without water, and the images of things future repreſented in them.

Capnomancy, from καπνος, ſmoak, and μαντεια, divination, is a kind of divination by means of ſmoke, uſed by the antients in their ſacrifices. The rule was, when the ſmoke was thin, and light, and roſe ſtrait up, it was a good omen; if the contrary, it was an ill one.

There was another ſpecies of *Capnomancy* conſiſting in the obſervation of the ſmoke riſing from poppy, or jeſſamin-ſeed, caſt upon light coals.

Gastromancy, from γαστηρ, belly, and μαντεια, divination, is a kind of divination practiſed among the antients, by means of words coming, or ſeeming to come out of the belly.

There is another kind of divination called by the ſame name, *Gaſtromancy*, which is performed by means of glaſſes, or other round, tranſparent veſſels: at the bottom whereof certain figures appear by magic art. It is thus called, by reaſon the figures appear, as in the belly of the veſſels.

Aruspicina, is the doctrine or diſcipline of the *Aruſpices*.

The *Aruſpices* were an order of prieſts among the antient *Romans*, who foretold things to come, chiefly by inſpecting the entrails of beaſts killed in ſacrifice. The antients were ſo fond of this art, that nothing of public or private affairs ſhould be tranſacted without it In *Aruſpicina* it was obſerved whether the beaſt came willingly to the altar or not. Whether the entrails were of a natural colour, and not ulcerated, or whether any part were defective or wanting; and when *Auguſtus* found two galls in his ſacrifice, the credulity of the people concluded a hope of peace with *Anthony*, and the amity of perſons in choler with each other.

Cato, who was himſelf an *augur*, had ſo bad an opinion of the ſolidity of the *Aruſpicina*, that he uſed to ſay, he wondered how one *Aruſpex* could look at another without laughing in his face.

The *Augurs* made a college of community, which at firſt conſiſted of three perſons, one for each tribe; then of four, when *Servius Tullius* encreaſed the tribes to that number;) then of nine four of them *Patricians*, and five *Plebeians*: *laſtly*, *Sylla* made the number fifteen. They bore an *augural* ſtaff or wand, called *lituus*; as the enſign of their office and authority. No affair of moment, could be reſolved on, without firſt conſulting them; and their advice, be what it would, was, by a decree of the ſenate, appointed to be exactly and religiouſly obſerved; but in all appearance, their advice was always agreeable to the ſentiments of the ſenate; elſe I am of opinion, that they had made no ſcruple to follow a contrary one: or, which is the more likely, thoſe advices were dictated by the ſenate, and that mummery of conſulting the *augurs* was only to render their decrees more ſolemn to the people, who are always eaſily impoſed upon by an outward ſhew of religion; for it is not reaſonable to ſuppoſe, that the moſt ſenſible part of that warlike and judicious nation could have been thus led by the noſe, or believed blindly all their ſuperſtitious ceremonies, and the pious frauds and impoſtures, invented with no other deſign than to abuſe the ignorance, and too great credulity of the vulgar.

To this chimerical doctrine of the heavenly bodies, we may add in this place, all the other tricks, impoſtures, and *legers de main*, made uſe of by *Aſtrologers*, jugglers, and fortune-tellers, to decoy us into their nets, and pick our pockets. There is ſcarce a corner in our ſtreets, which, notwithſtanding the ſalutary laws made againſt ſuch ſcandalous and criminal practices, is not peſtered with the emiſſaries of *ſtudents* in Astrology, and who take care to inform young buxom laſſes in a longing condition for a man; wives tired of their huſbands; barren ladies, who want to be rendered prolific; young widows, who would be glad to be married again; that in ſuch a place lives a ſtudent in *aſtrology*, or *ſtar-gazer*, who reſolves all lawful queſtions (as he calls them) by the help not only of the *ſtars* and *planets*, but likewiſe of *Brizomancy*, *Chiromancy*, &c.

Brizomancy, is the pretended art of foretelling future events by *dreams*.

Macrobius mentions five ſorts of *dreams*, viz. 1. a *viſion*; 2. a diſcovery of ſomething between ſleep and waking; 3. a ſuggeſtion caſt into our fancy,

fancy, called by *Cicero*, *visum*; 4. An ordinary *dream*; and, 5. A divine apparition or revelation in our sleep; such as were the *dreams* of the prophets, and of *Joseph*; as also of the *Magi* of the east.

The fictitious art of interpreting *dreams*, had its origin among the *Egyptians* and *Chaldæans*, those countries being fertile in superstitions of all kinds. The same art was brought from thence among the *Romans*, who judging some *dreams* worthy of observation, appointed persons on purpose to interpret them. Those who pretend that dreams are significatives of things to come, bring in confirmation of their opinion, an infinite number of *dreams*, which have been the fore-runners of very singular events; *viz* *Calphurnia*, *Julius Cæsar*'s wife, dreaming the night before his death, that she saw him stabbed in the capitol. *Artorius*, *Augustus*'s physician, dreaming before the battle of *Philippi*, that his master's camp was pillaged. The emperor *Vespasian* dreaming an old woman told him, that his good-fortune would begin, when *Nero* should have a tooth drawn, which happened accordingly. *Cæsar* dreaming he committed incest with his mother, was crowned emperor of *Rome*: and *Hippias*, the *Athenian* tyrant dreaming the like, died shortly after, and was interred in his mother earth. *Mauritius*, the emperor, who was slain by *Phocas*, dreaming a little before, that an image of Christ which was over the brazen gate of his palace, called him and charged him with his sins, and in the end demanded of him, whether he would receive the punishment thereof in this life or the next; and he answering in this, the image commanded he should be given, with his wife and children, into the hands of *Phocas*. Whereupon *Mauritius* awaking in great fear, asked *Philippus* his son-in-law, whether he knew any soldier in the army called *Phocas*; he answered, there was a commissary so called: and *Phocas* was his successor, having killed him, with his wife and five children. *Arlet*, while with child of *William the Conqueror*, dreaming that a light did spread from her womb, that shone all over *England*. *Maia*, *Virgil*'s mother, prince of the *Latin* poets, dreaming she was delivered of a laurel branch, &c.

But it is ridiculous to compare the *dreams* minded by the vulgar, and which they want to be interpreted by conjurers and fortune-tellers, to these sorts of *dreams*; since what they want to know, is, what is meant when they *dream* that they see *ants*, *armed men*, *asses*, *black-birds*, *birds fighting*, *candles burning*, *children born*, a *cross*, *dragons*, *eagles*, *broken eggs*, *fire*, *flies*, *fountains*, *white horses*, *king* or *queen*, &c. that they *commit adultery*, *eat apples*, *cut bacon*, *eat bacon*, *bathe in a clear fountain*, *in stinking water*, *eat beans*, *have a long beard or hairs*, *hear bells ring*, *hear a cock crow*, *fall in the dirt*, *hear a dog bark*, *lose their eyes*, *or their teeth*, *gather grapes*, *fall on the ground*; and an infinity of other silly questions, which the impostor interpreter has the impudence, in defiance of all laws and authority, to call lawful questions, and on whose interpretation the ignorant querist has but too often the folly to build an imaginary fortune. The ridiculous infatuation of *dreams* is so predominant here, even among persons who should know better, and especially the fair sex, that seldom a conversation passes without some *dreams* or other being brought on the tapis, to be interpreted by the company. I *dreamed* last night, says one, that I had lost some of my teeth: That's a sign, says another, that you will lose some of your relations. I am afraid I shall; replied the *dreamer*, for my cousin, or uncle, or brother such a one, is very ill: That's a very sure sign, says a third, for I *dreamed* once the same thing, and my poor husband (fetching then an affected sigh) died soon after: Not so sure neither, objected a fourth, for I *dream* often that I lose my teeth, and my husband is yet alive, and not likely to die soon as I know of, tho' he is a very great rogue to me.

What surprizes me most, is, that this ridiculous notion is so strongly inculcated in the minds of children, from their very cradle, that it is utterly impossible to root it out afterwards. If parents are not themselves ashamed of that scandalous infatuation, which is a plague to all those they are acquainted with, they should however have tenderness enough for their children, to forbear instructing them in the principles of that scandalous and ridiculous doctrine, which contributes so much toward disturbing their domestic peace and tranquility, and render them insupportable to themselves, and to those who are to live with them. Often the first salute a husband receives from his wife, in a morning, is the recital of her *dreams*, and half the day is spent in nothing else but relating and interpreting them. All the gossips she is visited by, must pass their verdict upon it, and the husband often obliged, to avoid being teazed with it, to forsake his house, till some other incidents have forced the dreamer to forget her *dream*. Such practice smells so much of *paganism* and *idolatry*, that it is a scandal to *Christianity*, as entirely contradictory of the orders of the Divine Providence. Why does not our clergy thunder from the pulpit against it, and represent it as an artifice of the tempter of mankind, to decoy our souls into his net?

Avicen makes the cause of dreams to be an ultimate intelligence moving the *moon* in the middle of that light with which the fancies of men are illuminated

minated while they fleep. *Ariftotle* refers the caufe thereof to common fenfe, but placed in the fancy. *Averroes* places it in the imagination. *Democritus* afcribes it to little images, or reprefentations, feparated from the things themfelves. *Plato* among the fpecific, and concrete notions of the foul. *Albertus*, to the fuperior influences which continually flow from the fky, through many fpecific mediums. And fome phyficians impute the caufe thereof to vapours and humours, and the affections and cares of perfons predominant when awake: for, fay they, by reafon of the abundance of vapours which immoderate feeding exhales, the brain, being therewith ftuffed, forms infinite monfters, and ftrange chimeras, whereof the greateft eaters and drinkers may well fatisfy us. Some dreams, continue they, are governed partly by the temperature of the body, and partly by the humour which abounds moft in them; to which may be joined, the apprehenfions which have preceded the day before, which is difcovered in hounds, and fome other creatures, which bray and bark in their fleep. As for dreams, conclude they, proceeding from the humours and temperature of the body, we fee the *Cholericks* dream of burning, combats, yellow colours, *&c.* The *Phlegmaticks*, of water, baths, of failing upon the fea, *&c.* The *Melancholicks*, of thick fumes, defarts, fantafies, hideous faces, *&c.* The *Sanguines*, of merry feafts, dances, *&c.* They that have the hinder part of their brain ftopped with clammy humours, called by phyficians *Ephialtes incubus*, or, as we call it, the *Night mare*, imagine, in dreaming, that they are ftifled. And they that have the orifice of their ftomach charged with malignant humours, are affrighted with ftrange vifions, by reafon of thofe venomous vapours that mount into the brain, and diftemper it.

Chiromancy, from χειρ, hand, and μαντεια, divination; is the art of divining the fate, temperament, and difpofition of a perfon, by the lines and lineaments of the hand; otherwife called *Palmiftry*.

We have a number of authors on this vain and trifling art; as *Pythagoras*, *Helenus*, *Ptolomæus*, *Hermes*, *Avicen*, *Racis*, *Artemidorus*, *Fludd*, and *Johannes de Indagines*; *Taifnerus*, and M. *De la Chambre* have done the beft.

This laft infifts on it, that the inclinations may be known by *infpecting the hand*, there being a very near correfpondence between the parts of the hand, and the internal parts of the body, the heart, liver, *&c.* whereon the paffions and inclinations much depend. He adds, however, that the rules and precepts of *Chiromancy* are not fufficiently warranted, the experiments whereon they ftand, not being well verified. He concludes, that there muft be a new fet of obfervations, made with juftnefs and exactitude; in order to give *Chiromancy* the form and folidity which an *art* or *fcience* demands.

This fictitious art is only practifed by *gypfies*, vagabonds, and filly old women; who have, however, cunning enough to make the vulgar believe that the feven *planets* predominate over the *feven mountains*, which this *art* places in the *palm* of a man's hand; and that the *lines* therein have a doctrine of community with the length of life; and that riches, accidents, or other events, are to be judged of thereby.

Of all thefe fanciful *arts* of the ancients, diffufed among the moderns, there are none which have fo much foundation in nature as *Phyfiognomy* and *Metopofcopy*.

Physiognomy, (fom φυσις, nature, and γινωσκω, I know,) is the art of knowing the humour, temperament, or difpofition of a perfon, from obfervation of the lines of his Face, and the characters of his features.

There feems to be fomething in *Phyfiognomy*, and perhaps, there is an apparent correfpondence between the face and the mind; that the features and lineaments of the one, are directed by the motions and affections of the other; that there is even a peculiar arrangement of the mufcles of the face, a peculiar difpofition of the countenance to each particular affection, and to each particular idea of the mind.

In effect, the language of the face, *Phyfiognomy*, is as copious, nay, perhaps, as intelligible, and diftinct as that of the tongue, and fpeech. However, we can very well fay, with *Tullius*, *Lib.* I. *Epift. ad quintum fratrem*, *Epift.* I. *Frons, oculi, vultus, perfæpe mentiuntur*, i. e. the forehead, eyes, and face, very often lie.

Metoposcopy is no more than a branch of *Phyfiognomy*, with this fingle difference, that *Metopofcopy* is the art of difcovering the temperament, inclinations and manners of perfons, by infpecting the lines of their foreheads.

ASTRONOMY.

ASTRONOMY (*Greek*, αστηρ, a ſtar, and νομος a rule or regulation) is the doctrine of the heavenly bodies, or the method of attaining the knowledge of the heavens and their *phænomena*.

By *Heaven* here we are to underſtand that univerſe or circular region, that encompaſs all the terreſtrial globe, and contains the *ſtars*, *planets* and *comets*.

The ancient *Aſtronomers* ſuppoſed that there were as many heavens, or at leaſt, different regions in that immenſe circle, as there were found different motions: and that each of theſe regions was a ſolid body; according to the *ſyſtem of Ptolemy*, as deſcribed in the *copper-plate*.

By the ſame rule others multiplied the number according to their obſervations on the celeſtial motions. So that *Eudoxus* made them 23, *Calippus* 30, *Regiomontanus* 33, *Ariſtotle* 47, and *Fra. Caſtor* no leſs than 70 heavens.

The figure of this *heaven* or *univerſe* is conſidered either as it appears to the naked eye, or as it is conceived by the underſtanding. Hence *Aſtronomy* is divided into *ſpherical* and *theoretical*.

SPHERICAL *Aſtronomy* repreſents the *heavens* as a concave, in whoſe center is the earth or rather the eye, about which the viſible frame revolves, with ſtars and planets fixed in the circumference.

This is more properly deſcribed by the *ſphere* in the copper-plate: where you'll find the diameter of the earth's orbit is ſo ſmall in reſpect of the diameter hereof, that the center of the *ſphere* is not ſenſibly changed by any alteration of the ſpectator's place in the ſeveral parts of the *orbit*: but ſtill, in all the points of the earth's ſurface, and at all times, the inhabitants have the ſame appearance of the *ſphere*; that is, the fixed ſtars ſeem to poſſeſs the ſame points in the ſurface of the *ſphere*.

The better to determine the places of the heavenly bodies in the *ſphere*, ſeveral circles are imagined to be deſcribed on the ſurface thereof; hence called circles of the *ſphere*; which are ten in number, *viz.* ſix greater, and four leſſer.

The greater are, the (a) *horizon*, (b) *meridian*, (c) *equator*, (d) *ecliptick*, (e) the *colures*, and the (f) *azimuths*; which are all equal, and cut each other into equal portions or ſemicircles, and cut the whole *ſphere* into two equal parts, or *hemiſpheres*, having their center in the center thereof.

The *leſſer circles* are, the two (g) *tropicks*, and the two (h) *polars*; which divide the *ſphere* into two unequal parts.

Of the four *greater circles*, there are three, *viz.* the *horizon*, *meridian*, and *equator*, whoſe poles, or the points they are underſtood to be drawn or deſcribed from, are of very great conſequence in the *ſphere*, and are called *cardinal points*. The two firſt are the *arctick*, or *North pole*, which is that viſible to us; and its oppoſite the *antarctick*, or *South pole*. Theſe two points, each 90 degrees diſtant from the *equator*, are called, by way of excellence, the *poles of the world*, and are the two extremities of the *axis* whereon the *ſphere* revolves; whence their name πολος, from πολειν, *vertere*, to turn. The next to theſe, are the *Zenith* and *Nadir*, called *vertical points*; one directly over our heads, which is the *Zenith*; and the other, *viz.* the *Nadir*, directly under our feet.

The ZENITH. is a point in the ſurface of the *ſphere*, from which a right line, drawn through the ſpectator's head, paſſes through the center of the earth. Hence there are as many *zeniths* as there are different places on the earth where the heavens may be ſeen; and upon the changing our place, we alſo change our *zenith*.

The NADIR, is that point diametrically oppoſite to the *zenith*. The *nadir* is the *zenith* to our *antipodes*; as our *zenith* is the *nadir* to them. Theſe two points are alſo the *poles* of the *horizon*.

The other *points*, are the EQUINOCTIAL, wherein the *ecliptick* and *equator* interſect; particularly that whence the *ſun* aſcends towards the *North pole*, is called the *vernal point*; and that by which he deſcends to the *South pole*, the *autumnal point*. Which points are conſidered as the *poles* of the *Meridian*.

The HORIZON, in *Greek* ὁριζων, from ὁριζω, *termino*, *definio*; and in *Latin*, *finitor*, finiſher) is a *circle*, which when, from an even and open place, we turn our eyes round about us, terminates every where our ſight, and ſeems to join the heavens and earth together; and ſerves, as I have already obſerved to divide the *ſphere*, or the world, into two equal parts, or hemiſpheres, *viz.* ſuperior, and inferior; and is ſuppoſed to be deſcribed from the two points oppoſite to us, *i. e.* the *zenith* and *nadir*: So that when we change place, we alſo change the *horizon*, becauſe the *zenith* and *nadir* are changed.

The Meridian (the second great *circle* in order) is a *circle* of the *sphere*, passing through the *zenith*, *nadir*, and *poles* of the world, and dividing the *sphere* into two *hemispheres*, the one eastern, and the other western.

It is called *meridian*, from the *Latin*, *meridies*, noon, or mid-day: for when the *sun* is in this *circle*, the day is half spent, in those places situate under it; the sun being then at an equal distance from the *east* and *west*.

The Equator, (the third of the great *circles* we have imagined.) is a *circle* of the *sphere* equally distant from the two *poles* of the world, or having the same *poles* with those of the world. It is called *equator*, because when the *sun* is therein, the days and nights are equal; which happens about the twentieth day of *March*, and again about the twenty-third of *September*; whence, also, it is called *equinoctial*.

Every point of the *equator* is a quadrant's distance from the *poles* of the world; whence it follows, that the *equator* divides the *sphere* into two hemispheres, in one of which is the northern, and in the other the southern *pole*; which are both joined by an imaginary line, called the *axis* of the world.

The *equator*, by its conversion from east to west, measures the day. For the *equator* being cut into 360 parts, or degrees, and the day divided into 24 hours, 15 of those degrees are elapsed in the space of an hour. Hence we have frequent occasion for the conversion of degrees of the *equator* into time; and, again, for the re-conversion of parts of time into parts of the *equator*. For performance whereof, see the treatise of *Geography*.

We must observe here, that from the various position of the *equator* to the *horizon*, we use to distinguish a triple situation of the *sphere*. For those are said to have the *sphere direct*, who dwell under the *equator*; because the *equator* cuts their *horizon* at right angles. On the contrary, the *sphere* is *oblique* to those who inhabit the parts between the *equator* and the *poles* of the world; because the *equator* cuts their *horizon* in an oblique manner. And those who are placed under the *poles*, have the *sphere* parallel; because the *equator* is parallel to their *horizon*; or rather, is the same as their *horizon*, and is parallel to the *tropicks* and *poles*.

Between these four great *circles*, is a *fascia*, or broad *circle*, called Zodiack, whose middle is in the *ecliptick*, and its extremes two *circles* parallel thereto, at such a distance from it, as to bound or comprehend the excursions of the *sun* and *planets*. It is called *zodiac*, from the *Greek* ζῶον, an animal; on account of the constellations therein.

The *sun* never deviates from the middle of the *zodiack*, *i. e.* from the *ecliptick*, (which is a line drawn in the middle of the *zodiack*) the *planets* all do it, more or less. Their greatest deviations, called *latitudes*, are the measure of the breadth of the *zodiack*; which is broader, or narrower, as the greatest latitude of the *planets* is made more or less. Accordingly, some make it 16, some 18, and some 20 degrees broad.

The Zodiack cutting the *equator* obliquely, makes an angle therewith of 23 degrees and an half; or, more precisely, of 23° 29′, which is what we call the *obliquity of the zodiack*, and is the sun's greatest declination.

The *zodiac* is divided into twelve portions, called *signs*; and those divisions, or *signs*, are denominated from the constellations which antiently possessed each part. *Ausonius* has comprehended the names of those *signs*, in the two following verses:

Sunt Aries, Taurus, Gemini, Cancer, Leo, Virgo,
Libraque, Scorpius, Arcitenens, Caper, Amphora,
Pisces.

But the *zodiack* being immoveable, and the stars having a motion from west to east, those constellations no longer correspond to their proper *signs*; whence arises what we call the *precession* of the *equinoxes*; a term applied to the equinoxes, which, by a very slow, insensible motion, change their places, going backwards, or westward, *i. e. in antecedentia*, as Astronomers call it, or contrary to the order of the *signs*.

When a star, therefore, is said to be in such a *sign* of the *zodiack*, it is not to be understood of that *sign*, or *constellation* of the firmament; but only of that twelfth part of the *zodiack*, or *dodecatemory* thereof.

Cassini has also observed a track in the heavens, within whose bounds most of the comets, though not all of them, are observed to keep, which, for this reason, he calls the *zodiack* of the comets.

This he makes as broad as the other *zodiack*, and marks it with *signs*, and *constellations*, like that; as *Antinous*, *Pegasus*, *Andromeda*, *Taurus*, *Orion*, the *lesser Dog*, *Hydra*, the *Centaur*, *Scorpion*, and *Sagittary*.

The points of the *ecliptick* whereby the *sun*'s ascent above the *equator*, and its descent below it are terminated, are called *solstitial points*. The first point, which is the beginning of the first degree of *Cancer*, is called the *Æstival* or *summer point*; and the latter, which is in the beginning of the first point of *Capricorn*, the *winter point*: therefore the time when the sun is in one of the *solstitial points*, that is, when he is at his greatest distance from the *equator*, which is 23 degrees and an half, is called *solstice*, because he then appears to *stand*

still,

ſtill, and not to change his place in the degrees of the *zodiack*, any way; not that he does not follow, then, his uſual courſe from eaſt to weſt, but becauſe he is no longer perceived to advance towards the *ſeptentrion*, or *meridian*; an appearance owing to the obliquity of our *ſphere*, and which thoſe who live under the *equator* are ſtrangers to.

The SOLSTICES are two in each year, the *ſummer ſolſtice*, and the *winter ſolſtice*. The *ſummer ſolſtice* is when the ſun is in the *Tropick*, which is on the 22d of *June*; when he makes the longeſt day. The *winter ſolſtice* is when he enters the firſt degree of *Capricorn*, which is on the 22d of *December*; when he begins to return towards us, and makes the ſhorteſt day.

This is to be underſtood as in our northern hemiſphere; for in the ſouthern, the ſun's entrance into *Capricorn* makes the *ſummer ſolſtice*; and that into *Cancer* the *winter ſolſtice*.

Beſides theſe two *ſolſtitial points* placed in the beginning of *Cancer* and *Capricorn*, there are two others in the beginning of *Aries* and *Libra*, called EQUINOCTIAL; which are the two points wherein the *Equator* and *ecliptick* interſect each other. That in the firſt point of *Aries* is called the *vernal*; and the other, in the firſt point of *Libra*, the *autumnal point*. In theſe four points, *viz.* the two *ſolſtitial*, and the two *equinoctial*, the four ſeaſons of the year begin; *viz.* the *ſpring*, the *ſummer*, the *autumn*, and the *winter*.

Through theſe points paſſes two circles, the laſt of the greater ones, called COLURES, from κόλος, *mutilus*, or *truncatus*, and οὐρα, Tail, *q. d.* appearing with the tail cut off; becauſe never ſeen entire above the horizon. One of them, becauſe paſſing through the *ſolſtitial* point of the *ecliptic*, is called *ſolſtitial colure*; the other *equinoctial*; becauſe it paſſes through the *equinoctial* point. Theſe two *colures* are imagined to interſect each other at right angles, in the poles of the world.

The four leſſer circles, which divide the *ſphere* into two unequal ſegments, are the two *tropicks*, and the two *polars*.

The TROPICKS, *i* K, are two circles parallel to the *equator*, at ſuch diſtance therefrom, as is equal to the ſun's greateſt receſs from the *equator* towards the poles; or to the ſun's greateſt declination; or the obliquity of the *ecliptick*. Of the two *tropicks*, that drawn through the beginning of *Cancer* is called the *tropick of Cancer*; and that through the beginning of *Capricorn*, the *tropick of Capricorn*.

They have their names from the *Greek* τροπη, *turn*, *converſion*; as being the limits of the ſun's way, or declination towards the north and ſouth; ſo that when the ſun is arrived at either of them, he turns the other way.

Hence, 1. Since the declination of the *ecliptick* is the arch BD, AC will be the diſtance of the *tropicks*; which is double the greateſt declination.

2. Wherefore, if the ſun's meridian altitude be obſerved, both in the winter and ſummer *ſolſtice*, and the latter be ſubtracted from the former, the remainder will be the diſtance of the *tropicks*; half whereof is the greateſt declination of the *ecliptick*.

The POLAR CIRCLES, are two leſſer circles of the *ſphere*, parallel to the *equator*, at the diſtance of 23 degrees from each pole, ſerving to mark the beginning of the frigid zones. The *polar circles* are particularly denominated from their reſpective neighbouring poles, the *arctick* and *antarctick*.

Theſe ſeveral *circles* are repreſented in their natural order, in an artificial *ſphere* called *armillary*, from its conſiſting of a number of *faſciæ*, or rings of braſs, or other matter; called, by the *Latins*, *Armillæ*, from their reſembling of bracelets, or rings for the arms. This *Armillary Sphere* ſerves to give an idea of the office and poſition of each circle thereof, and to ſolve various problems relating thereto. See *Armillary Sphere* in the ſecond plate of ASTRONOMY.

Armillary Spheres are of different kinds, with regard to the poſition of the earth therein; whence they become diſtinguiſhed into *Ptolemaic* and *Copernican Spheres*; in the firſt whereof the earth is in the center, and in the latter near the circumference, according to the poſition which that *planet* obtains in thoſe ſyſtems.

The *Ptolemaic Sphere*, is that commonly in uſe. In the middle, upon the *axis* of the *Sphere*, is a ball *t*, repreſenting the earth, on whoſe ſurface are the circles, &c. of the earth. The *Sphere* is made to revolve about the ſaid *axis*, which remains at reſt; by which means the ſun's diurnal and annual courſe about the earth, are repreſented, according to the *Ptolemaick Hypotheſis*: and even, by means whereof, all problems, relating to the *Phænomena* of the *ſun* and *earth*, are ſolved as upon the celeſtial globe, and after the ſame manner.

The *Copernican Sphere*, is very different from the *Ptolemaic*, both in its conſtruction and uſe; but ſo intricate, and inconſiderable, there needs no deſcription thereof.

Having thus far proceeded on the doctrine of the *Sphere*, and mentioned here the *Ptolemaic* and *Copernican Spheres*; let us now attempt the ſeveral *Syſtems* or *Hypotheſes* of the WORLD; but more particularly, thoſe of PTOLEMY, COPERNICUS, and TYCHO BRAHE.

The invention of *Aſtronomy* remains yet a problem, though *Belus*, king of *Aſſyria*; *Atlas*, king of of *Mauritania*, &c. are complimented with having been the first inventors and cultivators of it.

Some authors give the honour to the *Chaldæans*; and pretend, that a *Chaldæan*, *Astronomer*, and *Astrologer* are synonymous. Others carry its invention as high as *Adam*.

Rudbeck, compliments the *Swedes*, in his *Atlantica*, with the invention of *Astronomy*.

Porphyry would have the origin of *astronomy* traced as far as the building of *Babel*; because, as he writes, there were found in *Babylon*, when taken by *Alexander*, *celestial observations* for the space of 1903 years, which therefore must have commenced within 115 years of the flood, or 15 years of the building of *Babel*.

Achilles Tatius, with far greater foundation, considers the *Egyptians* as the first inventors of *Astronomy*, who took care to have their knowledge therein transmitted to posterity, by having it engraven on columns and pyramids. *Laertius* informs us, that from the *Egyptians*, *Astronomy* passed to the *Greeks*, and that *Thales Milesius* first, about the 19th *Olympiad*, and after him *Eudoxus* and *Pythagoras*, travell'd into *Egypt* to be instructed therein.

Pythagoras, after he had lived in a close community with the *Egyptian* priests for seven years, and had been initiated into their Religion, where he was let into the true system of the Universe; pass'd afterward into *Greece* and *Italy*, where he taught the first *elements* of that curious, though very *intricate science*. He had made so considerable a progress in it, that he went further in his discoveries, than his masters; for he was the first who placed the *sun* in the *center* of the *system*, and made the *earth* and *planets* to turn round him. Supposing the *diurnal motion* of the *sun* and *fixed stars* to proceed from the *earth's motion* round its own axis, and consequently apparent only, and not real. After *Pythagoras*, *Astronomy* sunk into neglect; most of the observations brought from *Babylon* were lost, and *Ptolemy* could recover but a very small number of them. However, *Philolaus* and *Aristarchus Samius*, with a few more of his disciples, continu'd to cultivate *Astronomy*.

It continu'd in that languishing state, till the *Ptolemies*, kings of *Egypt*, declar'd themselves its protectors, by erecting an academy at *Alexandria*, which produced several eminent Astronomers; and, among the rest, *Hipparchus*, who undertook to number the *stars*, and to leave the heavens as an inheritance to posterity. He foretold the *eclipses*, both of the *sun* and *moon*, for six hundred years; and on his *observations* is founded *Ptolemy*'s Μεγαλησυνταξις.

Astronomy was a-fresh introduced into *Europe*, after several ages exile, by the *Saracens*, who had got a tincture of it, in their conquest of *Egypt*, and brought what they knew of it from *Africa* into *Spain*, where it was *cultivated* by the greatest geniusses, and patronized by the greatest princes; even so far, that *Alphonsus*, king of *Castile*, made *Astronomy* one of his most serious occupations, and enriched it with those *tables* which still bear his name. *Copernicus* re-established the antient *Pythagorean system*, and *Tycho* published a *catalogue* of 770 *fixed stars* from his own observations. *Kepler*, from *Tycho*'s labours, soon after discovered the *true theory* of the *World*, and the *physical laws* by which the heavenly bodies move. *Galileo* first introduced Telescopes into *Astronomy*, and by their means discovered the *Satellites* of *Jupiter*, the various *Phases* of *Saturn*, the *Spots* in the *Sun*, and his *Revolution* upon his axis. *Hevelius*, from his own *observations*, furnished a *catalogue* of *fixed stars*, much more compleat than *Tycho*'s. *Huygens* and *Cassini* discovered the *Satellites* of *Saturn*, and his *ring*. And *Gassendus*, *Horrox*, *Bullialdus*, *Ward*, *Ricciolus*, *Gascoign*, &c. each contributed very considerably to the improvement of *Astronomy*.

Sir *Isaac Newton* first demonstrated, from *physical considerations*, the great laws that regulate all the heavenly motions, sets bounds to the *planets* orbs, and determines their greatest excursions from the *sun*, and their nearest approaches to him.

The Ptolemaick *System* places the *earth*, at rest, in the center of the universe; and makes the heavens solid and uncorruptible, revolve round the same from *east* to *west*, and carry all the heavenly bodies, stars, and planets along with them. See the *Plate*.

It is called *Ptolemaick System*; not because *Ptolemy* is the author of it, but because he perfected it; after the *Egyptians* and *Chaldeans*, had, long before him, placed the earth likewise at rest in the center of the universe; and imagining they had observed eight different motions in the *Heavens*, viz. the motion of the fixed stars from *east* to *west* in 24 hours; and the motion of the seven planets from *west* to *east*, they thought fit to distinguish eight different heavenly *orbs*, which moved round the earth, *viz.* the *orb* of the fixed stars, and seven *orbs* for the seven planets.

Plato, *Aristotle*, *Eudoxus*, *Calippus*, and almost all the most famous *Astronomers* who preceded *Ptolemy*, followed this system, and were pleased to call the *orb* or *heaven* of the fixed stars *primum mobile*, under the supposition, that by its motion the inferior orbs of the planets were carried in the space of of 24, or rather 23 hours, 56 minutes, 4 ſeconds from *eaſt* to *weſt*.

They had alſo appointed a certain period of time for the planets to perfect their courſe from *weſt* to *eaſt*, each in its reſpective orb, againſt the motion of the *primum mobile*, viz. *Saturn* accompliſhed his in almoſt thirty years, *Jupiter* in twelve, *Mars* in two, the *Sun* in one, *Venus* in a little more than ſeven months, *Mercury* in three months, and the *Moon* in one month.

The *Aſtronomers*, who ſucceeded theſe, particularly *Arſatalis* and *Timocharis* (who flouriſhed at *Alexandria* about 330 years before the birth of Chriſt,) having compared their own obſervations, with thoſe of their predeceſſors imagined to have diſcovered in the fixed ſtars, a motion from *weſt* to *eaſt*: confirmed therein, by pretending to have obſerved, that the firſt and the moſt weſtward ſtar in the horn of *Aries*, which the antient *Aſtronomers* had diſcovered in the greater circle of latitude, paſſing through the poles of the *Zodiac* and the vernal equinoctial point, had, according to the order of the *ſigns*, or by conſequence, advanced further with the reſt of the ſtars, which was confirmed two hundred years afterwards by *Hypparchus*, and alſo by *Ptolemy* himſelf, in the year of Chriſt, 130; therefore above the firmament, or the *heaven* of the ſtars, which *Ptolemy* ſuppoſed to be carried round its orb, by its proper motion, in the ſpace of 36000 years, they thought proper to imagine a ninth *heaven*, as a *primum mobile*, which, in the ſpace of 24 hours, could carry the other *heavens* along with him, from *eaſt* to *weſt*; which opinion was defended afterwards by *John de Sacrobosco* and others. But in the thirteenth century *Thebitius* and *Alphonſus*, king of *Caſtille*; and in the fourteenth, *George Puerback*, and *John Regiomontanus* thought to have diſcovered in the firmament or eighth *ſphere*, a third motion, which they called *trepidation*.

The ſectators of king *Alphonſus* conceived three motions in the eighth *ſphere*; the firſt they called *raptus*, whereby the eighth *ſphere*, together with the reſt of the inferior *orbs*, were carried by the *primum mobile*, in the ſpace of 24 hours, from *eaſt* to *weſt*. They were pleaſed to give it a ſecond motion which they called *proper*, whereby, in the ſpace of 49000 years, it was carried from *weſt* to *eaſt*; and the third they divided into two librations, whereby the ſame eighth *ſphere* ſeemed to waver or librate through an arch of two degrees and twenty minutes, ſometimes to the *eaſt*, and ſometimes to the *weſt*. They attributed the firſt titubation, or libration to a ninth *ſphere*, and the laſt, to a tenth, calling thoſe two *ſpheres* the *Chryſtalline Heavens*; the firſt ſerved to account for that ſlow motion of the fixed ſtars above-mentioned, and the ſecond was to ſolve the motions of *libration* and *trepidation*.

This *ſyſtem* is ſo abſurd and contrary to the ſimplicity of nature, and often contradictory to appearances, that it ſoon gave way to the *ſolar ſyſtem*.

This gives motion to the earth, and was taught by *Pythagoras* and his diſciples, and defended by *Plato*: but it could no be ſo well aſcertained, as it has been ſince the improvement of *aſtronomical obſervations*: By which Cardinal *Cuſanus* brought this ſyſtem into great reputation.

But *Nicholas Copernicus*, a prebend of *Thorn* in *Poland*, in 1530, eſtabliſhed it upon ſuch ſure and demonſtrable principles, that the learned world gave it the name of the *Copernican ſyſtem*; and is that *hypotheſis*, on which all his ſucceſſors in this ſtudy has endeavoured to improve ever ſince.

The moſt celebrated *Aſtronomers* in the *Copernican* ſchool, were originally *Rothmanus*, *Keppler*, *Galileo* and *Des Cartes*, who reduced this ſyſtem into ſuch an eaſy method, that ſome have ventured to call it the *Carteſian* ſyſtem. See the *Copper Plate*.

The *Sun* (a) is placed in the middle of our *vortex*, or *ſyſtem*, as a fixed ſtar. Around the *Sun* move in ſeveral *orbits*, firſt *Mercury* (b), who accompliſhes his courſe in the ſpace of three months; then *Venus* (c), who perfects hers in eight months. Afterwards comes the great *orbit* (e), which the earth runs round in its annual motion. About the earth in a particular *orbit* moves the *Moon* (d), or rather *Ellipſis*, and who accompliſhes her courſe in the ſpace of a month. The great *orbit* of the earth is received into the circle of *Mars*, which *Mars* over-run in the ſpace of two years; to this ſucceeds the circle of the *orbit* of *Jupiter*; and to *Jupiter*, *Saturn*, or the *orbit* of *Saturn*; ſo that *Jupiter*, in his *orbit*, in the ſpace of twelve years, and *Saturn* in his, in the ſpace of thirty, accompliſh their courſes or periods. Beſides as the *Moon* moves round the *earth*, likewiſe four ſmall *Moons*, or ſatellites move round *Jupiter*, and five round *Saturn*.

Des Cartes improved upon this ſyſtem, and adds that there are in our *vortex* or *ſyſtem*, in whoſe center the *Sun* is placed, ſeveral ſmaller *vortices*, viz. thoſe of *Saturn*, *Jupiter*, and of the *earth* itſelf. In the earth's *vortex*, the *Moon* moves, as in an *ellipſis*; and in the *vortex* of *Saturn*, and of *Jupiter* moves *Saturn*, and *Jupiter*'s ſatellites. The ſame *Des Cartes* believes, that what we have conceived of our *vortex* can alſo be applied or attributed to all the others, which we may imagine round the fixed ſtars; for every one of the fixed ſtars ſeem to him as ſo many *Suns*, which have every one of them their *vortex*.

The

The *Copernican* and *Cartesian system*, being thus clearly demonstrated, we'll proceed to the explication of its different *phænomena*.

1. When the earth by its diurnal motion, is carried from *west* to *east*, the *sun* appears to us to be carried from *east* to *west*, whence proceeds the vicissitude of the day and night.

2. The earth moves not only round its *axis*, but proceeds also each day in the great *orbit* or *zodiack*, according to the order of the *signs*, in the same manner a globe rolled on a plane, proceeds according to the length of the plane, while its superficies turns round the center or axis; or as a bird, flying from one end of a ship under sail to the other, moves also with the ship. Therefore, while the earth is between the *sun* and one of the signs, the *sun* appears to be in the sign opposite to that, *v. gr.* Suppose the *earth* to be between *Aries* and the *sun*, the *sun* appears then to be in *Libra*: if the *earth* be in *Cancer*, or between the *sun* and *Cancer*, the *sun* will be seen in *Capricorn*. In a word if the *earth* be in the northern *signs*, the *sun* will appear in the southern *signs*, and *vice versa*.

3. In this hypothesis the *axis* of the *earth*, must always be conceived parallel to itself, and to the *axis* * of the *equator*; for if it was parallel to the *axis* of the *ecliptick*, there would be a perpetual and universal *equinox*: That is to say, that the days would be always, and every where, equal to the nights; and there would happen no changes in the seasons. But as the *axis* of the earth, being parallel to the *axis* of the *equator*, or of the world, exceeds 23 degrees and an half from the *axis* of the *ecliptick*, and therefore inclines to the *plane* of the *ecliptick*, so as to form an angle of 66 degrees, 30 minutes, and to keep always its parallelism with the *axis* of the world, or to move always in the same sensible parts of *heaven*; hence proceeds, while the *earth* by its annual motion is carried round the *sun*, that succession in the vicissitude or changes of seasons; for example:

If at the beginning of *summer* (while the *sun* appears in *Cancer*, and the *earth* is in *Capricorn)* the *earth* be placed in OE, (*Fig.* 2.) and its *axis* (SM) be parallel to the *axis* of the world; and therefore distant 23 degrees 30 minutes from the *axis* of the *ecliptick*, and consequently inclined to the plane of the annual *orbit* of the *earth*, agreeable to the angle, BOEH, 66 degrees and an half, the *ray* of the *sun* perpendicular to the *earth*, or the *ray* carried from the *sun*'s center to the *earth*'s center will touch the superficies of the earth, not in the terrestrial *equator*, but in the *tropick* of *Cancer*, remote 23 degrees 30 minutes from the *equator* towards the *pole artick*, and therefore the illuminated hemisphere will comprehend the whole circle polar, *artick*; and exclude the whole *antartick*.

Let the *earth* be transferred into A. at the beginning of *autumn*, and the *axis* of the earth, SM, always remain parallel, as well to itself, as to the *axis* of the world: as the *sun* appears at that time in *Libra*, the *earth* being then in *Aries*, the *ray* conducted from the *sun*'s center to the *earth*'s center, *perpendicular* then, to the *axis* of the world, will fall on the superficies of the earth at the beginning of *Libra*, and be distributed to both poles.

Let's now imagine the *earth* in H, at the beginning of *winter*, the perpendicular *ray* of the *sun* (the parallelism of the *axis*, SM, always remaining) will fall on the *tropick* of *Capricorn*; and therefore the illuminated, or lighted hemisphere, will contain within itself the *antartick* pole, and exclude the *artick*.

Lastly, The *earth* being placed in V. at the beginning of the *spring*, *i. e.* at the beginning of *Libra*, at which time the *sun* appears in *Aries*, the *ray* conducted from the *sun*'s center to the *earth*'s center will reach the superficies of the *earth* at the beginning of *Aries*, and then both poles will be again illuminated; but as the illuminated face of the *earth* looks at the *sun*, it cannot be conspicuous to us who are placed without the *figure*.

Thus the Copernicans explain, and elucidate the vicissitudes of the seasons.

The space BC, or DE, in the sphere of the fixed stars, which is equal to the annual *orbit* of the earth, appearing almost as a point, by reason of its too great distance from us; hence it follows, that the *axis* of the *earth*, in each point of its great *orbit*, should always appear directed to the same points, or parts of the world; so that there should always appear the same altitude of the pole, the the same vertical stars, and of the same magnitude, with respect to the same part of the world, although the *earth*, by its annual motion in the *zodiack*, should approach nearer these or those stars, or nearer the north or south.

* A Parallelism, of the *earth*'s *axis*, is that situation, or motion of the earth's *axis*, in its progress through its orbit, whereby it still looks to the same point of the heavens, *viz.* toward the *pole star*; so that if a line be drawn parallel to its *axis*, while in any one position; the *axis*, in all other positions or parts of the *orbit*, will always be parallel to the same line. This *parallelism* is the necessary result of the earth's double motion; the one round the *sun*, the other round its own *axis*. Nor is there any necessity to imagine a third motion, as some have done, to account for this *parallelism*.

If this *hypothesis* should appear ridiculous, or impossible, to some, the *Copernicans* would tell them, that they should remember the great absurdities found in the *Ptolemaic system*; as the prodigious rapidity with which the *primum mobile* must accomplish its diurnal course; then the revolution of the inferior spheres, against the motion of the *primum mobile*, though they are daily carried along with it. Which absurdities are corrected, by the *Copernican hypothesis*; since, by the diurnal motion of the earth, that incredible velocity of the *sun*, as well as that of the fixed stars, whereby the remotest should be carried with 400,000 times more rapidity than a ball from a cannon) is rendered vain and useless. How easier it is, say they, for the small sphere of the earth, so fit for motion, by its round figure, to move round the *sun*; than for a huge machine, whose exterior figure is utterly unknown, to be carried with such incredible velocity round so small a *pole* as the earth.

When it is said, in the *Copernican hypothesis*, that the earth, while carried through its great annual *orbit*, keeps the *parallelism* of its *axis*; this is not to be so strictly understood, as if that *axis* did not change a little its *situation*, and could not by a very slow motion, *viz.* in the space of 25816 *Egyptian* years, according to *Copernicus*, describe a certain circle, towards the poles of the *zodiack*, against the order of the *signs*, or from east to west; the semidiameter of which circle, is, according to the said *Copernicus*, 23 degrees and 40 minutes: Whence it must follow, that the intersections of the *ecliptick*, and of the *equator*, or the *equinoctial points*, are carried, by the same motion, against the order, or *in præcedentia* of the signs; a motion called, by *Copernicus*, the *precession of the equinoxes*.

Hence he has drawn the appearance of the motion of the fixed stars, by which they seemed to be carried, according to the order, or *in consequentia* of the signs, from west to east, and changed the apparent mutation of distance of the fixed stars, from the *equinoctial points* toward the east, into a real motion of *precession of the equinoxes*.

Precession, in this place, is a term applied to the *equinoxes*, which by a very slow, insensible motion, change their places, going backward, or westward, *i. e. in antecedentia*, as Astronomers call it, or contrary to the order of the *signs*. The *pole*, the *solstices*, the *equinoxes*, and all the other points of the *ecliptick*, have a retrograde motion; and are continually moving from east to west, or from *Aries* towards *Pisces*, &c. by means whereof the *equinoctial points* are carried farther and farther back, among the preceding signs of stars, at the rate of about 50 seconds each year; which retrograde motion is called the *precession*, *recession*, or *retrocession* of the *equinoxes*.

Hence, as the fixed stars remain immoveable, and the *equinoxes* go backward, the stars will seem to move more and more eastward with respect thereto; whence the longitudes of the stars, which are reckoned from the first point of *Aries*, or the *vernal equinox*, are continually increasing.

Hence the motion of the *axis* of the earth has sometimes appeared unequal; since from the time of *Timocharides* to that of *Ptolemy*, the fixed stars seemed, every hundred years, to have moved a degree, according to the order of the signs. From *Ptolemy* to *Albategnius*, they run one degree every 66 years. At present, they accomplish one degree, according to *Tycho Brahe*, in 70 years; so that their revolution is finished in 25806 *Julian* years. But in *Ricciolus*'s opinion, they employ 72 years in running a degree; therefore they cannot accomplish their revolution in less than 25920 years.

To rectify this irregularity of motion, and keep still the fixed stars immoveable, *Copernicus* has imagined an irregularity in the motion of *precession of the equinoxes*; whose *anomaly* should be restored in 1717 *Egyptian* years.

Note, That Anomaly, in *Astronomy*, is the distance of a planet from the *aphelion*, or *apogee*; or an irregularity in the motion of a planet, whereby it deviates from the *aphelion* or *apogee*.

But as the obliquity of the *ecliptick* had been observed to vary otherwise, by the antient Astronomers, and its *anomaly* to take twice the time of the *anomaly* of the *equinoxes*, before it could be finished, *viz.* 3434 *Egyptian* years; he has explained both inequalities, by the sole motion of the poles of the earth; and by imagining the *axis* of the earth to be carried from north to south, and from south to north, in the interval of 24 minutes only; and from east to west, and from west to east, through an arch of 2 degrees, and 20 minutes; so that by those *complicate motions*, the extremity of the *axis* forms a *corolla intorta*, in the two revolutions of the *anomaly* of the *equinoxes*, and in one of the obliquity of the *zodiack*, following the order of the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9: Whence it is understood, that seven, or more, of those *corolla's*, are contained in an entire revolution of 25816 *Egyptian* years; during which time, the *axis* of the earth is carried round the poles of the *zodiack*, against the order of the *signs*

Now as to what relates to the *stations*, *directions*, and *retrogradations* of the *planets*, it may be explained in this *hypothesis*, with an admirable facility, and without being obliged to have recourse to *Epicycles*. *Venus* and *Mercury* have sooner finished their courses round the sun, than the earth; because they describe their circles nearer the sun; and the earth sooner than *Mars*, *Jupiter*, and *Saturn*. Whence it happens, that the earth passes, sometimes, between the ſuperior planets and the ſun, the ſame as *Venus* and *Mercury* paſs between the ſun and the earth. For example,

Let the *ſun* be k, and the annual circle of the earth b h j c T l; the circle of ſome of the ſuperior planets, *viz.* of *Saturn*, *Jupiter*, or *Mars*, be o d q R E P, an arch of which, or at leaſt a portion thereof, a planet ſhould viſit while the earth is running through its whole circle. Let alſo the firmament be M F G N.

If the *earth* be placed in N, and the planet in O, it will be ſeen in the point of the firmament M. Let the earth advance from L to B, and the planet from O to D, ſo that the earth ſhould be very near to paſs between that planet and the ſun; then the planet will be ſeen in G; and becauſe it will appear to have haſtened its motion from the point M, to the point C, ſuch motion ſhall be called a direct motion.

If afterwards the *earth* arrives from the point B to the point H, and the planet from the point D to the point q; this will again be ſeen in G, and be called ſtationary, which will be its firſt ſtation. But if the earth was to paſs to I, and the planet to R, the planet will appear in D; and thereby appearing to have retrograded againſt the order of the ſigns, it will be then called *retrograde*.

If the *earth* being in C, the planet be in E, it will be ſeen again in D, and appear ſtationary; therefore this will be its ſecond ſtation.

Laſtly, When the *earth* will be arrived from the point C into T, and the planet into P, it will appear in N; and as it ſeems then to have advanced according to the order of the ſigns, it will be called again *direct*.

In this manner, the *ſtation*, *direction*, and *retrogradation* of the ſuperior planets, *Mars*, *Jupiter*, and *Saturn* are very eaſily accounted for, according to the *Copernican hypotheſis*: Where we are to obſerve, that there is a greater quantity of *retrogradation* in *Mars* than in *Jupiter*, and in *Jupiter* than *Saturn*.

As to the other planets, called *inferior*, viz. *Venus* and *Mercury*; as they are nearer the *ſun* than the *earth*, they alſo perfect their courſe with a greater celerity than ſhe can; whence they appear ſometimes placed between her and the *ſun*; and hence ſeem ſometimes to advance, ſometimes to ſtand ſtill, and ſometimes to be retrograde.

Let us then place the *earth* to run in its *orbit* the part T B C D E F, *Fig.* 2. while *Mercury* runs the whole circle G L M N O. If the *earth* be in T, and *Mercury* in G, he'll be ſeen in the point of the firmament F. But if the *earth* be arrived at the point B, and *Mercury* at the point l, *Mercury* will be ſeen in P. And becauſe the progreſs will ſeem then to be made with a greater celerity, it will be called *direct*. But where he'll gain the point H, the *earth* being in C, then he is to be *ſtationary*, becauſe he ſeems to ſtay almoſt in the ſame point P. This is his firſt *ſtation*.

But if the *earth* occupies the point D, and *Mercury* the point N, he'll appear in q; and thus will be *retrograde*, becauſe he'll be ſuppoſed removed againſt the order of the *ſigns*. But if the *earth* being in E, *Mercury* is in O, he'll be thought *ſtationary*, becauſe he'll be ſeen in the ſame point q. And then it will be his ſecond *ſtation*.

Laſtly, When the *earth* will be in f, and *Mercury* in G j, *Mercury* will be referred to the point I, and then become *direct*, becauſe the progreſs will then appear made according to the order of the *ſigns*.

What is ſaid here of *Mercury*, is to be underſtood of *Venus*; this excepted, that theſe mutations are not ſo frequent in her, becauſe ſhe takes more time than *Mercury* to run through her *orbit*.

After theſe aroſe divers great men, as *Gaſſendus*, *Hevelius*, *Bullialdus*, *Ricciolus*, the two *Caſſini's*, Mr. *Huygens*, *Horrox*, Biſhop *Ward*, Mr. *Flamſteed*, Dr. *Halley*, Dr. *Gregory*, Dr. *Keil*, and, above all, that ſuperlative genius Sir *Iſaac Newton*; who all with the greateſt pains and diligence, applied themſelves to make obſervations, to invent inſtruments, and to inveſtigate the phyſical cauſes of celeſtial *phænomena*; in which they ſo happily ſucceeded, eſpecially the laſt great man, that the nature, extent, order, and conſtitution of all and every part of the SOLAR SYSTEM, both of PLANETS and COMETS, became ſo well defined, ſtated, and eſtabliſhed, as to admit of no conteſt or ſcruple, with any man properly qualified to underſtand it; and which therefore ought for the future to be called the NEWTONIAN SYSTEM *of the world*.

This SYSTEM (no longer now to be called an *hypotheſis*) is repreſented in a plate with the *orbits* of all the *planets* and *comets* (hitherto determined) and at their proper diſtances from the *ſun*, repreſented by the central point, with the ORRERY.

In the ſixteenth century the *Copernican ſyſtem* was attempted to be antiquated by *Tycho Brahe* a noble *Dane*; from whoſe works in *Aſtronomy* the world is favoured with a third *ſyſtem*, called after his name the *Tychonic ſyſtem*. See the *firſt plate* of ASTRONOMY.

In this *ſyſtem*, three things move round the *earth*, as round their centre; the *moon*, which is the neareſt to it, by a *monthly* motion; the *ſun*, which is more diſtant from it, by an *annual* courſe; and the *firmament*, or the *ſphere* of the *fixed ſtars*, the remoteſt of all three, by a ſlow motion of 25000 years.

Round

Round the *sun* five *errant stars*, or *planets*, have their particular motions, *viz. Mercury*, of three months; *Venus*, of eight months, *&c.* with this order, or rule, that the *sun*, by his annual motion, running through the *Zodiac*, carries them all along with him. Besides, as *Mercury* and *Venus*, by their revolutions round him, do not embrace the *earth*; *Mars*, *Jupiter*, and *Saturn*, embrace it by theirs, but especially *Mars*, which, while in B, becomes nearer the *earth* than the *sun* himself.

But there is no mention made, in the *Tychonick system*, of a diurnal motion; those who follow his *hypothesis*, place a *primum mobile* above the *firmament*, whereby the whole machine of the world may be moved by a diurnal motion; or suppose those three *mobiles*, the *moon*, the *sun*, and the *sphere* of the *fixed stars*, while by a slow motion they move from west to east in the *zodiac*, to be also moved daily from east to west, in a circle, almost parallel to the equator. Moreover they conceive that the five errant stars, besides their proper motions, they have round the *sun* from west to east through the *zodiac*, are also carried daily from east to west, in a plain parallel to the *equator*, not by themselves, but by the *sun* who serves them instead of a *primum mobile*.

The *Tychonicians* have this common, with the *Copernicans*, that they both acknowledge the heaven's fluid; and in fact the *Tychonick system* is nothing else but that of *Copernicus* inverted, for if the *sun* with *Venus* and *Mercury* was restored to the centre of the world, the earth would accomplish its annual period through the circle assigned to the *sun*, and the planets, or the sphere of the fixed stars would be understood to remove at such a distance, that the circle of *Saturn* would be every where equally distant from the fixed stars; and then the system would be the same as described by *Copernicus*.

As to the number of heavens, *Tycho*'s partisans admit of three, *viz.* the *Empyreum*, the *Firmament*, and the *Planetick*, which number they pretend to support with the authority of the Apostle, who is said, *Eph.* ii. *Corinth. c.* xii. *v.* 12. to have been caught up to the third heaven; *i. e.* as they interpret it, to the *Empyreum*. But those among them who place a *primum mobile* above the firmament, ought to reckon four heavens, and therefore cannot be assisted therein by the text of the apostle, which, on the contrary, the *Copernicans* and *Cartesians* borrow to support their *hypothesis*. For our *vortex* is the first heaven of the *Cartesians*; that vast region of the fixed stars conspicuous to us, establishes another with respect to us; and all that is extended beyond that immense region may form the *empyreum*, or a *third heaven*.

Tycho and his disciples had proceeded thus far in the explanation, as well of the diurnal motions of the heavenly bodies from east to west, in a plane parallel to the equator, as of the monthly, annual, *&c.* from west to east in the *zodiac*; but there remained still, for them, to explain the *station*, *direction*, and *retrogradation* of the planets, when *Kepler*, by an admirable invention, undertook that arduous task.

This famous *Astronomer* (considering the whole planetick region thus drawn, the *sun* in such a manner as for the *axis* to keep always its *parallelism*, and for each planet, besides, to have, at the times fixed, its particular motion round the *sun*) shews how to compose a spiral motion from those two, *viz.* of abduction from the *sun*, and of conversion round the *sun*. For example:

Let the earth be T, and the *orbit* of the sun, in which he is moved, SSSS. If *Jupiter* be in A, and by a composite motion, as we have said, be carried into B, it will become *stationary*; because it is not understood to move, nor according to the order of the signs, nor against it. If afterwards it passes from the point B to C, it will be direct, because it advances according to the order of the signs; and from the point C to the point D becomes again *stationary*. But from the point D to E, because carried against the order of the signs, it will be called *retrograde*.

However the planets do not accomplish a whole *spiral* every year; but that time is required which is necessary for a conjunction of the *sun* with the planet, particularly if the beginning of the *spiral motion*, is taken from the conjunction; or for an opposition, if the beginning of the *spiral motion* is expected from an opposition. Therefore we must imagine eleven of those *spirals* in the circle of *Jupiter*; twenty-nine in the circle of *Saturn*, &c. which *spirals* are greater in *Jupiter* than in *Saturn*, and again greater in *Mars* than in *Jupiter*; whence those *spirals* are not soon perfected in *Mars* as in *Jupiter*; nor so soon in *Jupiter* as in *Saturn*.

Let us proceed to demonstrate the distances, magnitudes, motions, *&c.* of the celestial bodies; premising a few observations on the figure and dimension of the earth.

The *figure of the earth* is demonstrated to be nearly spherical, thus: the *moon* is frequently seen eclipsed by the shadow of the *earth*; and in all *eclipses* that shadow appears circular, what way soever it be projected, whether towards the east, west, north, or south, howsoever it in diameter varies according to the greater or less distance from the earth.

Hence it follows that the shadow of the earth, in all its situations, is really *conical*; and consequently the body that projects it, *i. e.* the earth, is nearly *fpherical*. We fay it is nearly *fpherical*; for the inequalities of its furface prevent its being perfectly fo; befides *Huygens* and Sir *Ifaac Newton* have fhewn that the earth is higher and bigger under the *equator* than at the *poles*: fo that its figure, nearly, is that of an *oblate fpheroid*, fwelling out towards the equatorial parts, and flatted or contracted towards the poles. The reafon of this inequality is deduced from the diurnal rotation of the earth on its *axis*.

This *roundnefs* of the *earth* is farther confirmed by its having been frequently failed round: all the circumnavigators failing continually from eaft to weft, at length arrived in *Europe*, whence they fet forth; and in the courfe of their voyage obferved all the *phænomena*, both of the heavens and earth, to correfpond and confefs this *fpherical* figure.

The antients had various opinions as to the figure of the earth. *Anaximander*, held it cylindrical; *Leucippus*, in form of a drum. But the principal opinion was, that it was flat; that the vifible *horizon* was the bounds of the earth, and the ocean the bounds of the *horizon*: that the heavens and earth above this ocean, were the whole vifible univerfe, and that all beneath the ocean was *hades*: of which opinion were, not only divers of the antient poets and philofophers, but alfo fome of the Chriftian fathers, as *Lactantius*, St. *Auguftin* bifhop of *Hippo*, &c.

The Magnitude of the Earth, we are to confider next; and the number of miles its diameter contains, has been varioufly determined by feveral authors, antient and modern. The way to arrive at it is, by finding the quantity of a degree of a great circle of the *earth*. But this degree is found very different, according to the different methods and inftruments made ufe of, as well as the different obfervers.

The method obferved by Mr. *Norwood*, and the *French* aftronomers, *Picard*, *Caffini*, &c. viz. by meafuring the difference between two remote places on the fame meridian, is undoubtedly the beft; and was performed with fuch exceeding accuracy, efpecially by M. *Caffini*, that hardly any thing further or better can be expected. According to that author the *ambit*, or circumference of the *earth* is 123,750,720 *Paris* feet; or 134,650,777 *Englifh* feet; or 25031$\frac{1}{2}$ of our ftatute miles; whence, fuppofing the *earth* fpherical, its diameter muft be 7967 ftatute miles; and confequently its *radius*, or femi-diameter, may be taken in a round number 200 000,000 feet; its furface will be 199,444,206 miles; which being multiplied into $\frac{1}{3}$ of its femi-diameter, gives the folid content of the globe of the *earth* 264,856,000,000 cubic miles.

Mr. *Whifton* reckons the *ambit* of the *earth* to be 123,249,600 *Paris* feet, or 131,630,573, or thereabouts, *Englifh* feet.

We are now to explain the doctrine of the Fixed Stars.

Firft, we will begin with the motion of thefe *ftars*. Thefe *ftars* are called *fixed*; not from their being fixed in a folid concave; but becaufe we obferve always the fame diftance between them.

They have two kinds of motions: one called the *firft*, *common*, and *diurnal motion*, or the *motion* of the *primum mobile*: by this they are carried along with the *firmament* wherein they appear fixed, round the *earth*, from eaft to weft, in the fpace of twenty-four hours.

The other, called the *fecond*, or *proper motion*, is that whereby they go backwards, from weft to eaft, round the poles of the *ecliptick*, with an exceeding flownefs, as not defcribing above a degree of their circle in the fpace of 71 or 72 years, or 51 feconds in a year. Some have imagined, that when they have got round to the points whence they firft departed, nature will have finifhed her courfe, and the *ftars*, having performed their career, the heavens will remain at reft, unlefs the Being, who firft gave them motion, appoints them to begin another circuit. On the footing of this calculation, the world fhould laft about 30,000 years, according to *Ptolemy*; 25816, according to *Tycho*; 25920, according to *Riccioli*; and 24800, according to *Caffini*.

In effect, the *latitudes* of the *fixed ftars*, we find, by comparing the obfervations of the *antient* Aftronomers with thofe of the *moderns*, continue ftill the fame; but their *longitude* is, by the *fecond motion*, always increafing. Thus, for example, the *longitude* of *Cor Leonis* was found by *Ptolemy*, *A. D.* 138, to be 2° 30′; in 1115 it was obferved by the *Perfians* to be 17° 30′; in 1364, by *Alphonfus*, 20° 40′; in 1586, by the prince of *Heffe*, 24° 11′; in 1601, by *Tycho*, 24° 17′; and in 1690, by Mr. *Flamfteed*, 25° 31′ 20″: whence the *proper motion* of the *ftars*, according to the order of the *figns*, in circles parallel to the *Ecliptick*, is eafily inferred.

It was *Hipparchus* firft fufpected this *motion*; upon comparing the obfervations of *Tymocharis* and *Ariftyllus* with his own. *Ptolemy*, who lived three centuries after *Hipparchus*, demonftrated the fame by undeniable arguments. Some, it is true, have imagined a change in the *latitude* of the *ftars*; but fuch an opinion has but little countenance from obfervation. *Tycho Brahe* makes the increafe of *longitude* in a century 1° 25′; *Copernicus* 1° 23′ 40″ 12‴; *Bullialdus* 1° 24′ 54″; *Hevelius* 1° 24′ 46″ 50‴; whence, with Mr. *Flamfteed*, the annual increafe increase of the *longitudes* of the *fixed stars* may be well fixed at 50″.

From these *data*, the increase of the *longitude* of a *star*, for any given time, is easily had; and hence the *longitude* of a *star*, for any given year, being given, its *longitude* for any other year is readily found.

The next thing which falls under our considera-tion, with regard to the *fixed stars*, is their *magni-tudes*, which appear to be very different; which difference probably arises, not from any difference in their real *magnitudes*, but from their distances, which are different. From this difference the *stars* become distributed into seven several classes, called *magnitudes*.

The first class, or *Stars of the first magnitude*, are those nearest us, and whose diameters are there-fore biggest. Next these, are those of the *second magnitude*; and so on, to the *sixth*, which compre-hends the smallest *stars* visible to the naked eye; all beyond, are called *telescopick stars*. Not that all the *stars* of each class appear justly of the same *mag-nitude*; there is a great latitude in this respect, and those of the *first magnitude* appear almost all dif-ferent in lustre and size. Other *stars* there are, of *intermediate magnitudes*, which Astronomers cannot refer to this, rather than the next class, and there-fore place them between the two.

Procyon, for instance, which *Ptolemy* makes of the *first magnitude*, and *Tycho* of the *second*, *Flamsteed* lays down as between the *first* and *second*. Thus, instead of six several *magnitudes*, we have really six times six. Some authors assert, that the *stars* of the *first magnitude* subtend an angle of at least a minute; but the *earth's orbit* seen from the *fixed stars*, only subtends an angle of 20 seconds; and hence they conclude that the diameters of the *stars* are vastly greater than that of the *earth's* whole *orbit*. Now a sphere whose semidiameter only equals the distance between the *sun* and the *earth*, is, by some, supposed to be ten millions of times greater than the *sun*; consequently the fixed *stars* must be much more than ten millions of times greater than the *sun*. But Mr. *Whiston* is of opi-nion, that this is a mistake, and that the diameters, even of the largest *stars*, viewed through a teles-cope, which magnifies, for example, a hundred times, subtend no visible angle at all, but are mere lucid points.

The incertitude, as to the *magnitude*, and dis-tance of the *fixed stars* from us, proceeds from their having no *parallax* *; since all Astronomers, both *antient* and *modern*, agree, that the doctrine of the *distances* of the *celestial bodies* consists in their *paral-laxes*, and that it is impossible we should have any just observation without it.

Among the *fixed stars*, there is a long, white, luminous track, which seems to encompass the heavens like a swath, scarf, or girdle, called *Via Lactea*, or *Galaxy*, of Γαλαξτος, milk. It passes between *Sagittary* and *Gemini*, and divides the sphere into two parts. It is unequally broad, and in some parts is single, in others double. And it is an assemblage of an infinite number of minute *stars*, to be discovered only by a *telescope*.

The number of the *stars* appears to be vastly great, almost infinite; yet Astronomers have long ago ascertained the number of those visible to the eye; which are found vastly fewer than one would imagine. *Hipparchus*, 125 years before the *Incar-nation*, made the number of visible *stars* to be 1022. These were reduced into 48 *Constellations*; and he laid it down, that if there sometimes appeared more in winter nights, it was owing to a deception of the sense. *Ptolemy* added four *stars* to *Hipparchus's catalogue*, and made the number 1026. In the year of Christ 1437, *Ulug Beigh*, grandson of *Ta-merlane*, made a new *catalogue*, and gives 1017. But in the seventeenth century, when *Astronomy* began to be retrieved, their number was found to be much greater.

To the forty-eight *Constellations* of the antients were added twelve new ones, discovered towards the south pole, and two towards the north; besides several others not universally admitted, as the *Flower-de-lis*, the *Royal Oak*, &c.

Tycho Brahe published a catalogue of 777 stars, from his own observations; which *Kepler* from *Pto-lemy* and others increased to 1163, *Ricciolus* to 1468, and *Bayer* to 1725: Dr *Halley* 373, ob-served by him within the *Antarctic Circle*. *Hevelius*, from his own observations, and those of Dr. *Halley*, and the antients, made a catalogue of 1888 *stars*; and Mr. *Flamsteed* has since made a catalogue of no less than 3000 *stars*, all from his own most ac-curate observations. Of these 3000, it is true, there are many only visible through a *telescope*; nor does a good eye scarce ever see more than a hun-dred at the same time in the clearest heaven: the appearance of innumerable, more frequent in clear winter nights, arrives from our sight's being de-ceived by their twinkling, and from our viewing them confusedly, and not reducing them to any order. Yet for all this, the *stars* are really almost

* A PARALLAX is an arch of the heavens intercepted between the *true place* of a *star*, and its *apparent place*. The *true place* of a *star*, is that point of the heavens wherein it would be seen by an eye placed in the *center* of the *earth*. The *apparent place*, is that point of the heavens, wherein the *star* appears, to an eye on the *surface* of the *earth*.

infinite,

infinite. *Riccioli* makes no ſcruple to affirm, in his new *Almageſt*, that a man who ſhould ſay there are above twenty thouſand times twenty thouſand, would ſay nothing improbable; for a good teleſcope directed to any point in the heavens, diſcovers numbers, that are loſt to the naked ſight.

In the ſingle conſtellation of the *Pleiades*, inſtead of ſix or ſeven *ſtars* ſeen by the beſt eye, Dr. *Hook*, with a teleſcope twelve foot long, told ſeventy-eight; and with larger glaſſes many more of the ſame magnitude. *F. de Reita*, a Capuchin, affirms, that he has obſerved above 2000 *ſtars* in the ſingle conſtellation of *Orion*. The ſame author found above 188 in the *Pleiades*: and *Huygens*, looking at the ſtar in the middle of *Orion*'s ſword; inſtead of one, found it to be twelve. *Galileo* found 80 in *Orion*'s ſword; 21 in the nebulous *ſtar* of his head; and 36 in the nebulous *ſtar Præſepe*.

The antients portioned out the firmament into ſeveral parts, or *Conſtellations* *, reducing certain number of ſtars under the repreſentation of certain images, in order to aid the imagination, and the memory. In the book of *Job*, mention is made of the name of certain conſtellations, *Pleiades*, *Orion*: the ſame may be obſerved of *Homer* and *Heſiod*.

The antients only took in the viſible firmament, which they diſtributed under 48 *Conſtellations*; twelve whereof took up the *Zodiac*; the names they gave them are, *Aries*, *Taurus*, *Gemini*, *Cancer*, *Leo*, *Virgo*, *Libra*, *Scorpius*, *Sagittarius*, *Aquarius*, *Capricorn*, *Piſces*; from whence the ſigns of the *Ecliptic* and *Zodiac* take their names; though now no longer contiguous to the *Conſtellations*.

The ſtars on the northern ſigns of the *Zodiac*, were diſpoſed into 21 *Conſtellations*, viz. *Urſa major* and *minor*, *Draco*, *Cepheus*, *Bootes*, *Corona ſeptentrionalis*, *Hercules*, *Lyra*, *Cygnus*, *Caſſiopeia*, *Perſeus*, *Andromeda*, *Triangulum*, *Auriga*, *Pegaſus*, *Equuleus*, *Delphinus*, *Sagitta*, *Aquila*, *Ophiculus*, or *Serpentarius*, and *Serpens*; to which have been added ſince, *Antinous*, and *Coma Berenices*.

The ſtars on the ſouthern ſide of the *Zodiac* were diſtributed into 15 *Conſtellations*; their names *Cetus*, *Eridanus*, *Fluvius*, *Lepus*, *Orion*, *Canis major* and *minor*, *Argo*, *Hydra*, *Crater*, *Corvus*, *Centaurus*, *Lupus*, *Æra*, *Corona Meridionalis*, and *Piſcis Auſtralis*: to which have been ſince added the following *viz*. *Phœnix*, *Grus*, *Indus*, *Pavo*, *Piſcis Auſtralis*, *Piſcis volans*, *Toucan*, *Hydrus*, and *Xiphias*.

Of theſe *Conſtellations* the 15 laſt, with the greateſt part of *Argo*, *Navis*, *Centaurus* and *Lupus* are not viſible in our horizon.

In theſe *Conſtellations* the ſtars are ordinarily diſtinguiſhed by that part of the image wherein they are found. *Blayer* diſtinguiſhes them farther by the letters of the *Greek* alphabet; and many of them again have peculiar names, as *Arcturus* between the feet of *Bootes*; *Gemina* or *Lucida* in the *Corona Septentrionalis*; *Palilitium* in the *Bull's-Eye*; *Pleiades* in the back, and *Hyades* in the forehead of the *Bull*; *Caſtor* and *Pollux* in the head of *Gemini*; *Capella*, with the *Hædi* in the ſhoulder of *Auriga*, *Regulus*, or *Cor Leonis*; *Spica Virginis* in the hand, and *Vindemiatrix* in the ſhoulder of *Virgo*; *Antares*, or *Cor Scorpii*; *Fomahaut* in the mouth of *Piſcis Auſtralis*; *Regel* in the foot of *Orion*; *Sirius*, in the mouth of *Canis major*; and the *Pole-Star*, the laſt in the tail of *Urſa minor*.

The other *ſtars* not comprehended under theſe *Conſtellations*, yet viſible to the naked eye, the antients called *Informes*, or *Sporades*, ſome whereof the modern *Aſtronomers* have ſince reduced into new figures or *Conſtellations*. Thus *Hevelius*, *v. gr.* between *Leo* and *Urſa minor*, makes *Leo minor*; and between *Urſa minor* and *Auriga*, over *Gemini*, makes *Lynx*, under the tail of *Urſa major*, *Canes Venatici*, &c.

The *ſtars* in the *conſtellation* of *Aries*, in *Ptolemy*'s *catalogue*, are 18; in *Tycho*'s, 21; in the *Britannic catalogue*, 65. In *Taurus*, the ſecond in order, in *Ptolemy*'s *catalogue*, 44; in *Tycho*'s, 41; in the *Britannic catalogue*, 135. In *Gemini*, the third, in *Ptolemy*'s *catalogue*, 24; in *Tycho*'s, 29; in the *Britannic catalogue*, 89. In *Cancer*, the fourth, in *Ptolemy*'s *catalogue*, 13; in *Tycho*'s, 15; in *Bayer* and *Hevelius*'s, 29; in Mr. *Flamſteed*'s, 71. In *Leo*, the fifth, in *Ptolemy*'s *catalogue*, 32; in *Tycho*'s, 37; in the *Britannic catalogue*, 97. In *Virgo*, the ſixth, into which the *ſun* enters in the beginning of *Auguſt*, in *Ptolemy*'s *catalogue*, 32; in *Tycho*'s, 39; in the *Britannic catalogue*, 89. In *Libra*, the ſeventh ſign, ſo called, becauſe when the *ſun* is in it, at the *autumnal equinox*, the days and nights are equal, as if weighed in a ballance, there are 45 *ſtars*. In *Scorpio*, the eighth, in *Ptolemy*'s *catalogue* 20; in *Tycho*'s 10; in *Flamſteed*'s, 49. In *Sagittarius*, the ninth, in *Ptolemy*'s *catalogue*, 31; in *Tycho*'s, 16; in the *Britannic catalgue*, 50. In *Capricorn*, the tenth, in *Ptolemy* and *Tycho*'s *catalogues*, 28; in that of *Hevelius*, 29; in the *Britannic catalogue*, 51. In *Aquarius*, the eleventh, in *Ptolemy*'s *catalogue*, 45; in *Tycho*'s, 40; in the *Britannic catalogue*, 99. In *Piſces*, the twelfth ſign in *Ptolemy*'s *catalogue*, 38, in *Tycho*'s, 33; in the *Britannic catalogue*, 109.

Of the other 36, 21 are placed on the north of the *zodiac*, and 15 on the ſouth.

The firſt of thoſe on the north, is *Urſa major*, a *conſtellation* placed near the pole, which conſiſts, according to *Ptolemy*'s *catalogue*, of 35 *ſtars*; according

* *i. e.* An aſſemblage of *ſtars* under the name and figure of ſome *animal* or other thing, called alſo an *aſteriſm*.

cording to *Tycho*'s, of 56; and according to the *Britannic catalogue*, of 215. *Urſa minor*, plac'd alſo in the neighbourhood of the north pole, of 8, according to *Ptolemy* and *Tycho*; and of 14, according to *Flamſteed*. In *Draco*, the ſecond northern *conſtellation*, there are, according to *Ptolemy*, 31; according to *Tycho*, 32; according to *Bayer*, 33; and according to *Flamſteed*, 49. In *Cepheus*, the third, there are, in *Ptolemy's catalogue*, 13; in *Tycho*'s, 11; in *Hevelius*'s, 40; in the *Britannic catalogue*, 35. In *Bootes*, the fourth, in *Ptolemy's catalogue*, 23; in *Tycho*'s, 28; in *Bayer*'s, 34; in *Hevelius*'s, 52; in *Flamſteed*, 55. In *Corona Borealis*, the fifth, in *Ptolemy's catologue*, 8; in *Tycho*'s, 8; in the *Britannic catalogue*, 21. In *Hercules*, the ſixth, in *Ptolemy's catalogue*, 29; in *Tycho*'s, 28; in the *Britannic catalogue*, 95. In *Lyra*, the ſeventh, in *Ptolemy* and *Tycho*'s *catalogues*, 10; in the *Britannic catalogue*, 19. In *Cygnus*, the eighth, in *Ptolemy's catalogue*, 17; in *Tycho*'s, 19; in the *Britannic catalogue*, 107. In *Caſſiopeia*, the ninth, in *Ptolemy's catalogue*, 13; in *Tycho*'s, 28; in *Flamſteed*'s, 56.

In *Perſeus* (the tenth) in *Ptolemy*'s catalogue 29; in *Tycho*'s 29: In the *Britannick catalogue* 67. In *Andromeda* (the eleventh) there are two ſtars of the ſecond magnitude, and very conſpicuous; another is called *Umbiliculus Andromedæ*, and another *Lucida pedis Andromedæ*. In *Triangulum* (the twelfth) in *Ptolemy* and *Tycho*'s *catalogue* 4; in the *Britannick catalogue* 24. In *Auriga* (the thirteenth) in *Ptolemy*'s *catalogue* 14; in *Tycho*'s 23; in *Hevelius* 40; in the *Britannic catalogue* 68.

In one of theſe *conſtellations*, called alſo *Ericthonius*'s ſhoulder, there is a very bright ſtar, called *Capella*, and near it three others leſſer, placed in the form of an iſoſceles triangle, called *Hædi*.

In *Pegaſus* the fourteenth, in *Ptolemy*'s *catalogue* 20; in *Tycho*'s 19; in the *Britannic catalogue* 93; in *Equuleus* (the fifteenth) in *Ptolemy*'s *catalogue* 4; in *Tycho*'s 4; in *Flamſteed*'s 10. In *Delphinus* (the ſixteenth) in *Ptolemy*'s *catalogue* 10; in *Tycho*'s 10; in *Flamſteed* 18. In *Sagitta* (the ſeventeenth) in *Ptolemy* and *Tycho*'s *catalogue* 5. In *Flamſteed*'s 23. In *Aquila* (the eighteenth) in *Ptolemy*'s *catalogue* 15; in *Tycho*'s 17; in the *Britannic catalogue* 70. In this conſtellation there is a ſtar of the firſt magnitude. In *Serpentarius* (the nineteenth) in *Ptolemy*'s *catalogue* 29; in *Tycho*'s 25; in the *Britannic catalogue* 69. In *Serpens* (the twenty-firſt) in *Ptolemy*'s *catalogue* 17; in *Tycho*'s 19; in the *Britannic catalogue* 59.

The ſtars on the ſouthern ſide of the *zodiack* are diſtributed into 15 *conſtellations*, *viz*.

In *Cetus* (the firſt) in *Ptolemy*'s *catalogue* there are 22 ſtars; in *Tycho*'s 21; in *Hevelius*'s 22; in the *Britannic* 78. In *Eridanus Fluvius* (the ſecond) in *Ptolemy*'s *catalogue* 30; in *Tycho*'s 19; in *Flamſteed*'s 68. In *Lepus* (the third) in *Ptolemy*'s *catalogue* 12; in *Tycho*'s 13; in the *Britannic* 19. In *Orion* (the fourth) in *Ptolemy*'s *catalogue* 37; in *Tycho*'s 62; in the *Britannic* 80.

In this *conſtellation* there are two ſtars of the firſt magnitude, a reddiſh one in the ſhoulder, called *Bellatrix*; and another yellowiſh in the foot. There is, beſides, in it the *Balteus*, or *Girdle*, conſiſting of three ſtars. The antients ſuppoſed that *Orion* raiſed tempeſts at its riſing and ſetting; hence its name *Orion* from the Greek ὀρεῖν, to make water.

In *Canis major* (the fifth) in *Ptolemy*'s *catalogue* 18; in *Tycho*'s 13; in the *Britannic* 32.

In the mouth of *Canis major* there is a ſtar, the moſt brillant or ſhining of all, called *Sirius*, at which, when the *Sun* arrives, then the *Canicule*, or dog-days begin.

In *Canis minor* (the ſixth) in *Ptolemy's catalogue* 17. In (*Argo* (the ſeventh) in *Ptolomy*'s *catalogue* 8; in *Tycho*'s 11; in the *Britannic* 25. In *Hydra* (the eighth) in *Ptolemy*'s *catalogue* 25; in Dr. *Halley*'s 68. In *Cancer* (the ninth) in *Ptolemy's catalogue* 7; in *Tycho*'s 8; in the *Britannic* 11. In *Corvus* (the tenth) in *Ptolemy*'s *catalogue* 7; in *Tycho*'s 7; in the *Britannic* 10. In *Centaurus* with *Lupus* (the eleventh) in *Ptolomy*'s *catalogue* 19; in *Tycho*'s 4; in the *Britannic* 13.

Ara (the twelfth) conſiſts of 7 ſtars; whereof 5 are of the fourth magnitude, and 2 of the fifth. This *conſtellation* is not viſible in our hemiſphere; no more than *Corona Meridionalis*, nor *Piſcis Auſtralis*.

The changes which have happened in the *ſtars*, are very conſiderable. The firſt was in the year 125, before the Incarnation, when *Hipparchus* diſcovered a new *ſtar* to appear.

In the year 1572, *Tycho Brahe* obſerved another new ſtar in the *conſtellation Caſſiopeia*. Its magnitude at firſt exceeded that of the biggeſt of our ſtars, *Sirius* and *Lyra*; it even equalled that of *Venus*, when neareſt the *earth*, and was ſeen in fair day-light. It continued ſixteen months, toward the latter part whereof it began to dwindle, and at laſt totally diſappeared, without any change of place in all that time. *Leovicius* tells us of another ſtar appearing in the ſame *Conſtellation*, about the year 905, which reſembled that of 1572; and quotes another antient obſervation, whereby it appears that a new *ſtar* was ſeen about the ſame place in 1264. Dr. *Keil* takes thoſe to have been all the ſame *ſtar*; and does not know but it may make its appearance a-new 150 years hence.

Fabricius diſcovered another new *ſtar* in the neck of the *Whale*, which appeared and diſappeared ſeveral times in the years 1640 and 1662: its courſe and motion is deſcribed by M. *Bouillaud*. *Simon*

Marius

Marius diſcovered another in *Andromeda*'s Girdle in 1612 and 1613; tho' M. *Bouillaud* ſays, it had been ſeen before in the 15th century. Another was obſerved by *Kepler* in *Serpentarius*. Another of the third magnitude in the Conſtellation *Cygnus*, near the bill, in the year 1601, which diſappeared in 1626, and was obſerved again by *Hevelius* in 1659, till the year 1661, and again in 1666 and 1671, as a *ſtar* of the ſixth magnitude.

It is certain from the antient catalogues that many of the antient *ſtars* are not now viſible. This is particularly notorious in the *Pleiades* or ſeven *ſtars*, whereof ſix are now viſible to the eye; a thing long ago obſerved by *Ovid*. M. *Montaner*, in his letter to the *Royal Society*, in 1670, obſerves that there are now wanting in the heavens two *ſtars* of the ſecond magnitude, in the ſtern of the ſhip *Argo* and its yard, which had been ſeen till the year 1664. When they firſt diſappeared it is not known; but he aſſures us, that there was not the leaſt glympſe of them in 1668. He adds, he has obſerved many more changes in the fixed *ſtars*, even to the number of an hundred.

Some are of opinion that thoſe temporary *ſtars*, which upon their diſappearing have never been found to return again, are probably conjectured to be of the number of Comets, which make long excurſions from their ſuns, or the center of the upper planetary ſyſtems, *i. e.* from the fixed ſtars; returning too ſeldom to have their returns perceived.

The *fixed ſtars* ſhine with their own light.

Ariſtotle, lib. 1. *Meteor.* c. 7. imagined that Comets were only a kind of tranſient fires or meteors, conſiſting of exhalations raiſed to the upper region of the air, and there ſet on fire; far below the moon's courſe; but from the time of *Tycho Brahe*, all *Aſtronomers* have been of opinion, that *Ariſtotle* was miſtaken, and have all approved *Seneca*'s ſentiments, who, *lib.* 7. *natural. queſt. c.* 22. places a *comet* among the eternal works of nature; and conſiders it as an heavenly body, or ſtar, or planet, placed in another vortex ever ſince the creation. Beſides it is incredible that bituminous and ſulphurous exhalations could remain inflamed in the air, for ſo long a time, as we ſee a *comet* appear; add to it, that a *comet* has no *parallax*, which is a convincing proof of its immenſe diſtance from us; for the moon has a ſenſible *parallax*. For example:

Let the earth be A, *fig*. 2. in which two ſpectators will be placed, *viz.* in B and C: he who will be in C, will ſee the *moon* D in J, and *Mars* E in H; and he in B will ſee the *moon* D in F, and *Mars* E in G. Therefore both will judge that the *moon* and *Mars* do not exiſt in the ſame part of the heavens or firmament, or near the ſame ſtars; but will refer them to different parts of heaven, and to different ſtars; and the nearer the *earth* a ſtar is ſuppoſed to be, the greater will be the diverſity of aſpect. Hence if the ſtar be the remoteſt from the *earth*, ſuch as is L, ſo that the magnitude of the *earth*, with reſpect to that diſtance, ſhould not be ſenſible, or be like a point, then the ſtar will be ſeen in the ſame place by both ſpectators; which is the reaſon why *comets* have no *parallax*, becauſe ſeen in the ſame place from ſeveral ſpectators, and from ſeveral place, *viz.* from *London*, *Paris*, *Rome*, *Conſtantinople*, &c. therefore the *comets* are at an immenſe diſtance from us.

If any body was placed in the center of the world, he would ſee the right place of a ſtar. As if the earth was in the center of the world, and a perſon placed in that center, the moon would appear to him under thoſe ſtars it is really placed; but he who inhabits the ſuperficies of the earth, muſt ſee the moon under other ſtars, unleſs it be placed in its vertical; in which caſe, the lines of the true and apparent place concur. For example.

Let the center of the earth be A, *Fig* 2; and the moon D; the perſon placed in A, will ſee the moon in E; and he in B, ſee it in D: for the arch E D, is the difference of the true and apparent place, which is called *parallax*. But if one of the ſpectators be placed in A, and the other in C, to whom the moon ſhould be *vertical*; then becauſe the ray of the true, and the ray of the apparent place, coincide in the ſame point, there will be no *parallax* in the moon, becauſe it will be referred in E, by both ſpectators. Therefore, from a *parallax*, the diſtance of a ſtar from the arch is inveſtigated; and where there is no *parallax*, i. e. where the terreſtrial ſemidiamer, or the diverſity of aſpect from which the *parallax* is required, has no ſenſible magnitude, with reſpect to the diſtance of ſome celeſtial body, becauſe of its great diſtance from the earth; that celeſtial body muſt be ſuppoſed far above the planets of our *vortex*; which is the caſe of the *comets*, which have no *parallax*.

Or perhaps, it would be ſtill better to ſay, with *Pythagoras*, and the *Pythagoreans*, that the *comets* are ſome planets, which, though offuſcated with the too great radiancy of the ſun, and thereby hidden from us, are, nevertheleſs, ſome time diſtanced from the ſun, and come in ſight.

Des Cartes, *tert. part. princip. num.* 119. conjectures, that *comets* P, are only ſtars, formerly fixed like the reſt, in the heavens; but which becoming by degrees covered with *maculæ*, or ſpots, and at length wholly robbed of their light, cannot keep their place, but are carried off by the *vortices* of the circumjacent ſtars; and in proportion to their magnitude

nitude and solidity, moved in such manner, as to be brought nearer the orb of *Saturn*, and thus coming within reach of the sun's light rendered visible.

Bernoulli, in his system of *comets*, supposes some primary planet revolving round the sun in the space of four years, and 157 days; and at the distance from his body of 2583 semidiameters of the *great orbit*: this planet, he concludes, either from its vast distance, or smallness, to be invisible to us; but, however, to have, at several distances from him, several *satellites* moving round him, and sometimes descending as low as the *orbit* of *Saturn*; and that these, becoming visible to us, when in their *perigæum*, are what we call *comets*.

Others will have the motion of *comets* made in the excentrick circle of the *earth*, so that when they are in the *apogee* of that circle, they cannot be seen, because of their great distance from us; and are only visible, when near the *perigee*; and that it might very well happen, that even in the *perigee* they are not visible, since then they would be wrapp'd up in the rays of the sun, being never but in day-time on the horizon.

Some pretend to refute all these *hypotheses* from the very *phænomena* of the *comets*; objecting, 1. That those *comets*, which move according to the order of the signs, either advance slower than usual, or retrograde, a little before they disappear, if the *earth* be between them and the sun; and more swiftly, if the *earth* be situated in a contrary part: on the contrary, those which proceed contrary to the order of the signs, proceed more swiftly than usual, if the *earth* be between them and the *sun*; and more slowly and go retrograde, when the *earth* is in a contrary part. 2. So long as their velocity is increased, they move nearly in great circles; but towards the end of their course, deviate from those circles; and as often as the *earth* proceeds one way, they go the contrary way. 3. That they move in ellipses, having one of their *foci* in the center of the sun; and by *radii* drawn to the sun, describe areas proportionable to the times 4. That the light of their bodies, or *nuclei*, increases in their recess from the *earth* towards the *sun*; and, on the contrary, decreases in their recess from the sun towards the *earth*. 5. That their *tails* appear the largest and brightest immediately after their transit through the region of the sun; and that they always decline from a just opposition to the sun towards those parts which the bodies, or *nuclei*, pass over, in their progress through their *orbits*. 6. That this declination, *cæteris paribus*, is the smallest when the heads, or *nuclei*, approach nearest the sun; and still less, near the *nucleus* of the *comet*, than towards the extremity of the *tail*. 7. That the *tails* are somewhat brighter, and more distinctly defined in their convex, than in their concave part; and that they always appear broader at their upper extream, than near the center of the *comet*; which *tails* are transparent, the smallest stars appearing through them.

Some are of opinion, that Sir *Isaac Newton* solves all these *phænomena*, by his supposing that the *comets* are compact, solid, fixed, and durable bodies; in one word, a kind of planets, which move in very oblique *orbits*, every way, with the greatest freedom, preserving in their motions, even against the course and direction of the planets: their *tails* being a very thin, slender vapour, emitted by the head, or *nucleus* of the *comet*, ignited, or heated by the sun. From whence they draw the following conclusions, with him.

1. That it is evident, that the *comets*, which proceed according to the order of the signs, a little before they disappear, must move more slowly, or appear retrograde, if the *earth* be between them and the sun; and swifter, if the *earth* be in a contrary part: on the contrary, those proceeding against the order of the signs, &c. for since their course is not among the fixed stars, but among the planets; as the motion of the *earth* either conspires with them, or goes against them, their appearance, with regard to the *earth*, must be changed, and, like the planets, they must sometimes appear swifter, sometimes slower, and sometimes retrograde. 2. When the *comets* move the swiftest, they must proceed in strait lines; but in the end of their course, decline, &c. because in the end of their course, when they recede almost directly from the sun, the part of the *apparent motion*, which arises from the *parallax*, must bear a greater proportion to the whole *apparent motion*. 3. The *comets* must move in *ellipses*, having one of their *foci* in the center of the sun; because they do not wander precariously from one fictitious *vortex* to another, but, making a part of the solar system, return perpetually, and run a constant round. 4. The light of their *nuclei* must increase in their recess from the sun, and *vice versa*; because as they are in the regions of the planets, their access toward the sun, bears a considerable proportion to their whole distance. 5. Their *tails* must appear the largest, and brightest, immediately after their transit through the region of the sun; because then their heads being the most heated, will emit the most vapours; which *tails* must still decline from a strict opposition to the sun, towards those parts, which the heads pass over in their progress thro' their *orbits*; because all smoke and vapours emitted from a body in motion, tends upwards obliquely, still receding from that part towards which the smoking body proceeds. 6. That declination will be

be ſtill the leaſt near the *nucleus* of the *comet*, and when the *comet* is neareſt the ſun; becauſe the vapour aſcends more ſwiftly near the head of the *comet*, than in the higher extremity of its *tail*; and when the *comet* is at a leſs diſtance from the ſun, than at a greater. 7. The *tail* is brighter, and better defined, in its convex part, than in its concave: becauſe the vapour in the convex part, which goes firſt, being ſomewhat nearer and denſer, reflects the light more copiouſly. The *tail* muſt alſo appear broader towards the higher extremity of the *comet*, than towards the head; becauſe the vapour in a free ſpace perpetually rarefies and dilates. Laſtly, the *tail* muſt be tranſparent, becauſe conſiſting of infinitely thin vapour, &c.

There is no certain time fixed for the appearance of the *comets*. The duration of their appearance is alſo very uncertain; for, ſome are ſeen for a few days only; others, for ſeveral months.

All the *comets* ſeem to have a diurnal motion from *eaſt* to *weſt* towards the *earth*, and in that ſenſe to deſcribe circles parallel to the *equator*. Beſides that apparent motion they have in common with the other heavenly bodies, they have another proper, and peculiar to them under the *firmament*, which cannot be regularly determined; for ſome are carried to the *eaſt*, ſome to the *weſt*, and others otherwiſe.

The celerity of this peculiar motion is not equal in all the *comets*, but is rather various and unequal; ſince ſome of them run ſeveral more degrees of a great circle than others; neither is the celerity of the motion of each *comet* always equal: for the arch B, which it runs each day, is ſometimes greater, and ſometimes leſs, in ſuch manner, however, that if ſeveral right lines were drawn from the center of the *earth*, to be carried through the places wherein the *comet* is ſeen at that hour, thoſe lines would divide another right line into almoſt equal parts, which ſhould touch the circle deſcribed by the *comet*, in that place where its motion appears the moſt rapid. Neither is the way they run through always equal, ſince ſome deſcribe a greater ſpace in the heavens than others. But, however, let that ſpace be what it will, none, or very few, have been known to have deſcribed above one half of the great circle under the *firmament*, i. e. to have run more than half the heavens.

When *a comet* is ſeen to dart its rays toward that place of the heavens where its motion ſeems to carry it, thoſe rays are called the *beard* of the *comet*; when, on the contrary, thoſe rays are extended towards that part of the heavens whence its proper motion ſeems to recede, they are called the *tail* of the *comet*; but when they are equally diſperſed on all ſides, ſome call it the *hairs* of the *comet*. Thus the *comet* which was ſeen in 1664, at the beginning of *December*, in the meridional part of the world, to whoſe reſpect the *ſun* was *eaſt*, darting its rays towards the *weſt*, where its proper motion inclined, was called *bearded*; being turned afterwards towards the *ſun*, it ſhewed its *hairs*; and, laſtly, having the *ſun* on the *weſt*, its rays being then darted towards the *eaſt*, formed a *tail*.

Rohault believes that thoſe rays, whereof the *beard*, *tail*, or *hairs* of a *comet* are imagined to be made, are the rays of light reflected by the body of the *comet*, i. e. proceed from reflection.

Apollonius Myndius was the firſt who took *comets* for regular ſtars; and ventured to foretel, that one day the periods, and laws of their motion, would be diſcovered. *Aſtronomers*, however, are ſtill divided on that head; *Newton*, *Flamſteed*, *Halley*, and all the *Engliſh* Aſtronomers, ſeem ſatisfied of the return of *comets*. *Caſſini*, and others of the *French*, think it highly probable. *De la Hire*, and others, oppoſe it.

The SUN is the firſt heavenly body, placed within our *ſyſtem* that demands our attention.

The *ſun* by his force and action, communicates all the motion and ſtrength to the other heavenly bodies. The heat and light of the *ſun* demonſtrate its being of a fiery nature.

The fiery nature of the *ſun*, is proved by its rays being collected by concave mirrors, or convex lenſes, burning, conſuming, and melting the moſt ſolid bodies, or elſe converting them into aſhes.

Hence it follows, that its ſurface is every where fluid, that being the condition of flame.

The *figure* of the *ſun*, is a ſpheroid, higher under its *equator*, than under the *poles*; which is proved thus: the *ſun* has a motion about its own *axis*, and therefore the ſolar matter will have an endeavour to recede from the centers of the circles wherein it moves, and that with the greater force, as the peripheries of the circles are greater. But the *equator* is the greateſt circle, and the reſt towards the *poles* continually decreaſe: therefore the ſolar matter, though at firſt in a ſpherical form, will endeavour to recede from the center of the *equator*, further than from the centers of the *parallels*. Conſequently, ſince the gravity whereby it is retained in its place, is ſuppoſed to be uniform throughout the whole *ſun*; it will really recede from the center more under the *equator*, than under any of the *parallels*. And hence the *ſun*'s diameter drawn through the *equator*, will be greater than that paſſing through the *Poles*; and therefore its *figure* is not perfectly ſpherical, but *ſpheroidical*.

According to the *Copernican hypoth ſis*, which is now generally received, and which has even demonſtration on its ſide, the *ſun* is the center of the *cometary*

metary and *planetary* systems; round which, all the *planets*, and our *earth*, among the rest, revolve, in different periods, according to their different distances from the *sun*.

But it evidently appears, from the *phænomena* of the *sun*'s *maculæ*, or spots, that he has a *rotation* round its *axis*, like that of the *earth*, whereby the natural days are measured, only slower. Some of these spots have made their first appearance near the edge, or margin of the *sun*, and have been seen some time after on the opposite edge; whence, after a stay of about 14 days, they have re-appeared in their first place, and taken the same course over-again; finishing their entire circuit in 27 days time; which is hence deduced to be the period of the *sun*'s *rotation* round its *axis*. This motion of the spots is from *west* to *east*, whence we conclude that of the *sun*, to which the other is owing, to be from *east* to *west*.

Besides this *rotation* of the *sun* round his *axis*, it has an *apparent* annual motion round the *earth*, whereby he is seen to advance, insensibly, towards the eastern stars; though it be demonstrated that there is no such thing, and that such appearance is occasioned by the annual motion of the *earth*.

What's worthy our observation in this apparent annual motion of the *sun*, is, 1. That he always appears to move in the same *plane*, or *ecliptick* line, and never to change his course; and that the *earth*'s center is always inherent on the same *plane*, while it accomplishes its course round the *sun*; which is agreeable to this general rule, that all impulsive force must always operate according to the direction of a right line: and as the annual motion of the *earth* proceeds from a projectile impulsion, according to a right line, and from a perpetual attraction towards the center of the *sun*, it is absolutely necessary that the *earth*, as well as the rest of the *planets*, should form her course on the same plane, by a line of direction of an impulsive force, and which should pass through the center of the *sun*.

2. That his motion is inequable, tho' in the same *ecliptick*; for a little after the *vernal*, and some time before the *autumnal equinox*, his motion is moderately swift; but a little after the *winter's solstice*, the same motion is swifter; and after the *summer's solstice*, slower. This inequality of motion is occasioned by the *earth*, not describing a circle round the *sun*, but an *ellipsis*.

3. That the *apparent diameter* of the *sun* is greater in *winter*, while his motion is swifter, than in *summer*, while slower; because as the *earth*, as we have observed already, performs its course in an *ellipsis*, and in the same *ellipsis* is always removed from the *sun*, at an unequal distance, as well when it ascends from the *perihelion* to the *aphelion*, as when it descends from the *aphelion* to the *perihelion*; and as the *earth* is in its *perihelion* a little after the *winter solstice*, and in its *aphelion* a little after the *summer solstice*, the *apparent diameter* of the *sun*, or of his reciprocally proportional *distance* from the *earth*, must be either *greater* or *lesser*, as the *distance* is *greater* or *lesser*. Therefore it is found, towards the beginning of *winter*, very great; *middling*, towards the beginning of the *spring* and *autumn*; and very small about the beginning of *summer*.

4. That the *ecliptick* being divided into two parts by the *equinoctial points*, the *sun* stays longer in its northern part, than in the southern part; that is to say, the *elliptical orbit* of the *earth* is divided by the *equinoctial points* into two unequal parts; for the *perihelion* is not at a very great distance from the *winter solstice*: therefore the *equinoctial points* must almost coincide, not with the great *axis*, but with the right side, and thereby render the spaces unequal. Therefore the *apparent motion* of the *sun*, which in equal times describes equal spaces, must be unequal, and appear to stay several days longer in the six *northern*, than in the *southern signs*; and though this difference be of almost eight days, it nevertheless will decrease, in the succeeding years, so as to be reduced to nothing at last; and again decrease and increase, by course, as long as the annual motion will last.

5. That, however, the space of the entire annual revolution, which we call *year*, is equal to each other, and consists of 365 days, 5 hours, 49 minutes; since whatever be the inequality of the parts, when compared to each other, there is nothing taken, thereby, from the whole revolution: for the whole space of the same *ellipsis* is the same, and we begin to enumerate the areas from what place soever, because the beginning and the end of the numeration will be the same. There is, however, some inequality betwixt the time of the *anomaly* restored, or of the revolution from the point, of the *ellipsis*, to the same point, (which is equal to the *starry year*) and the time of the *tropical year*; for the *starry year*, or the revolution of the *earth* from a fixed star to the same star, is not always of the same magnitude with the *tropical year*.

6. That the *obliquity* of the *ecliptick*, or the angle wherein it cuts the *equator* is usually fixed at 23° 29′; which, therefore, is the greatest *declination* of the *ecliptick* from the *equator*.

The method of observing the greatest *declination* of the *ecliptick* is thus: about the time of one of the *solstices*, observe the *sun*'s *meridian altitude*, with the utmost care for several days successively; from the greatest *altitude* observed, subtract the *height* of the *equator*, the remainder is the greatest *declination* in the *solstitial point*. *Ricciolus*, *e. gr.* at *Bologna*, in the year 1646, observed the *sun*'s *meridian* *altitude*,

altitude, on the 20th of *June*, to be 68° 59′ 55″; on the 21ſt, 69° 0′ 10″; and on the 22d, 68° 59′ 55″. The greateſt, then was, 69° 0′ 10″; from which the *altitude* of the *equator*, 45° 29′ 50″, being ſubtracted, left 23° 30′ 20″, for the greateſt *declination*.

But the moſt eſſential, and the moſt worthy our obſervation of all the *ſun*'s *phænomena*, is his *parallax*, either diurnal or monthly, ſince thereby we diſcover his true diſtance, and his true magnitude, and with it the true diſtances and magnitudes of the other *planets*.

The great diſtance of the *ſun* renders his *parallax* too ſmall, to fall even under the niceſt immediate obſervation: indeed many attempts have been made both by the antients and moderns; and many methods invented for that purpoſe. The *firſt*, that of *Hipparchus*, followed by *Ptolemy*, &c. was founded on the obſervation of *lunar eclipſes*. The *ſecond* was that of *Ariſtarchus*, whereby the angle ſubtended by the ſemidiameter of the moon's orbit ſeen from the *ſun*, was ſought from the *lunar phaſes*: but theſe both proving deficient, *Aſtronomers* are forced to have recourſe to the *parallaxes* of the *planets* nearer us, as *Mars* and *Venus*; for from their *parallaxes* known, that of the *ſun*, which is inacceſſible by any direct obſervation, is eaſily deduced. For from the theory of the motion of the *earth* and *planets*, we know at any time the proportion of the diſtances of the *ſun* and *planets* from us; and the horizontal *parallaxes* are in a reciprocal proportion to thoſe diſtances: knowing therefore the *parallax* of a *planet*, that of the *ſun* may be found from it. Thus *Mars* when oppoſite to the *ſun*, is twice as near as the *ſun* is: his *parallax* therefore will be twice as great as that of the *ſun*: And *Venus*, when her inferior conjunction with the *ſun*, is ſometimes nearer than he is; her *parallax* therefore is greater in the ſame proportion.

Thus from the *parallaxes* of *Mars* and *Venus*, *Caſſini* found the *ſun*'s *parallax* to be ten ſeconds, which implies his diſtance to be 22000 ſemi diameters of the *earth*. In an obſervation of the tranſit of *Venus* over the *ſun*, which will be ſeen in *May* 1761. Dr. *Halley* has ſhewn a method of finding the *ſun*'s *parallax*, and diſtance to a five hundredth part of the whole.

Before we proceed, it is very proper to explain what is underſtood by *planets*, their diſtinction, *&c.*

PLANET, in *Aſtronomy*, is a celeſtial body, revolving round the *ſun* as a center, and continually changing its poſition with reſpect to other ſtars, whence its name πλανήτης, *wanderer*, in oppoſition to a *ſtar*, which remains fixed.

The *planets* are uſually diſtinguiſhed into *primary* and *ſecondary*.

The *primary planets*, called alſo ſimply, and by way of eminence, *planets*, are thoſe which move round the *ſun* as their proper center; and are again ſubdivided into ſuperior and inferior *planets*. The ſuperiors are thoſe further off the *ſun* than our *earth* is. Such are *Mars*, *Jupiter*, and *Saturn*. The inferior are thoſe nearer the *ſun* than our *earth* is, and ſituate between the *earth* and the *ſun*. Such are *Venus* and *Mercury*.

Secondary planets, are ſuch as move round ſome *primary planets*, as their reſpective center, in the ſame manner as the *primary planets* do round the *ſun*. Such are the *moon* moving round our *earth*; and thoſe others moving round *Saturn* and *Jupiter*, properly called *Satellites*.

The MOON is a dark and ſpherical body, which has no light of itſelf, but only ſhines with that ſhe receives from the *ſun*; whence only that half turned towards him is illuminated; the oppoſite one remaining in its native darkneſs. The face of the *moon* viſible on our *earth* is that part of her body turned towards the *earth*; whence according to the various poſitions of the *moon*, with regard to the *ſun* and *earth*, we obſerve different degrees of illumination; ſometimes a large, and ſometimes a leſs portion of the enlightened ſurface being viſible, which different degrees of illumination proceed alſo from the ſuperficies of the *moon* being rough, uneven, and not ſmooth.

From the *nature* of the *moon*, we'll proceed to her various *motions*.

Caſſini is of opinion, that the *moon* revolves, every month, round her proper *axis*; with the ſame face always turn'd towards the *earth*. Which can be eaſily underſtood, if we conſider that a man, who runs round the circumference of a circle he has deſcrib'd on an *area*, always looks on the center of that circle, ſince in that whole courſe he muſt revolve round himſelf.

2. The *moon* is obſerved to be carried every day, with the reſt of the heavenly bodies, from *eaſt* to *weſt*.

3. The *moon* advances, every day, very near thirteen degrees, from *weſt* to *eaſt*; ſo that ſhe finiſhes, or accompliſhes her courſe in the ſpace of 27 days, and almoſt 8 hours; which interval, we call a *periodical month*; becauſe then the *moon*, moved from *weſt* to *eaſt*, accompliſhes her period, *i. e.* from a determinate part of the heavens, to the ſame, or returns from one fixed ſtar, to the ſame fixed ſtar. But if we compare the *moon* with the *ſun*, who does not remain, like a fixed ſtar, in the ſame ſenſible place, but every day runs almoſt a degree in the *zodiack*, from *weſt* to *eaſt*; ſhe is longer in paſſing from one conjunction to another, than in returning from a determinate point of the heavens to the ſame point: therefore as the *ſun* will

will be advanced 26 degrees, or thereabouts, in the space of a *periodical month*, the *moon* must add two days, or more, to the *periodical month*, in order to compleat the *synodical month*, and overtake the *sun*, *i. e.* the space from one *syzygy* to the other: whence the *synodical month* consists of 29 days, 12 hours, 44 minutes, and 3 seconds; though commonly the minutes and seconds are neglected, and the *synodical lunar months* are reckoned to consist alternately of 29 and 30 days.

However, this motion of the *moon* does not describe a perfect circle, for it is an *elliptical*, or approaching to the *elliptical*. For if we follow *Des Cartes*'s hypothesis, the *vortex* of the *moon* being pressed on both sides by *Mars* and *Venus*, must be *elliptical*. Hence the *moon* occupies a lesser diameter of that *vortex* near the *syzygies*, *i. e.* near the conjunction and opposition with the *sun*, and a greater, when near the quadratures.

As the *plane* of the *moon's orbit*, and the *plane* of the *ecliptick*, cut each other in a right line, as, and in the same manner as the same *ecliptick* divides the *equator* in the *equinoctial points*; hence ensues, that they are inclined to each other in an angle of about five degrees. The points of these *intersections* are called *nodes*, by *Ptolemy*; whereof that where the *moon* ascends above the *plane* of the *ecliptick* northward, is called the *ascending node*, and the *head of the dragon*; and the other, the *descending node*, and the *dragon's tail*; and the interval of time between the *moon*'s going from the *ascending node*, and returning to it, a *dracontick month*.

If the line of the *nodes* was immoveable, that is, if it had no other motion but that whereby it is carried round the *sun*, it would still look towards the same point of the *ecliptick*, *i. e.* would always keep parallel to itself; but it is found by observation, that the line of the *nodes* constantly changes place, and shifts its situation from *east* to *west*, contrary to the order of the signs, and by a retrograde motion finishes its circuit in about 19 years; in which time each of the *nodes* returns to the point of the *ecliptick* whence it before receded. Hence it follows, that the *moon* is never precisely in the *ecliptick*, but twice each period, *viz.* when she is in the *nodes*; throughout the rest of her course she deviates from it, being nearer or further from the *ecliptick*, as she is nearer or further from the *nodes*.

We call the *moon*'s distance from the *nodes* her *latitude*, which is measured by an arch of a circle drawn through the *moon*, perpendicular to the *ecliptick*, and intercepted between the *moon* and the *ecliptick*. The *moon's latitude*, when at the greatest, never exceeds five degrees, and about 18 minutes; which *latitude* is the measure of the angles of the *nodes*.

M. *Cassini* observes, that while the *moon* is performing her revolution round the *earth*, she varies her distance from it, in three different manners. For, 1. She runs every day its *apogee*, 6 minutes, 42 seconds, towards the *east*, and her *excentricity* contains 42 parts of a *mile*, into which the semi-diameter of the *orbit* of the *moon* is supposed to be divided. This *excentricity* is less, when the *sun* is at an equal distance from the *moon*'s *perigee* and *apogee*; but when the *sun* approaches nearer the *moon's apogee* or *perigee*, that *excentricity* increases; and when the *sun* is existant in the *moon's apogee* or *perigee*, the lesser or simple *excentricity* is increased by a half part of it. The space of time wherein the *moon*, going from the *apogee*, returns to it again, is called the *Anomalistick month*.

Tycho Brahe has discover'd, that the *moon* changes her motion, according to her different distance from the *Syzygies* *. That in the first quarter, that is, from

* SYZYGY, (from the *Greek* συζυγια, *conjunctio*) is a term equally used for the *conjunction* and *opposition* of a planet with the *sun*. On the *phænomena* and circumstances of the *syzygies*, a great part of the *lunar theory* depends. For, 1. The force, which diminishes the gravity of the *moon* in the *syzygies*, is double that, which increases it in the *quadratures*: so that in the *syzygies* the gravity of the *moon* from the action of the *sun*, is diminished by a part, which is to the whole gravity, as 1 to 89,36; for in the *quadratures* the addition of gravity is to the whole gravity, as 1 to 178,73.

2. In the *syzygies* the disturbing force is directly as the distance of the *moon* from the *earth*, and inversly as the cube of the distance of the *earth* from the *sun*. And as the *syzygies* the gravity of the *moon* towards the *earth*, receding from its center, is more diminished, than according to the inverse *ratio* of the square of the distance from that center. Hence, in the motion of the *moon* from the *syzygies* to the *quadratures*, the gravity of the *moon* towards the *earth* is continually increased, and the *moon* is continually retarded in its motion; and in the motion from the *quadratures* to the *syzygies*, the *moon*'s gravity is continually diminished, and its motion in its *orbit* accelerated.

3. Further, in the *syzygies* the *moon*'s *orbit*, or circle round the *earth*, is more convex, than in the *quadratures*; for which reason, the *moon* is less distant from the *earth* at the former, than the latter. When the *moon* is in the *syzygies*, her *apsides* go backwards, or are retrograde. When the *moon* is in the *syzygies*, the *nodes* move *in antecedentia* fastest; then slower and slower, till they become at rest when the *moon* is in the *quadratures*.

Lastly, When the *nodes* are come to the *syzygies*, the inclination of the plane of the *orbit* is least of all. These several irregularities are not equal in each *syzygy*, but all somewhat greater in the *conjunction* than the *opposition*.

from the conjunction to her firſt *quadrature*,* ſhe abates ſomewhat of her velocity; which in the ſecond quarter ſhe recovers: In the third quarter ſhe again loſes; and in the laſt again recovers. This *Tycho* call'd the *Moon*'s *variation*.

There are other very conſiderable irregularities in the *moon*'s motion, in that of her *apogee*, and in the *nodes*: for when the *earth* is in it's *aphelion*, the *moon* is in her *aphelion* likewiſe; in which caſe, ſhe quickens her pace, and performs her circuit in a ſhorter time: On the contrary, when the *earth* is in its *perihelion*, the *moon* is ſo too; and then ſhe ſlackens her motion; and thus revolves round the *earth* in a ſhorter ſpace when the *earth* is in its *aphelion*, than when in its *perihelion*: ſo that the *periodical months* are not all equal.

The irregularity of the *moon's apogee* is diſcover'd by its being found to move forwards, when it coincides with the line of the *Syzygies*, and backwards, when it cuts that line at right angles. Nor is this progreſs and regreſs in any meaſure equal; in the conjunction and oppoſition it goes briſkly forwards, and in the quadratures moves either ſlowly forwards, ſtands ſtill, or goes backward.

The motion of the *nodes* is not uniform; but when the line of the *nodes* coincides with that of the *Syzygies*, they ſtand ſtill; when the *nodes* are in the quadratures, *i. e.* when their lines cut that of the *Syzygies* at right angles, they go backward, from eaſt to weſt; and this Sir *Iſaac Newton* ſhews, with the velocity of $16'' \, 19''' \, 24''''$ in an hour.

Aſtronomers determine the period of the *moon*'s revolution round the *earth*, or the *periodical month*, and the time between one oppoſition and another, or the *ſynodical month*, by computing the time between two eclipſes, or oppoſitions; and dividing this, by the number of lunations that have paſs'd in the mean time: hence they find the *quotient* to be the quantity of the *ſynodical month*. They likewiſe compute the *ſun*'s mean motion during the time of the *ſynodical month*, and add this to the entire circle deſcribed by the *moon*. Then, as the ſum is to 360°, ſo is the quantity of the *ſynodical month* to the *periodical*.

Or, 1. The quantity of the *periodical month* being given; by the *Rule of Three* we may find the *moon*'s diurnal and horary motion, *&c.*

2. If the *ſun*'s mean diurnal motion be ſubtracted from the *moon*'s mean diurnal motion, the remainder will give the *moon*'s diurnal motion from the *ſun*.

3. Since in the middle of a total eclipſe the *moon* is in the *node*; if the *ſun*'s place be found for that time, and to this be added ſix ſigns, the ſum will give the *place of the node*.

4. The *nodes* have a motion, and proceed *in antecedentia*, *i. e.* from *Taurus* to *Aries*, from *Aries* to *Piſces*, &c. if then to the *moon*'s mean diurnal motion be added the diurnal motion of the *nodes*, the ſame will be the motion of the latitude; and thence by the *Rule of Three* may be found in what time the *moon* goes 360° from the *Dragon*'s *Head*, or in what time ſhe goes from, and returns to it; that is, the quantity of the *Dracontic month*.

5. If the motion of the diurnal *apogee* be ſubtracted from the mean motion of the *moon*, the remainder will be the *moon*'s mean motion from the *apogee*; and thence, by the *Rule of Three*, is determined the quantity of the *Anomaliſtick month*.

To find the *moon*'s age, we muſt add to the day of the month the epact of the year, and the months from *March* incluſive. The ſum, if under 30 muſt be ſubtracted from it; if over, the exceſs is the *moon*'s age. If the month has but 30 days, the exceſs above 29 is the *moon*'s age.

To find the time of the *moon* being in the meridian, we muſt multiply her age, if under 15 days by 4, and divide the product by 5; the quotient gives the hour, and the remainder multiplied by 12 the minute. If her age exceeds 15, we muſt ſubtract 15, and proceed with the remainder as before. To find the time of the *moon*'s beginning to ſhine, we muſt multiply her age, if under 15 by 48, and divide the product by 60: the quotient

* The QUADRATURE, *Fig.* 7. of the *moon*, is her aſpect, or ſituation, when ſhe is 90° diſtant from the *ſun*: Or her *quadrature* is when ſhe is in the middle point of her *orbit*, between the points of *conjunction* and *oppoſition*, which happens twice in her revolution, *viz.* in the firſt and third quarters.

When the *moon* is in her *quadrature*, ſhe exhibits that *phaſis* which we call the *half moon*, *i. e.* ſhe ſhines with juſt half her face, and is ſaid to be biſſected, or *dichotomized*. It is very difficult to fix the preciſe moment, when the *moon* is biſſected, or in her true *dichotomy*. Obſervation informs us, that when ſhe is 30 minutes diſtant from the *quadratures*, ſhe appears biſſected; but ſhe appears ſo too in the *quadratures* themſelves, and ſometimes afterwards, as *Ricciolus* acknowledges, in his *Almageſt*. So that ſhe appears *dichotomized*, or cut in two, at leaſt for the ſpace of a whole hour, in which time any moment may be taken for the true point of *dichotomy*, as well as any other. But the infinite number of moments of time, give an infinite diverſity of diſtances. The moment in which the true *dichotomy* happens, being thus uncertain, but it being granted, withal, that it happens before the *quadrature*; *Ricciolus* takes the middle point between the *quadrature* and the time when it is firſt dubious, whether the *moon* be *dichotomized*, or not, for the true *dichotomy*.

gives the hour; and the remainder the minute. If her age be above 15 days, we muſt ſubtract the time thus found from 24; the remainder gives the time of ſhining in the morning.

We'll proceed to ECLIPSES of the SUN and MOON.

ECLIPSE, from the *Greek* ἐκλειψις, from ἐκλειπω, *I fail*, in *Aſtronomy*, is a privation of the light in one of the luminaries, by the interpoſition of ſome opake body, either between it and the eye; or between it and the *ſun*.

When the *moon* paſſes between the *earth* and the *ſun*, and deprives us of his aſpect, that is called an *eclipſe* of the *ſun*, which is always the greater, the greater is the part it ſteals from our ſight, which may alſo ſometimes be total, if the eclipſe covers it entirely.

Eclipſe of the *ſun*, *Fig.* 4. is diſtinguiſhed into *total* and *partial.*

As the *moon* is found to have a *parallax* of latitude, *eclipſes* of the *ſun* only happen when the latitude of the *moon*, viewed from the *ſun*, is leſs than the aggregate of the apparent ſemidiameter of the *ſun* and *moon.* Therefore ſolar *eclipſes* happen when the *moon* is in conjunction with the *ſun*, in or near the *nodes*, *i e.* at the new *moons.* Conſequently the memorable *eclipſe* of the *ſun*, at our ſaviour's paſſion, happening at the time of full *moon*, when the *ſun* and *moon* are in oppoſition, was preternatural.

If there is not an *eclipſe* of the *ſun* every new *moon*, though the new *moon* covers the *ſun* from the *earth*, it is becauſe the *moon*'s way is not preciſely under the *ecliptick*, but placed obliquely thereto; only interſecting it twice in every period; ſo that *eclipſes* can only be occaſioned in ſuch new *moons*, as happen in theſe interſections or *nodes*, or very near them. In the *nodes*, when the *moon* has no viſible latitude, the *occultation* is total, *Fig.* 5; and with ſome continuance, when the *diſk* * of the *moon* in *Perigæo*, appears greater than that of the *ſun* in *Apogæo*, and its ſhadow is extended beyond the ſurface of the *earth*; and, without continuance, or moderate diſtances, when the cuſp or point of the *moon*'s ſhadow barely touches the *earth.* Out of the *nodes*, but near them, the *eclipſes* are partial.

The other circumſtances of ſolar *eclipſes* are, 1. That none of them are univerſal; that is, none of them are ſeen throughout the whole hemiſphere, which the *ſun* is then above; the *moon*'s diſk being much too little, and much too near the *earth* to hide the *ſun* from the diſk of the *earth*, which is fifteen times bigger than it. 2. Nor does the *eclipſe* appear the ſame in all parts of the *earth*, where it is ſeen; but when in one place it is total, in another it is partial. Farther, when the *moon* being in her *Apogee*, appears much leſs than the *ſun*, as happens moſt ſenſibly, when he is in *Perigæo*; the cuſp of the lunar ſhadow not reaching the *earth*, ſhe becomes in a central conjunction with the *ſun*, yet not able to cover his diſk; but lets his whole limb appear like a lucid ring or bracelet, hence called an *annular eclipſe.* 3. It does not happen at the ſame time in all places where it is ſeen; but appears more early to the weſtern parts, and later to the eaſtern. 4. Its beginning is always on the weſtern ſide the *ſun*, and on the ſame ſide it ends. 5. In total *eclipſes* of the *ſun* the *moon*'s darkened *diſk* is ſeen covered with a faint dawning light; which is commonly attributed to the reflection of the light from the illuminated part of the *earth.* *Laſtly*, in *total eclipſes* of the *ſun*, the *moon*'s limb † is ſeen ſurrounded by a pale circle of light; which the late *Aſtronomers* take for a manifeſt indication of a lunar atmoſphere.

To calculate an *eclipſe of the ſun*, we muſt find, 1. The mean new *moon*, and thence the true one, together with the place of the luminaries for the apparent time of the true one. 2. Compute the apparent time of the new *moon* obſerved for the apparent time of the true new *moon.* 3. Compute the latitude ſeen, for the apparent time of the new *moon* ſeen. 4. Thence determine the digits eclips'd. 5. We muſt find the times of the greateſt darkneſs, immerſion, and emerſion; and thence determine the beginning and ending of the *eclipſe.*

Flamſteed has invented a method of repreſenting the *ſolar eclipſes*, which, by a geometrical conſtruction, removes all the difficulties and impediments of the *Calculus*; which is this:

There muſt be underſtood innumerable lines conducted from the circles of the *earth* (through a plane which ſhould touch the *lunar orbit*; which plane muſt be level to the right line which connects

* DISK, in *Aſtronomy*, is the body or face of the *ſun* or *moon*, ſuch as it appears to us. The *Diſk* is conceived to be divided into twelve equal parts, called *digits*; by means whereof it is, that the magnitude of an *eclipſe* is meaſured, or eſtimated. Such an *eclipſe* was ſo many digits or parts of the *ſun*, or *moon*'s diſk. *Mercury* and *Venus* are ſometimes ſeen in the *ſun*'s *diſk*, tranſiting the *ſun*'s *diſk.* In a *total eclipſe* of either of thoſe luminaries, the whole *diſk* is obſcured or darkened; in a partial *eclipſe* only part of them.

† The LIMB ſignifies the outermoſt border, or edge of the *ſun* or *moon*, when the middle or *diſk* is hid in an *eclipſe* of either luminary. *Aſtronomers* obſerve the lower and the upper *limb* of the *ſun*, in order to find its true heighth, which is that of its center.

the centers of the *ſun* and of the *earth*) to the center of the *ſun*. All thoſe lines ſhall cut the ſaid plane, and will ſhew the terreſtrial ſphere, projected with its circles on that plane: ſo that the eye placed in the *ſun*'s center, muſt ſee the *earth*, and its annual, as well as diurnal motion, accompliſhed in the ſame plane, in the ſame manner we ſee from the *earth*, the *moon* and the *ſun*, with all their mutations, as if they were but plain ſuperficies, and had their ſpherical circles deſcribed in plain *diſks*: then from the projection of ſuch ſpherical terreſtrial ſuperficies, will ariſe in this plane, a circle of baſis, called the *diſk of the earth*; and which is to be every where equal to the plane of the *ecliptick*: then will ariſe, likewiſe, a right line extended on each ſide through its center, which will repreſent the axis of the *earth*, projected in that plane, inclin'd on each angle to the plane of the *ecliptick*, according to the difference of the ſeaſons. And the *parallelliſm* of the terreſtrial axis, on reaſon of its different ſituation to our plane, will make the inequality of the angle in the ſame plane. There will ariſe, likewiſe, in the ſame plane, by the diurnal motion of each point in the ſuperficies of the *earth*, innumerable *eclipſes*, by whoſe different ſituations the place in the plane given will be determined, and ſeparated from them all.

Therefore, if in the *ſolar eclipſes* we can diſcover in that plane, the lines, and the ways which the *moon* will paſs through, we'll diſcover, alſo, the place of our hemiſphere which is to be at that time darkened, by its interpoſition; which can be done in the following manner:

Having found the leſſer diſtance of the center of the *earth*, or of the *diſk* and *penumbra* of the center, and likewiſe the diſtance of its ſmaller line in our plane, from the area of the *ecliptick*, let be drawn from the point of the leſſer diſtance in the plane, a line perpendicular to it; this line will trace the paſſes or way of the *penumbra*, in the baſe, or *diſk* of the circle. Then we muſt mark in that right line the hours, with their quarters and minutes of our meridian, which anſwer to the *phænomena* of the *eclipſe*; marking, likewiſe, in the ecliptick line of our plane, the hours, with their parts, ſo that each hour, and each ſmaller part of the hour, mark the point where your place, deſcribed in the *ellipſe*, is fixed: In this manner, and by thoſe moments of time given, in our right, and elliptical line, we'll diſcover the *phænomena* of the *eclipſe* which are to appear in our place. Take from a ſcale of equal parts, eſpecially that from whence you have taken your whole delineation, the ſemidiameter of the *penumbra*, and having carried one ſhank of your compaſſes through the paths of the *penumbra*, and direct the other towards the path of your place, if it cannot reach it, there will be no occultation of the *ſun* in your place; but if, on the contrary, you perceive that it not only reaches it, but even goes beyond it, then there will be an *eclipſe*; *total*, if there be an interſection between the trace of the *penumbra*, and that of your place; and only *partial*, if there be no ſuch interſection. Likewiſe, you'll have the middle of the *eclipſe* at that very time, when having applied the ſhanks of the compaſſes to the axis of the parallel *ecliptick*, you'll obſerve the ſame hour in both traces, or paths. Laſtly, you'll find the end of the *eclipſe*, when it will be proper to mark the ſame hour, in the path of the center of the *penumbra*, and in the path of your place; whence the beginning, middle, and end of an *eclipſe* may be accompliſhed by a projection of lines, without the aſſiſtance of a *calculus*, or *parallaxes*.

Immersion, or *incidence* of an *eclipſe*, we have ſo often mentioned in this place, is the moment when part of the *ſun* or *moon*'s *diſk* firſt begins to be hid. And Emersion, or *expurgation* of an *eclipſe*, is the time when the eclipſed luminary begins to re-appear, or emerge out of the ſhadow.

Eclipse *of the moon*, *Fig.* 6. is a deficiency of light in that planet, occaſioned by a diametrical oppoſition of the earth, between the *ſun* and *moon*.

When all the light of the *moon* is intercepted, or when her whole *diſk* is covered, the *eclipſe* is ſaid to be *total*; when only part, *partial*. When the *total eclipſe* laſts for ſome time, it is ſaid to be total with continuance; when only inſtantaneous, total without continuance. *Eclipſes of the moon* only happen in time of full *moon*; becauſe it is only then the *earth* is between the *ſun* and *moon*. Nor do they happen every full *moon*, by reaſon of the obliquity of the *moon*'s way with reſpect to the *ſun*'s; but only in thoſe full *moons*, which happen either in the *nodes*, or very near them, where the aggregate of the apparent ſemidiameters of the *moon*, and the *earth*'s ſhadow, is greater than the latitude of the *moon*, or the diſtance between their centers.

The moſt conſiderable circumſtances in the *eclipſes* of the *moon*, are, 1. That as the ſum of the ſemidiameters of the *moon*, and *earth*'s ſhadow, is greater than the aggregate of the ſemidiameters of the *ſun* and *moon*, it is evident *lunar eclipſes* may happen in a greater latitude of the *moon*, and at a greater diſtance from the *nodes*; and conſequently are more often obſerved in any one part of the *earth*, than ſolar ones; though with reſpect to the whole *earth* the latter are as frequent as the former. 2. *Total eclipſes*, and thoſe of the longeſt duration, happen in the very *nodes* of the *ecliptick*; by reaſon the ſection of the *earth*'s ſhadow, then falling on the

moon,

moon, is confiderably greater than her *difk*. There may likewife be *total eclipfes* within a little diftance of the *nodes*; but the further, the lefs their duration; further off ftill, there are only partial ones, and at length none at all: as the latitude and the femidiameter of the *moon*, together, are either lefs, equal, or greater than the femidiameter of the fhadow. 3. All *lunar eclipfes* are univerfal, *i. e.* are vifible in all parts of the globe which have the *moon* above their horizon; and are every where of the fame magnitude, and begin and end together. 4. In all *lunar eclipfes* the eaftern fide is what firft immerges, and alfo emerges; fo that though at firft the *moon* be more wefterly than the *earth*'s fhadow, yet her proper motion being fwifter than the fame, fhe overtakes, and out-goes it. 5. The *moon*, even in the middle of an *eclipfe*, has ufually a faint appearance of light; which *Gaffendus*, *Ricciolus*, *Kepler*, &c. attribute to the light of the *earth*'s atmofphere tranfmitted thither. Lafty, fhe grows fenfibly paler, and dimmer, before ever fhe enters within the *earth*'s fhadow, which is attributed to the *earth*'s *Penumbra*; this PENUMBRA, is a faint, or partial fhade, obferv'd between the perfect fhadow, and the full light of an *eclipfe*. The *penumbra* arifes from the magnitude of the *fun*'s body; were he only a luminous point, the fhadow would be all perfect; but by reafon of the diameter of the *fun*, it happens, that a place which is not illuminated by the whole body of the *fun*, does yet receive rays from a part thereof. A *penumbra* muft be found in all *eclipfes*, whether of the *fun*, *moon*, or the other planets, primary or fecondary; but it is moft confiderable with us in *eclipfes* of the *fun*. In *eclipfes* of the *moon* the *earth* is encompaffed, indeed, with a *penumbra*, but it is only fenfible to us on the *earth* near the total fhadow. The *Penumbra* extends infinitely in length, inafmuch as to each point of the diameter of the *fun* there anfwers a point infinite in length, into which no rays enter from that point, though they do from others. M. *de la Hire* examines the different degrees of the *penumbra*, and reprefents them geometrically, by the ordinates of a curve, which fhall be among themfelves, as the feveral parts of the *fun*'s *difk*, wherewith a body planted in the *penumbra* is enlightened.

Before we can expect to be mafters of a fure method of calculating the times, places, magnitudes, and other *phænomena* of the *eclipfes* of the *moon*, we muft endeavour to find, 1. The length of the *earth*'s fhadowy cone 2 The apparent femidiameter of the *earth*'s fhadow, in the place of the *moon*'s paffage, for any given time. And 3. The arch between the centers, (*Fig.* 12.) and the arch C. after the *moon*'s latitude at the time of her oppofition, together with the angle at the *node* B, has been given

The length of the *earth*'s fhadowy cone is found, by finding the *fun*'s diftance from the *earth* for the given time. Suppofe for example, the *fun*'s greateft diftance from the *earth* 34996 femidiameters of the *earth*; and the *fun*'s femidiameter to be to that of the *earth*, as 153 to 1; then will the length of the fhadowy cone be found $230\frac{1}{4}$. Hence, as the *moon*'s leaft diftance from the *earth* is fcarce $6\frac{1}{2}$ femidiameters, the *moon*, when in oppofition to the *fun* in or near the *nodes*, will fall into the *earth*'s fhadow, though the *fun* and *moon* be in their *apogees*; and much more, if they be in or near their *perigees*, by reafon the fhadow is then longer, and the *moon* nearer the bafe of the cone.

By finding the *fun* and *moon*'s diftance from the *earth*, and thence their *horizontal parallaxes*, is found the apparent femidiameter of the *earth*'s fhadow, in the place of the *moon*'s paffage for any time given; if the *parallaxes* be added together, and the apparent femidiameter of the *fun* be fubtracted from the fum, then the remainder is the apparent femidiameter of the fhadow. Thus fuppofe the *moon*'s *horizontal parallax* 56′ 48″, the *fun*'s 6″; the fum is 56′ 54″: from which the *fun*'s apparent femidiameter, 16′ 5″, being fubtracted, leaves 40′ 49″ for the femidiameter of the fhadow. M *de la Hire* omits the *fun*'s *parallax* as of no confideration; but increafes the apparent femidiameter of the fhadow by a whole minute. for the fhadow of the atmofphere, which would give the femidiameter of the fhadow, in our inftance, 41′ 13″.

Since in the fpherical triangle A I L, (*Fig.* 35.) rectangular at I, the fide A L is given, as alfo the angle A L I, as being the complement of L A I, or B, to a right angle: the arch between the centers, A I. is found by fpherical trigonometry: and fince the angle L A I is equal to B, each of them, with A B, making a right angle; and the *moon*'s latitude A C is given; the arch L I will likewife be found by fpherical trigonometry.

We determine the bounds of an *eclipfe of the moon*, by adding the apparent femidiameters of the *moon*, in *perigæo*, and of the fhadow, fuppofing the *fun* in *apogæo*; by which we fhall have the fide M O (*Fig.* 36.) Then in the fpherical triangle M N O, having given the angle at the *node*, whofe quantity is the *moon*'s greateft latitude in the conjunction. the right angle E, and the leg M O, we muft find the *moon*'s diftance from the *node* N O, which is the utmoft bound. beyond which the *eclipfe* cannot reach. Adding, after the fame manner, the apparent femidiameters of the *moon* in *apogæo*, and of the fhadow of the *fun* in *perigæo*. for the take of having the arch L K, in the triangle N L h, the diſtance of the *moon* in the aſcending *node* will be found by ſpherical trigonometry; which is the bound within which the *moon* will neceſſarily be *eclipſed*. For example; the ſemidiameter of the ſhadow, when the *ſun* is in *apogæo*, and the *moon* in *perigæo*, according to *Kepler*, is 49′ 40″, and the apparent ſemidiameter of the *moon* in *perigæo* 16″ 22″; conſequently, M O is 66′, or 1° 6′; and therefore there will be no *eclipſe* at all, if the *moon*'s latitude be greater than 1° 6′. Now as the ſame angle N, is ſuppoſed by *Kepler* to be 5° 18′;

Log, of *ſine* N	89655337
Sine M O	82832433
Whole *ſine*	100000000
Log. of *Sine* * O N	93177096

The Remainder correſponding to which, in the tables, is 11° 59′ 50″. If, therefore, the *moon*'s diſtance from the aſcending *node* be greater than 12°, no *eclipſe* can happen, And, in like manner, the ſemidiameter of the ſhadow in the *ſun*'s *perigee*, and the *moon*'s *apogee*, is 43′ 50″, and the *moon*'s ſemidiameter in her *apogee* 15′: conſequently L h is 58′ 50″; and therefore there will be an *eclipſe*, if the *moon*'s latitude do not exceed 58′ 50″: But here, as before, the argument of the latitude is found 1° 40′.

If we will determine the *quantity of an eclipſe*, or *the number of the digits eclipſed*, we muſt add the *moon*'s ſemidiameter to the ſemidiameter of the ſhadow, and ſubtract, from the ſum, the arch between the centers; the remainder gives the ſcruples, or parts of the diameter, *eclipſed*.

To find *the time of half duration of an eclipſe*, or the arch of the *lunar orbit* which her center deſcribes from the beginning of the *eclipſe* to the middle thereof; we muſt add the ſemidiameters of the ſhadow A P, and the *moon* P M, together; the ſum gives A N. From the ſquare of A N, we muſt ſubtract the ſquare of A I, the remainder is the ſquare of I N; and the ſquare root of this reſidue is the arch I N, required. But we will, perhaps, have the ſcruples of half duration of *total darkneſs*, in a *total eclipſe*. Then we'll ſubtract the *moon*'s ſemidiameter S V, from the ſemidiameter of the ſhadow A V; the remainder is A S. In the triangle A I S, which is rectangular at I; therefore we have the arch A S, given by the laſt method; and the arch between the centers A I; where the arch I S is found, as in the laſt problem.

We'll proceed ſtill further, and find, the beginning, middle, and end of a *lunar eclipſe*. Which to perform, we'll ſay, as the *moon*'s horary motion from the *ſun*, is to 3600 horary ſeconds; ſo are the ſeconds of the arch L I, (*Fig.* 35.) to the horary ſeconds equivalent thereto: then ſubtracting theſe ſcruples, or ſeconds, in the firſt and third quadrant of the anomaly, from the time of full *moon*; and adding it to the ſame in the ſecond and fourth, the reſult is the time of the *middle of the eclipſe*. Then we'll ſay again, as the *moon*'s horary motion from the *ſun*, is to 3600 ſcruples, or ſeconds; ſo are the ſeconds of half duration I N, to the time of half duration; the double of which gives the whole duration. Laſtly, We'll ſubtract the time of half duration from the time of the *middle of the eclipſe*, the remainder will be the *beginning of the eclipſe*. And if we add the ſame to the ſame, the ſum will be its end.

To calculate an *eclipſe of the moon*, proceed in the following manner:

1. To find whether there will be an *eclipſe*, or not. For the given time of the mean full *moon*, we muſt compute the *moon*'s diſtance from the *node*. 2. The time of the true full *moon* muſt be computed, with the *ſun* and *moon*'s true place reduced to the *ecliptick*. 3. For the time of the true full *moon*, we are to compute the *moon*'s true latitude, the diſtance of each luminary from the earth, with the *horizontal parallaxes*, and apparent ſemidiameters. 4. For the ſame time we muſt find the *ſun* and *moon*'s true horary motion. 5. The apparent ſemidiameter of the ſhadow. And, 6. The arch between the centers A I, with the arch L I. 7. Compute the ſcruples of half duration. And thence, 8. Determine the beginning, middle, and end of the *eclipſe*. Laſtly, find the ſcruples *eclipſed*, and thence the quantity of the *eclipſe*.

From the *moon* let us deſcend to the lower planets.

MERCURY, is ſo ſmall a planet, that it can ſcarcely be diſtinguiſhed, though almoſt equal in radiancy or brightneſs to the fixed ſtars; but is never ſeen, but when in a very great digreſſion from the *ſun*, and is ſeldom diſcovered round, even by the teleſcope, but only divided into two parts, like the *moon* while in the quadratures.

The mean diſtance of *Mercury* from the *ſun* is to that of our *earth* from the *ſun*, as 387 to 1000, its

* SINE, is a right line drawn from one extremity of an arch, perpendicularly upon the radius, drawn from the other extremity. Or the *ſine* is half the chord of twice the arch. That *arch*, is a part of any curve line, for example, of a *circle*, *ellipſis*, or the like. And that *chord*, is the baſe, or line that joins the two extremes of the *arch*.

excentricity 8 degrees. The inclination of its *orbit*, that is, the angle formed by the plane of its *orbit*, with the plane of the ecliptic, is 6 degrees 52 minutes. Its diameter to that of the earth, as 3 to 4; and therefore the globe of *Mercury* will be to that of the earth, as 2 to 5. According to Sir *Iſaac Newton*, the heat and light of the *ſun* on the ſurface of *Mercury*, is ſeven times as intenſe as on the ſurface of our earth in the middle of ſummer: which, as he found by experiments made for that purpoſe by a thermometer, is ſufficient to make water boil.

The revolution of *Mercury* round the *ſun*, or his year, is performed in 87 days 23 hours; his diurnal revolution, or the length of his day, is not yet determined; nor is it certain, whether he has ſuch a motion round his own axis or not. The force of gravity on his ſurface, is ſeven times as ſtrong as on the ſurface of the earth. Its denſity, and conſequently the gravitation of bodies towards the center cannot be accurately determined; but, no doubt, it muſt exceed that of our earth, by reaſon of the exceſs of heat there.

Mercury changes his *phaſes*, like the *moon*, according to his ſeveral poſitions, with regard to the *ſun* and *earth*. As to his ſituation, *Mercury* is ſometimes obſerved betwixt the *earth* and the *ſun*; and ſometimes beyond the *ſun*. Its greateſt diſtance from the *ſun*, with regard to us, never exceeds 28 degrees, whence it is ſeldom viſible; being commonly either loſt in the *ſun*'s light, or, when the moſt remote from the *ſun*, in the *crepuſculum*. The beſt obſervations of this planet are thoſe made when it is ſeen on the *ſun's* diſk; for in its lower conjunction it paſſes before the *ſun* like a little ſpot, eclipſing a ſmall part of his body, which was firſt obſerved by *Caſſendi* in 1632; but not without a teleſcope.

Next to *Mercury* ſtands VENUS, conſtantly attending the ſun, and never departing from him above 47 degrees. When ſhe goes before the ſun, that is, riſes from him, ſhe is called *Phoſphorus*, or *Lucifer*, or the *morning ſtar*; and when ſhe follows him, that is, ſets after him, *Heſperus*, or *Veſper*, or the *evening ſtar*.

The diameter of *Venus* is to that of the earth, as 10 to 19; her diſtance from the ſun is $\frac{723}{1000}$ of the earth's diſtance from the ſun; her excentricity 5; the inclination of her *orbit* 3° 23′; her periodical courſe round the ſun performed in 224 days, 17 hours; and her motion round her own axis, in 23 hours. Her greateſt diſtance from the earth according to *Caſſini*, is 38000 ſemidiameters of the earth; and her ſmalleſt 6000. Her *parallax* is 3 minutes.

Venus, when viewed through a teleſcope, is rarely ſeen to ſhine with a full face, but has *phaſes* juſt like thoſe of the moon; being now gibbous, now horned, *&c.* and her illumin'd part conſtantly turned towards the *ſun*, *i. e.* it looks towards the eaſt, when *Phoſphorus*; and towards the weſt, when *Heſperus*.

The *phænomena* of *Venus* evidently ſhew the falſity of the *Ptolemaic* ſyſtem: for that ſyſtem ſuppoſes, that *Venus*'s orb, or heaven, incloſes the *earth*; paſſing between the *ſun* and *Mercury*. And yet all our obſervations agree, that *Venus* is ſometimes on this ſide the *ſun*, and ſometimes on that; nor did ever any body ſee the earth between *Venus* and the ſun; which yet muſt frequently happen, if *Venus* revolv'd round the *earth*, in a heaven below the *ſun*. *Venus* is eaſily diſtinguiſhed, by her brightneſs, and whiteneſs, which exceeds that of all the other planets, and which is ſo conſiderable, that in a duſky place ſhe projects a ſenſible ſhadow. Her place is between the *earth* and *Mercury*.

The viſible conjunctions of *Venus* with the *ſun*, are not ſo frequent as thoſe of *Mercury*, by reaſon of the ſlower motion of *Venus*, whereby ſhe ſeldomer attains to the places given. And becauſe her periodical times, compared with the periodical times of the *earth*, are leſs commenſurable, and therefore very ſeldom co-incident.

MARS, is one of the three ſuperior *planets*, and of thoſe three the neareſt to us; being placed between the *ſun* and *Jupiter*. Its mean diſtance from the *ſun*, is 1524 of thoſe parts, whereof the diſtance of the *ſun* from the earth is 1000; its excentricity 141; the inclination of its orbit, that is, the angle formed by the plane of its orbit with the plane of the *ecliptic*, 1 degree, 52 minutes; the periodical time, in which it makes its revolution round the *ſun*, 686 days, 23 hours.

It muſt be obſerved, that in the *Copernican* and *Tychonic* hypotheſes, the earth is contained within the circumference of this circle; and that hence *Mars* is, at certain times, in oppoſition to the *ſun*; that is, when near the *earth*; and ſometimes *Mars* is nearer to it than the *ſun* himſelf; as it is evident in both ſyſtems: and then he appears bigger to us, than while in conjunction with the ſun, tho' in conjunction, as well as in oppoſition, it ſhines in full orbit; but in conjunction he is ſuperior to the *ſun*, and at a greater diſtance from us; but nearer, when in oppoſition, in the quadratures, he has the ſame *phaſes* the moon has, but they are very little ſenſible to us.

Mars always appears with a ruddy troubled light, whence we conclude it is encompaſſed with a thick, cloudy atmoſphere, which by diſturbing the rays of light in their paſſage and repaſſage through, it occaſions that appearance.

Jupiter, is one of the ſuperior planets, ſituate between *Saturn* and *Mars*, remarkable for its brightneſs, which by its proper motion ſeems to revolve round the earth in about 12 years. It has a rotation round its own axis in 9 hours 56 minutes; and a periodical revolution round the ſun in 4332 days, 12 hours, 20′ 9′: It is the biggeſt of all the planets; its diameter, to that of the ſun appears, by aſtronomical obſervations, to be as 1077 is to 10000; to that of *Saturn*, as 1077 to 889; to that of the earth, as 1077 to 104. The force of gravity on its ſurface is to that on the ſurface of the ſun, as 797,15 is to 10,0000; to that of *Saturn*, as 797,15 to 534,337; to that of the earth, as 797,15 to 407,832. The denſity of its matter is to that of the ſun, as 7404 to 10000; to that of *Saturn*, as 7404 to 6011; to that of the earth, as 7404 to 3921. The quantity of matter contained in its body is to that of the ſun, as 9,248 to 10,000; to that of *Saturn*, as 9,248 to 4,223; to that of the earth, as 9,248 to 0,0044.

The mean diſtance of *Jupiter* from the ſun is 5201 of thoſe parts, whereof the mean diſtance of the earth from the ſun is 1000, tho' *Kepler* only makes it 5196 of thoſe parts. *Caſſini* calculates *Jupiter*'s mean diſtance from the earth to be 115 000 ſemidiameters of the earth. *Gregory* computes the diſtance of *Jupiter* from the ſun to be five times as great as that of the earth from the ſun; whence he gathers, that the diameter of the ſun, to an eye placed in *Jupiter*, would not be a fifth part of what it appears to us; and therefore its diſk would be twenty-five times leſs, and his light and heat in the ſame proportion.

Jupiter appears almoſt as large as *Venus*, but is not altogether ſo bright. He is eclipſed by the moon, by the ſun, and even by *Mars*. He has three appendages, called *Zones* or *Belts*, which Sir *Iſaac Newton* thinks are formed in his atmoſphere. In theſe are ſeveral *maculæ* or ſpots, carried from eaſt to weſt (in a part conſpicuous to us) in the ſpace of 9 hours 56 minutes, the diſcovery of which is controverted between *Euſtachio*, *P. Gotignies*, *Caſſini*, and *Campani*.

In 1610, the 7th of *January*, at one the following night, *Galilæo* diſcovered, round *Jupiter*, four little planets or moons, which move round him, and which he called the *Aſtra Medicæa*, and we the *Satellites* of *Jupiter*. Thoſe nearer to him move with a greater celerity, than thoſe at a greater diſtance. *Simon Marcus* has defined their revolutions in the following manner. Revolves:

The firſt and innermoſt	The ſecond.	The third.	The fourth.
d h ′ ″	d h ′ ″	d h ′ ″	d h ′ ″
1 18 28 30	3 13 18 00	7 03 56 34	16 18 09 15

Caſſini obſerved that the firſt or innermoſt of theſe *Satellites* of *Jupiter*, was five ſemidiameters of *Jupiter*, diſtant from *Jupiter* itſelf, and made its revolution in one day, 18 hours, and 32 minutes. The ſecond, which is ſomewhat greater, he found eight diameters diſtant from *Jupiter*, and its revolution 3 days, 13 hours, and 12 minutes. The third, which is the greateſt of all, is diſtant from *Jupiter* 13 ſemidiameters, and finiſhes its courſe in 7 days, 3 hours, and 50 minutes. The laſt, which is the leaſt of all, is diſtant from *Jupiter* 23 ſemidiameters; its period is 16 days, 18 hours, and 9 minutes.

Jupiter's *Satellites*, when they enter its ſhadow (like the moon when ſhe enters the earth's ſhadow) are eclipſed, becauſe they are opake bodies, and receive their light from the ſun. The three firſt cauſe three eclipſes in each revolution. 1. When the *Satellite* enters the diſk of *Jupiter*. 2. When the ſhadow of the *Satellite* darkens the diſk of *Jupiter*. 3. When the ſuperior part of *Jupiter* hides the *Satellite*. 4. When the *Satellite* is immerged in *Jupiter*'s ſhadow. Therefore the firſt *Satellite* cauſes eclipſes within ſeven days; the ſecond eight; the third four; and all together twenty-eight. The firſt *Satellite*, when arrived at the node, cauſes four eclipſes within ſeventeen days.

Caſſini has invented proper tables for the computation of the eclipſes of the *Satellite* next *Jupiter*, which indicates the very moment of the eclipſe.

Saturn is of all the planets the fartheſt from the earth and the ſun, on which account, though the biggeſt of all the planets it appears the ſmalleſt, and to ſhine but with a feeble light Its period, or the ſpace of time wherein he revolves round the ſun (which makes his year) according to *Kepler*, is 29 years, 174 days, 4 hours, 58 minutes, 25 ſeconds, and 30 thirds; whence his diurnal motion muſt be 2 minutes, 0 ſeconds, 36 thirds; though *De la Hire* makes his diurnal motion 2 minutes, 1 ſecond. The inclination of his plane to that of the *ecliptic*, *Kepler* makes 2° 32′; *De la Hire* 2° 33′. Its mean diſtance from the ſun is 326925 ſemidiameters of the earth; and from the earth 210,000 of the ſame. Its ſmalleſt diameter, according to *Huygens*, is 30 ſeconds. The proportion of its diameter to that of the earth, as 20 to 1; of its ſurface to that of the earth, as 400 to 1; of its ſolidity to that of the earth, as 1 to 8000.

The diſtance of *Saturn* from the ſun being ten times greater than that of the earth from the ſame, it it is found that the apparent diameter of the ſun ſeen from him, will not exceed 3 minutes, which is but little more than twice the diameter of *Venus*.

It is doubted, whether or no *Saturn*, like the other *planets*, revolves round its axis: it does not appear, from any aſtronomical obſervations, that he does; and there is one circumſtance that ſhould ſeem to argue the contrary, *viz.* that whereas the earth, and other *planets*, which we know do revolve on their axes, have their *equatorial diameters* greater than their *polar*; nothing like this is obſerved in *Saturn*.

The ſuppoſed various and extraordinary *phaſes* of *Saturn*, have long perplexed the Aſtronomers. But *Huygens* has reduced all his *phaſes* to three principal ones, *viz. round, brachiated*, and *anſated*.

Saturn has a *ring* peculiar to himſelf, which ſurrounds his middle like an arch, or like the horizon of an *armillary ſphere*, without touching him any where; the diameter whereof is more than double that of the planet which it ſurrounds; the former containing 45 diameters of the earth, the latter only 20. When raiſed enough to be out of the ſhadow of the body of *Saturn*, it reflects the light of the ſun very ſtrongly. Dr *Keill* obſerves, that the thickneſs of the *ring* takes up one half of the ſpace between its outer, or convex ſurface, and the ſurface of the planet. This *ring* is found to be an opake, ſolid, but ſmooth, and even body.

Saturn performs his courſe round the ſun, attended with five *Satellites*, or *ſecondary planets*; the firſt of which was diſcovered by *Caſſini*, at the Royal Obſervatory at *Paris*, *anno* 1672, to be diſtant from the center of *Saturn*, a diameter and two thirds of the *ring*, and to accompliſh his courſe round *Saturn* in the ſpace of 4 days, 12 hours, and 27 minutes. The ſecond had been long before diſcovered by *Huygens*, and is a great deal bigger than the firſt. This is diſtant from *Saturn*'s center, four diameters of the *ring*, and revolves round him in 16 days, 23 hours. The third was obſerved by *Caſſini*, *anno* 1671, towards the latter end of *October*, in a great digreſſion from *Saturn*, but ſoon vaniſhed from his ſight, and could not be ſeen again till towards the 15th of *December*, and ſoon diſappeared again, till the beginning of *February*, 1673; when it continued viſible for thirteen days ſucceſſively.

Dr. *Halley*, in the *Philoſophical Tranſactions*, gives us a correction of the theory of the motion of the fourth *Satellite*. Its true period he makes 15 days, 22 hours, 41 minutes, 6 ſeconds; its diurnal motion, 22° 34′ 38″ 18‴; its diſtance from the center of *Saturn*, 4 diameters of the *ring*; and its orbit to be little or nothing diſtant from that of the *ring*, interſecting the *orbit* of *Saturn* under an angle of 23 degrees and a half.

The ORRERY, which is a machine (ſee the *figure* thereof in the Copper Plate) that repreſents the *true* SOLAR SYSTEM, and gives a juſt idea of the number, motions, order, and poſitions of the heavenly bodies.

This *machine* is alſo called a *Planetarium*, and is fixed in a frame of ebony, contained by twelve vertical planes, on which are repreſented the *twelve ſigns* of the *zodiac*. The upper ſurface is flat, of poliſhed braſs, on whoſe outward circumference are ſcrewed in twelve braſs pillars, which ſupport a large flat ſilvered *ring* marked 12, repreſenting the *ecliptic*, with ſeveral circles drawn upon it. The three innermoſt are divided into *twelve parts* for the *ſigns* of the *zodiac*, each of which is divided into *thirty degrees*, and among theſe degrees are graved in their proper places, the *nodes*, *aphelia*, and greateſt north and ſouth *latitudes* of the *planets*. Between the next two *circles* are the *cardinal points*. The next three *circles* have the *months* and the *days* of the month, according to the *new ſtile*.

Upon the braſs-ſurface of the machine are graduated ſilver-circles, which carry the *planets* (repreſented by ſilver-balls) upon arbours or ſtems, that raiſe them up to the height of the plane of the *ecliptic*; and turning about the handle or winch of the ORRERY, all the *planets* move at their proportional diſtances from a little *gilt ball* in the middle, which repreſents the *ſun*; and perform their revolutions according to their periodical times. There are fixed *indices* of blued ſteel, which ſhew the *longitudes* of the *planets*, by pointing to the diviſions of the ſilvered rings or circles, as they move round. But as theſe circles, being *concentric*, give only the mean diſtances, the true *orbits*, according to their *excentricities*, are graved on the outſide of each circle, with the periodical times taken from the tables, to ſhew what the revolutions are, nearer than can be performed by any machine.

The *nodes* and *aphelia*, with the places of greateſt north and ſouth *latitudes*, are alſo marked on thoſe *orbits*.

In the middle of this large circle, deſigned to repreſent the *ecliptic*, is fixed a *globe*, 1. to repreſent the *ſun*. Next the *ſun* is a ſmall ball, 2, to repreſent *Mercury*. Next to this is *Venus*, 3, repreſented by a larger ball. And, at a greater diſtance from the *ſun*, you ſee the *earth*, 4, repreſented by an ivory ball, ſurrounded, at ſome diſtance, by a ring, which expreſſes the *orbit* of the *moon*, making an angle with the circle that repreſents the *ecliptic*, and thereby ſhewing the inclination they have to each other in the heavens, and alſo the line of the *nodes*. Within the ſame ring is another ivory ball, 5, with

5, with a black cap or case, to represent the *moon*; the cap is contrived always to cover that hemisphere, which is turned from the *sun*, and thereby distinguisheth the enlightened part from the dark side, and, consequently, her age. 6. Represents *Mars*. 7. Is *Jupiter* attended with his *satellites*, or four *moons*. And 8, the outmost of all the *planets*, is *Saturn* with his *ring* or *belt*, and five *satellites* or *moons*. All these are fixed upon small stems, which severally represent their *axes*, each of which hath its peculiar and proper inclination to the plane of that circle which represents the *ecliptic*. 9. Is a dial-plate. 10, 10, 10, *Meridians*; 11. The *equator*. 12. The *ecliptic* with its circles, already described. 13, 13. Two keys for locking and unlocking the diurnal and annual motions; and as to the *arctic* circle, tropic of *cancer*, and moveable *horizon*, they are named in the figure.

The principal use of the Orrery is to render *the theory of the earth and the moon* easy and intelligible; and to evidence to our senses how all these appearances happen, which depend on the annual or diurnal rotation of the *earth*, and the monthly revolutions of the *moon*: as the variety of seasons, the vicissitudes and various lengths of days and nights, the manner of *solar* and *lunar eclipses*, the various *phases* of the *moon*, &c. There have been various forms invented for this noble instrument, two of which have principally obtained, *viz.* the hemispherical *orrery*, and the whole *sphere*: though the *orrery* at first was made without any *sphere*, with only the *sun*, the *earth* and *moon* revolving about it; but as this was too imperfect a state, they soon began to invest it, some with a half *sphere*, and others with a whole *sphere* to be an adequate representation of the *solar system*.

The *hemispherical orrery*, as that above described, has been made in greater numbers than any other, on account of their being made much cheaper and easier than those in a *sphere* of the same size; there being a vast difference between placing an hemisphere on the box of an *orrery*, and disposing an *orrery* in a large moveable *sphere*. But the idea given us by the former, is very imperfect and unnatural in comparison of the latter, and it is surprizing to think how they should have so great a run. An *orrery*, therefore, adapted to an *armillary sphere*, is the only machine that can exhibit a just idea of the *true system of the world*, with the diurnal and annual motions of the heavenly bodies; but is likewise capable of exhibiting the *third motion of the earth*, viz. that motion of the *earth*, by which the *poles* of the world revolve about the *poles* of the *ecliptic*, and occasions what is commonly called the precessions of the *equinoxes*, or more properly the the retrogression of the *earth*'s *nodes*.

As the distances are in their true proportions to each other, so likewise are the bodies of the *planets* in their just proportions to one another. But it cannot be expected, that the diameters of the *planets* should be in proportion to the diameters of the *orbits*; because taking *Jupiter* under three inches diameter, and the *earth* a little more than a quarter of an inch, it would require the *system* to be of the bigness of a mile and $\frac{3}{4}$, the *orbit* of *Saturn* 9000 feet in diameter, and so on of the rest; which would make the machine 3000 times bigger than it is. And if the bodies were suited to the dimensions given, the bodies must be 3000 times less, which would render them all invisible, but the *sun*; and that would be less than $\frac{1}{100}$th part of an inch. For this reason, as a ball big enough to represent the *sun* cannot be put on, we are to suppose the *sun* (in respect of them) as big as the inner circle of the silver-ring, which represents the *ecliptic*.

As the *orbit* of the *moon*, and the *orbits* of the *satellites* of *Jupiter* and *Saturn*, are quite lost in his proportion of the *orbits* of the *primary planets*, much more are the *satellites* themselves; therefore the *satellites* are usually not put on in this position of the machine. But *Saturn*'s *ring* is joined to *Saturn*'s *body*, according to its proportion, and the inclination of its plane to the plane of *Saturn*'s *orbit*: and as the *planet* is carried round, the *ring* always moves parallel to itself, as it does in the heavens. Thereby we see why the inhabitants of the *earth*, in one revolution of *Saturn*, see the *ring* twice in the most open situation of the *Ansæ*, as at 8, and twice, as if it had no *ring*, that is, when the edge of the *ring* is towards the *earth* (the plane of the *ring* going through the observer's eye) and the successive increasing and decreasing of the visible bigness af the *Ansæ*.

Jupiter, with his *moons*, is represented at 7, and the spots whereby his revolution has been observed.

When you have a compleat idea of the proportional bigness of the *planets*, *Jupiter* and *Saturn* are taken off, and others put on three times less than the former, in order to put *satellites* about them (and at the same time the *moon* is joined to the *earth*) and shew how the *satellites* accompany their *primary planet* in its course round the *sun*. These *satellites*, which are pearls upon crooked stems, do not turn by clock-work round their primaries (as has been done in some large *orreries*) but are only set by the hand: because, to do it, would be only a needless expence, to give a false notion of their bigness, distances, and inclination of their *orbits*, in respect of their primaries.

But to give a right notion of *Jupiter* and his *satellites*, and of *Saturn* and his *satellites*, there is shewn

shewn for each of these *planets* a *system* a-part, where the distances from the primary, and the bigness of the *satellites*, are expressed: and in this *system*, tho' *Jupiter* is but of about an inch diameter, the outermost *satellite* is as far distant from *Jupiter*'s center, as *Saturn* is from the *sun* in the *machine*; which shews the inconsistency and disproportion of making the *sat llites* to move round *Jupiter* in an *orrery*. *Saturn's satellites* are still more improperly put in; because four of them move in *orbits* very much inclined to *Saturn's ecliptic* (*viz.* in an angle of above thirty degrees) and the fifth has its *orbit* almost in the same plane as *Saturn's ecliptic*, with a diameter greater than the diameter of the whole *orrery*, even when *Saturn* is three times less than the *Saturn* of the *orrery*.

The next thing which is put on, is a contrivance to shew, that all the confusion of the *planets motions* in the *Ptolemaic hypothesis* (called their stations and retrogradations) is not really, but apparently so, in the *Copernican* or true *system* of the world. And this is done by two steel *indices*, one of which being always applyed to the *sun*, and successively to the top of the stem of the *planet* to be examined, whilst the other is applied to the *earth* (as a center) and the said *planet*: by turning the handle of the *machine*, the *heliocentric* and *geocentric* places of the *planet* are seen on the *ecliptic* at the same time; shewing why the *planets* seem to go backwards and forwards when viewed from the *earth*; though they go all the while regularly from *west* to *east*, as they would be seen from the *sun*.

When the *machine* is put in motion, all these bodies move round that which represents the *sun*, and, at the same time, both that, and all those which represent such of the *planets* as have been observed to have a *rotation* about their *axis*, turn round upon the said stems, and in their proper times. The *satellites*, or *moons*, also revolve about their *primaries* at the same time; and the *ring* that represents the *orbit* of the *moon* has likewise its proper motion, whereby that of its *nodes* is also expressed. The whole *machine* is put into motion by turning a small winch, 14, like the key of a clock, with very little strength. And, above this winch, is a cylindrical pin, which may be drawn a little out, or pushed in at pleasure: when it is pushed in, all the *planets*, both *primary* and *secondary*, will move according to their respective periods, by turning the handle or winch: when it is drawn out, the motions of the *satellites* of *Jupiter* and *Saturn* will be stopped, while all the rest move freely. In the place of the *sun*, you may fix a brass-lamp, with two convex-glasses, made on purpose; which, being placed with the glass directly to the *earth*, and turning round in the same time with the *earth*, throws a continual strong light upon it and the *moon*, in whatever part of its *orbit* it is; and so not only the times in which the *eclipses* of the *sun* and *moon* will happen, are shewn, but the *phænomena* themselves are truly represented

When you propose to use this *machine*, place a small black patch, or a bit of wafer, upon the middle of the *sun*, right against the first degree of ♈: you may also place patches upon *Venus*, *Mars*, and *Jupiter*, right against some noted point in the *ecliptic*; put on the handle, and push in the pin which is just above it. One turn of this handle answers to a revolution of the ball, which represents the *earth*, about its *axis*; and, consequently, to 24 hours of time, as may be seen by the motion of the hour *index*, 9, which is marked, and placed at the foot of the wire, on which the ball of the *earth* is fixed: again, when the *index* has moved the space of ten hours, *Jupiter* makes one complete revolution round its *axis*; and so of the rest.

By these means the revolutions of the *planets*, and their motions round their own *axes*, will be represented to the eye. And it is worth observation, that the diurnal motion of the *planets* was discovered, by observing the motions of the spots upon the surface of the *sun*, and of the *planets* in the heavens, after the same manner as we here observe the motions of their representatives, by that of the marks placed upon them in this *machine*.

This *machine* is so contrived, that the winch may be turned either way; so that the same number of revolutions being made backwards, they will bring all the *planets* to their former aspects or situations in respect to each other.

It would be too great an undertaking here to give an account of the mechanism of the *larger sort* of ORRERIES, which represent the movements of all the heavenly bodies; nor, indeed, can it be done either by diagram or description, to render it intelligible to the most discerning reader; but, instead of that, we shall exhibit an idea of the theory and structure of an useful, concise, and portable PLANETARIUM, which any gentleman may have made for a small expence, and will exhibit, very justly, the motions of all the *primary planets* about the *sun*, by wheel-work; and those that have *secondaries*, or *moons*, may have them placed about their *primaries* moveably by the hand, so that the whole shall be a just representation of the *solar system*, or true state of the heavens, for any given time of the year.

In order to this we must compare, and find out the proportion, which the periodical times, or revolutions of the *primary planets*, bear to that of the *earth*; and they are such as are expressed in the table below, where the first column is the time of the *earth*'s period in days and decimal parts; the second, that of the *planets*; the third and fourth

fourth are numbers in the ſame proportion to each other: as,

365,25 : 88	☿ : : 83 : 70,	for *Mercury*.
365,25 : 224,7	♀ : : 52 : 32,	for *Venus*.
365,25 : 686,9	♂ : : 40 : 75,	for *Mars*.
365,25 : 4332,5	♃ : : 7 : 83,	for *Jupiter*.
365,25 : 10759,3	♄ : : 5 : 148,	for *Saturn*.

If we now ſuppoſe a ſpindle or arbor with ſix wheels fixed upon it in an horizontal poſition, having the number of teeth in each, correſponding to the numbers in the third column, *viz.* the wheel AM of 83 teeth, BL of 52, CK of 50 (for the *earth*), DI of 40, EH of 7, and FG of 5; and another ſet of wheels moving freely about an arbor, having the number of teeth in the fourth column, *viz.* AN of 20, BO of 32, CP of 50 (for the *earth*), DQ of 75, ER of 83, and FS of 148; then, if thoſe two arbors, of fixed and moveable wheels are made of the ſize, and fixed at the diſtance from each other, the teeth of the former will take thoſe of the lattter, and turn them freely, when the *machine* is in motion.

Theſe arbors, with their wheels, are to be placed in a box, of an adequate ſize, in a perpendicular poſition: the arbor of fixed wheels to move in pivots at the top and bottom of the box; and the arbor of moveable wheels to go through the top of the box, to a proper height, on the top of which is to be placed a round ball, gilt with gold, to repreſent the *ſun*. On each of the moveable wheels is to be fixed a ſocket, or tube, aſcending above the top of the box, and having on the top a wire fixed, and bent at a proper diſtance into a right angle upwards, bearing on the top a ſmall round ball repreſenting its proper *planets*.

If then on the lower part of the arbor of fixed wheels be placed a pinion of ſcrew teeth, a winch turning a ſpindle with an endleſs ſcrew, playing in the teeth of the arbor, will turn it with all its wheels; and theſe wheels will move the others about with their *planets*, in their proper and reſpective periods of time, very exactly. For, while the fixed wheel CK moves its equal CP once round, the wheel AM will move AN a little more than four times round, and ſo will nicely exhibit the motion of *Mercury*; and the wheel FG will turn the wheel FS about $\frac{1}{29,5}$ round, and ſo will truly repreſent the motion of *Saturn*: and the ſame is to be obſerved of all the reſt.

The *planets* are repreſented by the ſame Characters the Chemiſts uſe to repreſent their metals by, on account of ſome ſuppoſed analogy between thoſe celeſtial, and ſubterraneous bodies. *Saturn* is repreſented by the character ♄. *Jupiter* by ♃. *Mars* ♂. *Venus* ♀. *Mercury* ☿. To which we now add, *Tellus*, the *Earth*, marked ⊕, or ♀.

The inſtruments requiſite in *Aſtronomical obſervations*, are *Teleſcopes*, of ſeveral ſizes; *Armillary* and *Zodiacal ſpheres*; *Celeſtial globes*, *Aſtronomical quadrants*, *Azimuthal horizons*, *Sextants*, &c.

A Telescope, is an optical inſtrument, conſiſting of ſeveral glaſſes, or lenſes, ſitted into a tube, through which remote objects are ſeen, as if nigh at hand. The *teleſcopes* us'd in *Aſtronomical obſervations*, called alſo *Aſtronomical teleſcopes*, conſiſt of an object glaſs, which is that glaſs turned towards the object; and an eye-glaſs, which is that next the eye, both convex.

Armillary Sphere, is an *Aſtronomical* inſtrument, repreſenting the ſeveral circles of the ſphere, in their natural order; ſerving to give an idea of the office and poſition of each thereof, and to ſolve various problems relating thereto. It is thus called, as conſiſting of a number of *faſciæ*, or rings of braſs or other matter, called by the *Latins*, *armillæ*, from their reſembling of bracelets, or rings for the arm. By this it is diſtinguiſhed from the *globe*, which though it has all the circles of the ſphere on its ſurface, yet is not cut into *armillæ*, or rings, to repreſent the circles ſimply, and alone; but exhibits alſo the intermediate ſpaces between the circles.

The Celestial Globe, is an artificial ſphere, made of metal, plaiſter, paper, or other matter; on whoſe convex ſurface the fixed ſtars are placed, at proportionable diſtances, together with the principal circles of the ſphere. The uſe of this inſtrument is very extenſive; ſcarce any thing in the *ſpherical Aſtronomy*, but may be exhibited thereby, without having recourſe to *trogonometrical calculation*. The principal points are contained in the following problems, with their ſolutions; which will let the reader enough into the nature and reaſon of this inſtrument, to apply it, of his own accord, in any other caſes.

To find. 1. The right aſcenſion and declination of a ſtar, repreſented on the ſurface of the *globe*. 2. The longitude and latitude of a ſtar. 3 The *ſun*'s place in the ecliptick. 4. The declination of the *ſun*. 5. The place of a planet, with its right aſcenſion and declination; its longitude and latitude, for the time given. 6. To rectify the *globe*, or adjuſt it to the place, *&c.* ſo as it may repreſent the preſent ſtate or ſituation of the heavens. 7. To know all the ſtars and planets, by means of the *globe*. 8. To find the *ſun*'s oblique aſcenſion, his eaſtern amplitude and azimuth, with the time of riſing.

rising. 9. The *sun*'s oblique descension, western amplitude and azimuth, with the time of setting. 10. The length of the day and night. 11. The rising, setting, and culminating of a star; its continuance above the horizon, for any place and day; together with its oblique ascension and descension, and its eastern and western amplitude and azimuth. 12. The altitude of the *sun*, or a *star*, for any given hour of the day or night. 13. The altitude of the *sun* by day, or of a *star* by night, being given; to find the time of that day or night. 14 To find the interval of time between the rising of two *stars*, or their culminations. And, 15. To find the beginning and ending of the *crepusculum*, or twilight.

1. The right ascension and declension of a *star* is found, by bringing the *star* to the graduated side of the brazen meridian; then the number of degrees intercepted between the equator and the point of the *meridian* cut by the *star*, gives its declination; and the degree of the equator, which comes under the meridian together with the *star*, is its right ascension

2. By applying the center of the quadrant of altitude over the pole of the ecliptick, in the same hemisphere with the *star*, and bringing its graduated edge to the *star*; the degree on the quadrant cut by the *star*, is the *star*'s latitude, reckoned from the *ecliptick*; and the degree of the ecliptick cut by the quadrant, its longitude.

3. If we seek the day of the month in the proper calendar on the horizon, we'll find against that day in the circle of signs, the sign and degree the *sun* is in for that day. This done, by finding the same sign upon the ecliptick on the surface of the *globe*, we'll have found the *sun*'s place for that day.

4. The *sun*'s place for the day given being brought to the meridian, the degrees of the meridian intercepted between the equinoctial and that place, are the *sun*'s declination for that day, at noon.

5. Apply the center of the quadrant of altitude, on the pole of the ecliptick, of the same denomination with the latitude, and bring it to the given longitude in the ecliptick; this point is the planet's place: and bringing it to the meridian, its right ascension and declination will be found.

6. To rectify the *globe*, &c. 1. If the place be in north latitude, the north pole must be raised above the horizon; if in the south, the south pole. 2. The quadrant of altitude is to be fixed on the zenith, *i. e.* on the latitude of the place. 3. By means of a compass, or meridian line, the *globe* must be placed in such a manner, as that the brazen meridian may be in the plane of the terrestrial meridian. 4. The degree of the ecliptick the *sun* is in, must be brought to the meridian, and the horary index set to 12: Thus will the *globe* exhibit the face of the heavens for the noon of that day. 5. By turning the *globe* till the index comes to any other given hour: thus will the *globe* shew the face of the heavens for that time.

7. The *stars* and planets are easily known, by means of the *globe*; if, 1. We adjust the *globe* to the state of the heavens for that time. 2. If we look on the *globe* for some one *star*, which we know, *e. gr.* the middlemost *star* in the tail of the *great bear*. 3. If we observe the position of the other most conspicuous *stars* in the same constellation; for by transferring the eye from the *globe* to the heavens, we'll easily note the same there. 4. Thus we may proceed from this to the neighbouring constellations, till we have learned them all.

8. By rectifying the *globe* for the hour of twelve, and bringing the *sun*'s place to the eastern side of the horizon, the number of degrees then intercepted between that degree of the equator now come to the horizon, and the beginning of *aries*, is the *sun*'s oblique ascension The degrees on the horizon intercepted between the east point thereof, and the point wherein the *sun* is, is the ortive, or rising amplitude. The hour pointed to by the index, is the time of the *sun*'s rising. Turning the *globe* till the index points to the present hour, we must lay the quadrant to the *sun*'s place, the degree cut by the quadrant, in the horizon, is the *sun*'s azimuth.

9. The *sun*'s oblique descension, western amplitude, and azimuth, with the time of setting, is found in the same manner, as its oblique ascension, eastern amplitude, &c. excepting that the *sun*'s place must be here brought to the western side of the horizon; as in the former it was to the eastern.

10. The length of day and night is found, 1. By finding the time of the *sun*'s rising; which being numbered from midnight, the double thereof gives the length of the night. 2. By subtracting the length of the night from the whole day, or 24 hours, the remainder is the length of the day.

11. Having adjusted the *globe* to the state of the heavens at twelve o'clock that day, we'll find the eastern amplitude, azimuth, and the time of rising of a *star*, by bringing the *star* to the eastern side of the horizon; and by bringing the same *star* to the western side of the horizon, we'll find its western amplitude, and azimuth, and the time of its setting. The time of rising subtracted from that of setting, leaves the continuance of the *star* above the horizon; and this continuance above the horizon subtracted from 24 hours, leaves the time of

its continuance below the horizon. Lastly, The hour to which the index points when the *star* is brought to the meridian, gives the time of *culmination*, or the transit of a *star*, or *planet*, over the meridian; or that point of its *orbit* wherein it is at its greatest altitude.

12. The altitude of the *sun*, or a *star* for any given hour of the day, or night, is found; 1. By adjusting the *globe* to the position of the heavens, and turning it till the index points at the given hour. 2. Then fixing on the quadrant of altitude at 90 degrees from the horizon, and bringing it to the *sun*'s or *star*'s place, the degrees of the quadrant intercepted between the horizon and the *sun* or *star*, is the altitude required.

13. The altitude of the *sun* by day, or of a *star* by night, being given; the time of that day or night is found, 1. By rectifying the *globe* as in the preceding problem. 2. By turning the *globe* and quadrant till such time as the *star*, or degree of the ecliptick the *sun* is in, cut the quadrant in the given degree of altitude; then does the index point at the hour sought.

14. By rectifying the *globe*, and bringing the quadrant to the given azimuth in the horizon, and turning the *globe* till the *star* comes to the same; the index will shew the time of the day or night.

15. If the pole of the *globe* is rais'd so many degrees above the horizon, as is the elevation of the pole of the place; if the first *star* is brought to the horizon, and the time observed the index points to; if the same be done by the other *star*; then by subtracting the former time from the latter, the remainder is *the interval between the risings of the two stars*.

16. The *crepusculum*, or twilight, is found, by first rectifying the *globe*, and setting the index to the twelfth hour, the *sun*'s place being in the meridian. 2. By noting the *sun*'s place, and turning the *globe* westward, as also the quadrant of altitude, till the point opposite to the *sun*'s place cut the quadrant of altitude in the eighteenth degree above the horizon, the index will shew the time when the twilight commences in the morning. 3. By taking the point opposite to the *sun*, bringing it to the eastern hemisphere, and turning it till it meet with the quadrant of altitude in the eighteenth degree, then will the index shew the time when twilight ends.

An ASTRONOMICAL QUADRANT, (*see* T in the *first plate of* ASTRONOMY) is an instrument usually made of brass, sometimes of wooden bars, only faced with plates of iron, or the like; having its limb curiously divided, diagonally, or otherwise, into degrees and minutes, and even seconds, if possible; with plain sights fixed to one side of it, or, instead thereof, a telescope; and an index moving about the center, carrying either plain sights, or a telescope. These *quadrants* are of principal use, in taking observations of the *sun*, *planets*, or fixed *stars*. The *antients* used only plain sights, but the *moderns* have found it of great benefit to use telescopes instead of them. And the contrivance of moving the index, by the help of a screw on the edge of the limb, and of readily and easily directing it, and the *quadrant* upon its pedestal, to any desired *phænomenon*, by means of the screws and dented wheels, is a still greater improvement of the instrument, whose use is obvious; for it being adjusted, as above, and turned horizontally round on its axis, till, through the moveable telescope, the object be seen to fall in with the point of intersection of the cross bars; the degrees cut by the index give the altitude required.

Gunter's QUADRANT, (*ibid.*) thus called from the inventor's name, *Edmund Gunter*, besides the graduated limb, fixed sights, and a plummet, as the other *quadrants*; has likewise a stereographical projection of the sphere on the plane of the equinoctial, with the eye placed in one of the poles; by which, besides the common uses of other quadrants, several useful questions in *Astronomy* are easily solved, *viz.* To find the *sun*'s meridian altitude for any given day, or the day of the month for any given meridian altitude. 2. The hour of the day. 3. The *sun*'s declination from his place given, and contrarywise. 4. His Right ascension, or contrarily. 5. His azimuth, and contrarywise. 6. The hour of the night, from some of the five stars laid down on the *quadrant*.

1. The thread being laid to the day of the month in the scale next the limb; the degree it cuts in the limb, is the meridian altitude of the *sun*. Thus the thread being laid on the 15th of *May*, cuts 59° 30′, the altitude sought. And contrarily, the thread being set to the meridian altitude, will shew the day of the month.

2. Having put the bead, which slides on the thread, to the *sun*'s place in the ecliptick, the *sun*'s altitude must be observed by the *quadrant*; then, if the thread be laid over the same in the limb, the bead will fall upon the hour required. Thus, suppose on the 10th of *April*, the *sun* being then in the beginning of *Taurus*, we observe the *sun's* altitude by the *quadrant* to be 36°, we place the bead to the beginning of *Taurus* in the *Ecliptic*, and lay the thread over 36° of the limb; and find the bead to fall upon the hour-line marked 3 and 9; accordingly, the hour is either 9 in the morning, or 3 in the afternoon. Again, laying the bead on the hour given, (having first rectified, or put it to the *sun's* place) the degree cut by the thread on the limb,

limb, gives the *altitude*. *Note*, That the bead may also be rectified, by bringing the thread to the day of the month, and the bead to the hour-line of 12.

3. Setting the bead to the *sun's* place in the *ecliptic*, and moving the thread to the line of *declination*, the bead will cut the thread of *declination* required. Contrarily, the bead being adjusted to a given *declination*, and the thread moved to the *ecliptic*, the bead will cut the *sun's* place.

4. We must lay the thread on the *sun's* place in the *Ecliptic*, and the degree it cuts on the limb, is the *right ascension of the sun*. Contrarily, laying the thread on the *right ascension*, it cuts the *sun's* place in the *ecliptic*.

5. Rectify the bead for the time, (as in the second article) and observe the *sun's altitude*; bring the thread to the *complement* of that *altitude*; thus the bead will give the *Azimuth* * sought, among the *Azimuth* lines.

6. Fit the bead to the *star* you intend to observe, and find how many hours it is off the meridian, (by the second article) then from the *right ascension* of the *star*, subtract the *sun's right ascension*, converted into hours; and mark the difference; which difference added to the observed hour of the *star* from the meridian, shews how many hours the *sun* is gone from the meridian, which is the hour of the night. Suppose, for example, on the 15th of *May*, the *sun* being in the 4th degree of *Gemini*, I set the bead to *Arcturus*; and observing his altitude, find him to be in the west, about 52° high, and the bead to fall on the hour-line of 2 afternoon; then will the hour be 11 hours, 50 minutes past noon, or 10 minutes short of midnight. For 62°, the *sun's right ascension*, converted into time, makes 4 hours, 8 minutes, which subtracted from 13 hours, 58 minutes, the *right ascension* of *Arcturus*, the remainder will be 9 hours, 50 minutes; which added to 2 hours, the observed distance of *Arcturus* from the meridian, shews the hour of the night to be 11 hours, 50 minutes.

A SEXTANT, is an *astronomical instrument*, made like a *quadrant*; excepting that its limb only comprehends 60 degrees. The use and application of the *sextant*, is the same with that of the *quadrant*.

Of BAKING.

BAKING is the art of preparing bread, or of reducing meal of any kind into *bread*. Who first invented this useful art, I will not pretend to say: but by the mention of *shew-bread* amongst the *Hebrews*, it was known to the *Levites*, that attended the tabernacle in the wilderness.

Some have ascribed the invention to the *Grecians*; and add, that it passed into *Italy* about the year of *Rome* 583, after the war with *Pyrrhus*. This is certain, the *Cappadocians*, and after them the *Lydians*, and the *Phœnicians*, are the most applauded *bakers* in antiquity.

At *Rome* the *bakers* were held in great esteem, and were incorporated with great privileges, and subjected to certain restrictions.

The fraternity of *bakers*, by the *Roman* laws held their effects in common, and could not dispose of any part of them. Each bake-house had a *patronus*, who had the superintendency thereof; and these *patroni* elected one out of their number each year, who had the superintendance over all the rest, and the care of the college. Out of the body of the *bakers* were every now and then one admitted among the senators.

To preserve honour and honesty in the college of *bakers*, they were expresly prohibited all alliance with comedians and gladiators; each had his shop or bake-house, and they were distributed into fourteen regions of the city. They were excused from guardianship and other offices, which might divert them from their employment.

By the *English* statutes *bakers* are declared not to be handicrafts. No man for using the mysteries or sciences of *baking*, *brewing*, *surgery*, or *writing*, shall be interpreted a handicraft, 22 *H.* 8. *c.* 13.

The *bakers*, by a law enacted in the last sessions of parliament, are prohibited the use of *allum* in their making of bread, under severe penalties.

The forms of *baking*, among the *Europeans*, is reduced to two; the one for *unleavened*, the other for *leavened bread*; though very few, the *Jews* excepted, use, at present, *unleavened bread*; as being too insipid, and even those but in the time of their *passover*, or of some other particular feast.

The other manner of *baking leavened bread*, is called *manchet-baking*; which is done in this manner: the meal, ground and bolted, is put into a trough, and being opened in the middle, to a bushel is put about three pints of warm ale, with barm, and

* The AZIMUTH of the *sun*, or a *star*, is an arch of the horizon, comprehended between the meridian of the place, and any given *vertical* circle. The *Azimuth* is the *complement* of the eastern and western *amplitude* of a *quadrant*.

and ſalt to ſeaſon it: this is kneaded together with the hands through the break, or for want whereof with the feet through a cloth; after having lain an hour to ſwell, it is molded into manchets, which ſcorched in the middle, and pricked a-top to give room to riſe, are *baked* in the oven by a gentle fire.

The common bread *making* is performed thus: the meal being in the trough, ſome leaven (ſaved from a former batch filled with ſalt laid up to ſour, and at length diſſolved in warm water) is ſtrained through a cloth into a hole made in the middle of the heap, and worked with ſome of the flour to a moderate conſiſtence: this is covered up with meal, where it lies all night, and in the morning the whole heap is ſtirred, and mixed together with a little warm water, barm, and ſalt, by which it is ſeaſoned, ſtiffened, and brought to an even leaven; it is then kneaded, or trodden, molded, and *baked.*

In the kneading of the maſs, it muſt be obſerved, that it is not worked too long, elſe it would render the bread heavy, and hinder it to riſe in the oven; neither is it to be worked in too great a hurry, for then the mixture proving imperfect, would fill the bread with lumps of flour, render it harſh, and of an indifferent taſte; part of it being leavened, and the other unleavened; which to avoid, the water muſt be poured by degrees, and the maſs worked by degrees; waiting to pour no more water, till the firſt poured being ſo incorporated with the maſs, by the working of it, till it has brought it to a due conſiſtence, neither too hard, nor too ſoft; and then pour more water upon that maſs already worked, and then the workman approaches, with his hand, new flour, near that maſs, all ready worked, incorporating both together, and ſo on, till the end of the operation. The water muſt be neither too hot, nor too cold; for if too hot, it renders the fermentation through the whole maſs too great, and cauſes a diſagreeable ſourneſs in the bread; if too cold, it hinders the fermentation, which renders the bread heavy, and gives it a ſweet, unpalatable taſte. In winter, the leaven is aways prepared in a warm place, elſe it would have little or no effect; and the maſs, after it has been kneaded, is kept longer before it is put into the oven, than in the ſummer; in order to give time to the leaven to ferment through the whole maſs.

There is an art in heating the oven for the *baking* of bread; for if it is too hot, it hinders the bread from riſing, and makes it almoſt all cruſt; if too cold, inſtead of evaporating the whole humidity, it keeps the greateſt part of it within the maſs, and renders the bread heavy and diſagreeable: therefore a gradual heat is beſt; for then the bread riſing and *baking* by degrees, acquires a due conſiſtence, and a ſavoury taſte.

It muſt be obſerved, alſo, that the leaven, arrived at an extraordinary ſourneſs, is not to be uſed, not even in the ſmalleſt quantity; for it would communicate a very diſagreeable taſte to the whole.

Bisket, (*i. e. bis*, twice, *coctus*, baked) which is a ſort of bread, for the ſervice of the ſea, is made in the ſame manner as other bread, with this ſingle difference, that it paſſes the oven twice. The firſt time it is *baked* to the conſiſtence of common bread, and kept till it has ſweated all its humidity, and then put into the oven again, to dry it quite; otherwiſe it would be ſubject to grow mouldy, and ſour. For long voyages, they bake it four times, and prepare it ſix months before the embarkation.

Ginger-Bread, is a rich ſort of bread, the flavour and taſte whereof are heightened and improved with ſpices, and particularly *ginger*, whence the name. There are various forms and preparations of *ginger-bread.* The following is well recommended. "Into a pound of almonds grate a "penny white loaf, and beat them together; to "the mixture add an ounce of *ginger*, ſcraped "fine, and anniſeed and liquorice in powder, of "each a quarter of an ounce: pour in two or "three ſpoonfuls of roſe-water, and make the "whole into a paſte, with half a pound of ſugar; "mould and roll it, print it and dry it in a "ſtove."

Others make it with treacle, citron, lemon and orange-peel, candied ginger, coriander and carraway ſeed, mixed up with as much flour, as will make it into a paſte.

In all the other parts of the world they have little or no notion of *baking*, except in thoſe parts where the *Europeans* have ſettled, and where they are numerous; every where elſe they follow yet the primitive ſimplicity of baking their bread under the embers; the greateſt part of the eaſtern and weſtern nations having not even the leaſt notion of bread. Eſpecially thoſe who dry their meat by the *ſun*, and eat it without any other cookery, as moſt of the *Tartars.* In the *Weſt-Indies*, and on the coaſt of *Brazil*, ſome *Indian* nations make bread of a ſort of root, they call *caſſave*, or *caſſabre*, which is a ſort of poiſon of itſelf, before its preparation; which is done in this manner; they pound the root, to extract all its juice, in which conſiſts all its malignity; they afterwards dry it in the *ſun*, ſo that it may eaſily be reduced into a ſort of *farina*, or flour, which they mix with water, and mould it into the form of a large pancake, which they bake before the fire. When baked, it is as white as a ſheet of paper; I have eat ſome, and found it very palatable. They could, if they would, make a pretty tolerable good bread of maiſe, which they have in abundance; but they content themſelves with broiling the whole ear upon the coals, and eat it ſo without any other preparation.

Of BOOKS, *and particularly of the* Bible.

BOOK (formed from the *Saxon*, *Boc*, which comes from the Northern *Buech*, a beech tree, on which our anceſtors uſed to write) is the production of wit and learning, digeſted in ſome form or order, and reduced into writing for inſtruction or entertainment; and to have it tranſmitted to poſterity.

Book is diſtinguiſhed from *pamphlet*, and ſingle paper, by its greater length; and from *tome* or *volume*, by its containing the whole writing; which is often divided into ſeveral *volumes*.

Books are commonly divided into *divine* or *ſacred*, and *human books*.

The *divine* or *ſacred books* are either wrote by inſpiration, as the *Pentateuch*, the *Prophets*, the *Books* of *Solomon*, the *New Teſtament*, &c. which ſeveral *books*, collected together, compoſe a whole one, called, The Bible.

The Bible is the moſt valuable, and moſt reſpected of all the *divine*, *ſacred books*, as containing, the firſt precepts, given to *Moſes*, by the Almighty himſelf, amidſt the thunder and lightening of *Mount Sinai*, of the religious worſhip and ceremonies, he was to be adored with upon *earth*, and the firſt articles of a true faith.

The *Bibles* are diſtinguiſhed according to their language, into *Hebrew*, *Greek*, *Latin*, *Chaldee*, *Syriack*, *Arabick*, *Coptick*, &c.

The firſt traduction of the *Bible* is that of the *Septuagint*, made 280 years before the incarnation of *Jeſus Chriſt*, through the care of *Demetrius Phalereus*, under the reign of *Ptolemy Philadelphus*, king of *Egypt*, to perfect the famous library of *Alexandria*, which contained 200,000 *volumes*. This tranſlation was received by the *Jews*; and our Saviour, as well as his Apoſtles, made uſe of it, in the goſpel; but it was corrupted ſoon after the birth of our Saviour, as well by the *Jews*, as through the ignorance of the *Copyiſts*. *Origen* was the firſt, who attempted to purge it of its imperfections, and reſtore it to its priſtine purity. In which noble and uſeful undertaking he was ſucceeded by the martyr *Lucian*. *Heſychius*, likewiſe applied himſelf to it, and St. *Jerome* perfected it.

Antient authors do not agree among themſelves as to the manner of this tranſlation. Some ſay that the *ſeventy* worked upon it ſeparately, and that comparing afterwards their ſeveral verſions together, they were all found alike in all things. Others pretend, that they worked at it two and two. And others, that they did it altogether, conſulting one another on the moſt difficult paſſages. The firſt manner is conſidered as a fable, and as mere romance, by a great many very learned divines.

We have at preſent *Bibles*, in the ſeveral languages above-mentioned, both manuſcript and printed, and almoſt all according to the verſion of the *Septuagint*, but very imperfect. *F. Simon* is of opinion that the oldeſt manuſcript *Hebrew Bibles* are not above 6 or 700 years: nor does *Rabbi Monahem*, who quotes a vaſt number of them, pretend that any exceed 600 years. The beſt are thoſe copied by the *Jews* of *Spain*, and the moſt common thoſe copied by the *Jews* of *Germany*.

The *Bible* was tranſlated into *Greek* by *Aquila*, under the emperor *Adrian*; but that verſion was very imperfect and full of omiſſions. *Theodotion* publiſhed a new one in 189. *Theodotion* had been a diſciple of *Tatian*; he followed *Marcion*, and from his ſchool, paſſed to the ſynagogue of the *Jews*, where he was received on condition that he ſhould tranſlate the *Old Teſtament* into *Greek*, which he did with more truth and ſincerity than *Aquila* had done, though there are many additions and omiſſions, which he has marked with a great deal of care and attention. The numerous editions we have of the *Bible* in *Greek* can all be reduced to three, *viz.* that of *Complutum*, or *Alcala de Henares*, that of *Venice*, and that of *Rome*. The firſt publiſhed in 1515 by Cardinal *Ximenes*, and inſerted in the *Polyglot Bible*, uſually called the *Complutesſian Bible*. This edition is one of the beſt extant, and has been reprinted in the *Polyglot Bible* of *Antwerp*, in that of *Paris*, and in the 4to *Bible*, commonly called, *Bible of Vatable*. The ſecond is that of *Venice* in 1518, reckoned full of faults of the *Copyiſts*, as having been printed juſt as it ſtood in the manuſcript: it has been reprinted at *Straſburgh*, *Baſil*, *Francfort*, and other places. The beſt of them all is the third, printed at *Rome*, in 1587, with *Greek Scholia*, collected from the manuſcripts in the *Roman* libraries, by *P. Morin*. This fine edition has been reprinted at *Paris* in 1628, by *J. Morin*, prieſt of the oratory, who has added the *Latin* tranſlation, which in the *Roman* was printed ſeparately, with *Scholia*. The *Greek* edition of *Rome* has been printed in the *Polyglot Bible* of *London*; to

which

which are added at bottom the various readings of the *Alexandrian* manuſcript.

The *Latin Bibles* are alſo reduced to three claſſes, *viz.* the antient *Vulgate*, tranſlated from the *Greek Septuagint*; the *modern Vulgate*, the greateſt part of which is done from the *Hebrew* text; and the new *Latin* tranſlations, done alſo from the *Hebrew* text in the ſixteenth century.

The *antient Vulgate* is of very great antiquity in the *Latin* church, ſince it was the common, or vulgar verſion, before St. *Jerome* made a new one, whence it is named *Vulgate*. The *Vulgate* was held by St. *Auguſtine* to be preferable to all the other *Latin* verſions then extant; as rendering the words and ſenſe of the ſacred text more cloſely and juſtly than any of the reſt.

We have, a conſiderable number of editions of the *modern Vulgate*. That inſerted by the order of Cardinal *Ximenes*, in the *Bible* of *Complutum*, is one of the beſt, as well as that of *R. Stephens*, printed in 1540, and reprinted in 1545; in which are added, on the margin, the various readings of ſeveral *Latin* manuſcripts, which he had conſulted. This edition was reviſed afterwards by the doctors of *Louvain*, who likewiſe added to it the various readings of ſeveral *Latin* manuſcripts.

The correction of Pope *Clement* VIII, in 1592, is now the ſtandard of all the *Roman* churches; from this the *Bibles* of *Plantin* were done, and from thoſe of *Plantin* all the reſt.

There are great numbers of *Latin Bibles*, of the third claſs, comprehending the verſions from the originals of the *ſacred books* made within theſe 200 years. The firſt is that of *Santes Pagninus*, a *Dominican*, printed at *Lyons*, in 4to, in 1528; much eſteemed by the *Jews*. This the author improved in a *ſecond edition*. In 1542, there was a beautiful *edition* of the ſame at *Lyons*, in folio; and *R. Stephens* reprinted it, with the *Vulgate*, in 1557. There is alſo another *edition* of 1586, in *four columns*, under the name of *Vatable*. This verſion of *Pagninus*, corrected by *Arius Montanus*, was inſerted in the *Polyglot* of *Philip* II. and ſince in that of *London*.

The *Samaritan Bible*, which admits no more for holy Scripture than the *Pentateuch*, or five books of *Moſes*, being the moſt antient of all, deſerves alſo the firſt rank. This verſion has never been printed alone, nor any where but in the *Polyglots* of *London* and *Paris*. This *Samaritan Pentateuch* differs in ſome reſpect from that of the *Jews*, and is written in different characters, called *Samaritan Characters*; which *Origen*, St. *Jerome*, and other fathers, and criticks, antient and modern, take to be the primitive characters of the antient *Hebrews*, though others maintain the contrary.

What we call *Chaldee Bibles*, are not properly a ſtrict verſion of the ſcriptures, but only gloſſes and paraphraſes upon it, which the *Jews* call *Targum*; for as during their long captivity in *Babylon* they had forgot their antient language the *Hebrew*, and now underſtood nothing but the language of their maſters, the *Chaldeans*, there was a neceſſity of explaining the prophets in that language; and to this neceſſity is owing the firſt beginning of the *Chaldee Paraphraſe*, to make the ſenſe of the text underſtood. Each doctor made a paraphraſe of ſome part thereof in the vulgar tongue; and as theſe ſeveral interpretations, in time, became very voluminous, certain *Rabbins* undertook to collect them together, and this collection they call the *Targum*. Though they do not agree about the antiquity of the *Targum*; for the more modern *Jews*, having blended their own comments, with thoſe of the antients, no certain age or æra can be fixed for the whole work.

Widmanſtradius printed, at *Vienna*, in 1562, the whole *New Teſtament* in *Syriac*, in a beautiful character: After him there were ſeveral other editions; and it was inſerted in the *Bible* of *Philip* II. with a *Latin* tranſlation. *Gabriel Sionita* alſo publiſhed a beautiful *Syriac* edition of the *Pſalms* at *Paris*, in 1525, with a *Latin* interpretation. The whole *Bible* is printed in *Syriac* in the *Polyglots* of *London* and *Paris*. In which two *Polyglots* there are alſo *Arabick* verſions of the whole Scriptures, that of the *Old Teſtament* being attributed by ſome learned men to *Saadias*; they give for reaſon, that *Aben Ezra*, a great antagoniſt of *Saadias*, quotes ſome paſſages of his verſion, which are the ſame with thoſe of the *Arabick* verſion in the *Polyglots*; yet others are of opinion that *Saadias*'s verſion is not extant. *Juſtinian*, biſhop of *Nebio*, printed at *Genoa* in 1516, an *Arabick* verſion of the *Pſalter*, with the *Hebrew* text and *Chaldee* paraphraſe, adding *Latin* interpretations. In 1672 there was printed at *Rome*, by order of the congregation *de propagandâ fide*, an entire *Arabick* edition of the *Old Teſtament*. The *Arabick* verſion of the *Pentateuch*, of *Erpenices*, called alſo the *Pentateuch* of *Mauritania*, as being made by the *Jews* of *Barbary*, and for their uſe, is eſteemed literal, and very exact; as well as the four Evangeliſts, publiſhed at *Rome* in *Arabick*, with a *Latin* verſion, in 1591; which have been ſince reprinted in the *Polyglots* of *London* and *Paris*. We have ſeveral authentick manuſcript copies of the *Bible* in *Coptick* in the great libraries, eſpecially that of the king of *France*.

The *Æthiopians* have alſo tranſlated the *Bible* in their language; of which we have a very accurate *New Teſtament*, printed at *Rome* in 1548, though found fault with by thoſe, who diſcover ſomething in in it, which rises in judgment against them. The same has been reprinted in the *English Polyglot*, * as well as the *Psalms*, *Canticles*, some chapters of *Genesis*, *Ruth*, *Joel*, *Jonah*, *Zephaniah*, and *Malachi*, all in the same language.

Some of the *Armenian* doctors about the time of St. *Chrysostom*, made an *Armenian* version of the *Bible* from the *Greek* of the *seventy*, which was first printed entire into 4to at *Amsterdam*, in 1664, by one of their bishops, with the *New Testament* in 8vo.

The *Persian Pentateuch*, printed in the *London Polyglot*, is the work of *Rabbi Jacob*, a *Persian Jew*; but we have nothing now remaining of that antient *Persian* version of the old *Bible*, mentioned by some of the fathers. There was also a version made of the whole *Bible* (the book of *Kings* excepted) into *Gothick*, by *Aphilas*, a *Gothick* bishop; the four Evangelists were printed in 4to at *Dort*, from an antient manuscript in 1665; having nothing else remaining of that version. The reason given for *Aphilas* omitting the book of *Kings* is, his being afraid that the frequent mention of the wars therein should inspire too much of the military genius into his countrymen.

Con. Basil, duke of *Ostravia*, had an entire *Bible* in the *Sclavonick* tongue, printed at *Ostravia*, in *Volhinia*, in the year 1581, at his own expence, for the common service of all Christians, who speak the *Sclavonick* language, whereof the *Muscovitish* is a dialect, for which reason this version is commonly called the *Muscovite Bible*.

It would be endless to rehearse here the vast number of versions of the *Bible* in other vulgar tongues, as *English*, *French*, *German*, *Spanish*, *Italian*, *Dutch*, &c. since we have so many catalogues of them in several authors. The first essay towards the *English* translation was made by the celebrated Dr. *Wickliff* a few years before the Reformation; who translated the *New Testament*. But there was no *complete* BIBLE in our tongue till *Miles Coverdale* obliged the Reformers with one in the reign of *Henry* VIII.

The books of the *Bible* have not always been of an equal authority. St. *Jerome* assures us that the antient canon, or catalogue of the books of the *Old Testament*, made by the *Jews* under *Esdras*, in a great assembly of their doctors, which they call by way of eminence, *the great Synagogue*, consisted of no more than twenty-two books; though it is pretended by some authors, that the *Jews* themselves agree that they put books therein, which had not been so before the *Babylonish* captivity: such are those of *Daniel*, *Ezekiel*, *Haggai*, and those of *Esdras* and *Nehemiah*.

Some of the fathers have, besides, distinguished the sacred writings into *Proto-canonical*, and *Deuterocanonical*. The *Proto-canonical* are those whose authority has never been suspected, and the *Deutero-canonical*, those, whose canonicity was doubtful; for which reason, they were added to the canon after the rest. The *Deutero-canonical books*, in the modern canon, are the books of *Esther*, either the whole, or at least the seven last chapters thereof; the epistle to the *Hebrews*; that of *James*; and that of *Jude*; the second of St. *Peter*; the second and third of St. *John*; and the *Revelations*. The *Deutero-canonical* parts of *books*, are in *Daniel*, the hymn of the *three children*; the prayer of *Azariah*; the histories of *Susannah*, of *Bel* and the *Dragon*; the last chapter of St. *Mark*; the bloody sweat, and the appearance of the angel, related in St. *Luke*, chap. xxii. and the history of the adulterous woman in St. *John*, chap. viii..

Among the *canonical books* of the *Old Testament*, the *Pentateuch*, or five books of *Moses*, viz. *Genesis*, *Exodus*, *Leviticus*, *Numbers*, and *Deuteronomy*, are the first in order, as being, likewise, the first for antiquity, since there is no authentic account of any other *book*, either sacred, or profane, having been written before them. The whole *Pentateuch* is attributed to *Moses*, as author thereof; though father *Symon*, in his critical history of the *Old Testament*, produces several passages to prove that the legislator of the *Jews* was not wholly the author of the *Pentateuch*, as we now have it; which sentiment is very well supported by the interpolations at the end of the *Pentateuch*; since it is absurd to suppose *Moses* the author of the account of his own death and burial, and of the comparison between him and the succeeding prophets in *Israel*. *Esdras* is thought the author of the interpolated passages, being supposed to have published the *Old Testament*, or at least a part of it, corrected, and enlarged, on his return from the *Babylonish* captivity. See Dr. *James*'s scholastic history of the *Canon* of *scripture*, and *Huetii* Demonstra Evangelica.

At the head of the *Pentateuch* stands the *book* of *Genesis*, which the *Hebrews* call *Bereschith*, because it begins with that word, which in their language signifies in *principio*, in the beginning; and the *Greeks Genesis*, Γένεσις, production, generation; because it begins with the history of the production and generation of all beings. *Moses* is thought to be the author of the *Genesis*, and it contains the relation of 2367 year, *viz.* from the beginnig of the world to the death of *Joseph*. The *Jews* are forbid to read the beginning of *Genesis* and the beginning of *Ezekiel*, before thirty years of age.

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* From πολυ many, and γλῶττα lang uage.

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The *Exodus*, by the *Hebrews* called *Veellee Semoth*, *hæc nomina*, these are the names; which are the initial words of the *book*; and by the *Greek* Ἔξοδος, which literally imports a *going out*, or *journey*, because the history of the *Israelites* passage out of *Egypt* is related therein. The *Exodus* contains, besides, the story of what was transacted into *Egypt*, from the death of *Joseph* to the delivery of the *Jews*; as well as what passed in the wilderness, and particularly at mount *Sinai*, to the building of the tabernacle.

The *Leviticus*, called by the *Jews*, *Vajickra*; and the *Numbers*, *Vajiedabber*; contains nothing else but the ceremonial and other laws; and the *Deuteronomy*, *Elleh haddebarim*, is a repetition, or recapitulation of the law, which *Moses* had before delivered them at large. And hence *Deuteronomy* is still called by the *Rabbins*, *Repetition*. They likewise call it, *The book of reprimands*, on account of the 28th chapter, which is full of blessings promised to such as keep the law, and of curses threatened to such as transgress it. It is pretended, that *Deuteronomy* was written the fortieth year after the delivery from *Egypt*, in the country of the *Moabites*, beyond *Jordan*; *Moses* being then in the 120th year of his age. It contains in *Hebrew* eleven Parasches, though only ten in the edition of the *Rabbins* at *Venice*; twenty chapters, and 955 verses. In the *Greek*, *Latin*, and other versions, it contains 34 chapters. The last is not of *Moses*; some say it was added by *Joshua*, immediately after *Moses*'s death, which is the most probable opinion. It was the *Greeks*, when they first translated the law, that gave the five parts into which it was divided, the name of *Genesis*, *Exodus*, *Leviticus*, *Numbers*, and *Deuteronomy*, which is the reason why all these names are *Greek*, except the *Leviticus*, which is *Hebrew*; for it does not appear that *Moses* made any division of what he wrote, into *books*; or that he gave different names and titles to the different parts of his work: nor do the *Jews*, even at this day, distinguish them in the copies they use in the Synagogues; but write them all running as one single work, without any other distinction beside that of little and great Parasches; though in other copies, used by private persons, they are divided into five parts, as among us; but they give them no other name, but the first word wherewith each division begins; much as we do in quoting a decree, or chapter of the canon law

Joshua is the next in order of the *canonical books* of the *Old Testament*, and contains what happened to the *Israelites* under the conduct of that famous general *Joshua* whom *Moses* had appointed for his successor in the government of the people. The author of this *book* is not known, no more than that of the following, called the *Judges*, which is a collection of several little histories, which at first were separate, but were afterwards collected by *Esdras*, or *Samuel*, into a single volume; and, in all likelihood, were taken from the antient journals, annals, or memoirs, composed by the several Judges.

The canonicity of the *book* of *Job* has been very much disputed among the learned divines; neither can they agree, as to the author of that *book*; though the most common opinion is, that *Moses* published that work during the captivity of the *Israelites* in *Egypt*, to give them an example of patience in their miseries. The great erudition which appears throughout the whole, is certainly worthy that great man, who had been instructed in all the sciences of the *Egyptians*; but the learned in the *Hebraick* tongue, pretend, that there are several terms in it, which were not in use till after *David*; and that it is full of phrases of the *Idumean* language; which makes them conjecture, that the author who composed it was of that country. Some have believed, that there has never been such a man as *Job*; that the author of the *book*, which goes under his name, had invented the subject; but how does that sentiment agree with the prophet *Ezekiel*, who mentions *Job* with *Noah*? and with St. *James* in his epistle, chap. v. who proposes him to the *Christians* as a model of patience they are to follow, when persecuted for the faith?

Sixteen *prophets* are ranked among the *canonical books*, four *greater*, so called from the length, or extent of their writings; and twelve *lesser*, from the shortness of their writings. The *greater prophets* are *Isaiah*, *Jeremiah*, *Ezekiel*, and *Daniel*; and the *lesser*, *Hosea*, *Joel*, *Amos*, *Obadiah*, *Jonah*, *Micah*, *Nahum*, *Habakkuk*, *Zephaniah*, *Haggai* *Zechariah*, and *Malachi*. In the *Greek* church the *lesser prophets* are placed in order before the great ones, apparently because many of the *lesser prophets* are more antient than the *greater*. The *Greeks*, also, as well as the *Jews*, ranked *Daniel* among the *lesser prophets*; the *Jews* pretending that he is no more to be ranked among the *prophets* than *David*: not but that both the one and the other foretold many important things, but because their manner of life differed from that of the other *prophets*.

The *canonical books* of the *New Testament*, are the *four Evangelists*, the *Apocalypse*, or *Revelations*, the *Acts of the Apostles*, and the *epistles of St.* Paul, *St.* Peter, *St.* Jude, *and St.* James.

Among the *four Evangelists*, the *gospel* of St. *Matthew* is placed the first. He wrote it in *Hebrew*, (*Anno Christ*. 41. and the third of the Emperor *Caligula*) for the instruction of the *Jews* who believed in *Christ*, the actions of whose humanity

manity are particularly described therein; it is for that reason, that St. *Matthew* is represented, among the four Evangelists, under the figure of a man. His gospel was so much esteemed, from the time of its publication, that St. *Barnabas* us'd to carry always a copy of it along with him in all his travels, with which he was buried, and which was found on his stomach when the place of his sepulchre was discovered under the Emperor *Zeno*. The *Nazarenes* kept it a long while without making any alteration in it; and it was from them St. *Jerome* had a copy of it, in order to translate it into *Latin*. But in process of time it was corrupted, as well by the *Nazarenes*, as by the *Ebionites*, the *Corinthians*, and *Carpocratians*, who took occasion from the human genealogy described therein, to deny the divinity of *Christ*. St. *Jerome* says, that in his time the *Hebrew* original was kept in the library of *Cæsarea*.

St. *Mark* wrote his gospel by St. *Peter*'s order, who had took a particular care to inform him of the actions and miracles of *Jesus Christ*. *Tertullian* says, that in his time it was called the *Gospel of St. Peter*. It is an abridgment of that of St. *Matthew*, St. *Jerome*, St. *Augustine*, and St. *Chrysostom*, are of opinion, that the original is *Greek*; and Cardinal *Baronius*, that St. *Mark* writing the history of *Christ* for the use of the *Romans*, he must have done it in a language they understood; and that in several places of his gospel there are locutions entirely *Latin*; perhaps while St. *Mark* was at *Aquileia*, (if we believe an old tradition which is not warranted by good authors) he translated into *Greek* the gospel he had wrote in *Latin*. At *Rome*, the *Greek* tongue was very common, since St. *Paul* wrote to the faithful in that language; but *Suetonius* assures us, that it had been much discredited by the Emperor *Claudius*, in whose time St. *Mark* wrote.

St. *Luke*'s gospel was wrote against the errors of several hereticks, which, himself says at the beginning, was the occasion of his writing it; and that he has learned the things he is a going to recount, from those who had seen them, and who had been the first ministers of the word, meaning the apostles, and St. *Paul* in particular, to whom he had been given, by the churches, for a companion in his travels. He mentions several things, in his gospel, of the birth, preaching, and miracles of *Christ*, which the other evangelists say nothing of; even his style is more elegant than theirs.

St. *John* wrote his at the intreaty of the bishops of the oriental church, to refute the errors of *Ebion* and *Cerinthus*.

St. *Luke* is the author of the *Acts of the Apostles*. The principal design of this work, is the history of St. *Paul*, though he has omitted several of the most important actions of that apostle, which we find in his epistles.

The epistle of St. *Paul* to the *Romans*, which is the first in order, was wrote at *Cenchrea*, the port of *Corinth*. This epistle contains the fundamental truths of the *christian* religion, the corruption of human nature by *Adam*'s sin, the reparation by the grace of *Christ*, the efficacy of that remedy, the secret of his eternal election, which he founds entirely on the will of God, who, of the same mass of corruption, forms vessels of honour, and vessels of ignominy, without having the least right to ask him the reason of that difference. He proposes to himself all the objections, which human pride can make against that choice; but instead of resolving them, he has recourse to the unscrutability of God's judgments, which are to be respected by mankind with humility, without attempting to fathom them with pride, as if the creator owed something to those who are all born in the same condemnation by the original sin, and might, without injustice, be left in it.

The apostle wrote the first epistle *to the Corinthians* at *Ephesus*; and at *Rome* those to the *Ephesians*, *Philippians*, *Colossians*, the second epistle to *Timothy*, and the famous epistle to the *Hebrews*; wherein, by the divine explication of the priesthood of *Christ*, he shews his profound erudition in the law of *Moses*, as well as in the sublime truths of the gospel. This epistle has been a subject of great controversy among the learned, who could not agree as to the author thereof, nor understand the *sacrifice* mentioned therein. From *Macedon* he wrote the first to *Timothy*.

The antient fathers have been long divided about the *Apocalypse*, or *Revelation*. The antient fathers, both *Greeks* and *Latins*, have received this *book* for *canonical*, though attributed to another *John*. St. *Jerome* says, that, in his time, the *Greek* churches questioned if it had been wrote by St. *John* the evangelist. St. *Basil*, and *Gregory Nazianzen*, absolutely rejected it, and the council of *Laodicea* never mention it in their canon of the sacred writings. *Dionysius Alexandrinus* censures it as written in bad *Greek*, and even finds solecisms and barbarisms in it, in abundance: though he allows it to contain a mystick sense, which, he says, he admires, even where he does not understand it.

On the other hand, St. *Justin*, *Irenæus*, *Theophilus Antiochenus*, *Melito*, *Apollonius*, *Clemens Alexandrinus*, and *Tertullian*, make no doubt of its being canonical. The third council of *Carthage* held in

397, placed it in the canon of the *New Teſtament*; and the churches both of the eaſt and weſt have acknowledged it ever ſince. Of all their objections againſt the authority of this book, that ſeems the beſt grounded, which is drawn from thoſe words, *c.* ii. *v.* 18. *write to the angel of the church of* Thyatira; there was not, ſay they, any *Chriſtian* church at *Thyatira* at that time. St. *Epiphanius*, who grants them this point, is forced to have recourſe to the prophetick ſpirit, as if St. *John* had foreſeen there would be a church there in courſe of time. Several orthodox writers have rejected the *Apocalypſe*, as countenancing the reveries of *Cerinthus* touching the carnal reign of *Chriſt* on earth.

In the firſt century of the church, there were a great many other books attributed to the apoſtles, *viz.* the Acts, Goſpel, Apocalypſe, and Judgment of St. *Peter*. The Goſpel and Apocalypſe of St. *Paul*; his rapture to heaven, forged by the *Cainites*; his Acts; a third Epiſtle to the *Corinthians*, and to the *Theſſalonians*, and one to thoſe of *Laodicea*. A new Apocalypſe was attributed to St. *John*; *Cerinthus* being ſuſpected to have been the author thereof. St. *Thomas*, St. *Bartholomew*, St. *James the minor*, St. *Matthias*, St *Thadee*, and St. *Barnabas*, were preſented with each his goſpel. *Chriſt* himſelf was not ſpared by the impoſtors of thoſe times, for under his name was publiſhed a book entitled, *Of the magick art*, addreſſed to St *Peter* and to St. *Paul*.

Books are certainly of divine invention, ſince the oldeſt we have any warranted account of, and which conſequently has been the firſt, is the Decalogue given to *Moſes* by God himſelf, who wrote it on ſtones. Men afterwards taking the hint from it began to write *books* likewiſe, but on different matters; for inſtead of ſtones they made uſe of parts of vegetables for matter of their *books*, as of the leaves and barks; eſpecially the leaves of palm-trees, and the rinds and barks of *Telia* or *Philyra*, and the *Egyptian papyrus*; which continued long the common matter of *books*; inſomuch that moſt of the names and terms belonging to *books*, in moſt languages, are taken thence: as the *Greek Bibles*, the *Latin liber*, *codex*, *folium*, *tabulæ*, and the *Engliſh book* itſelf. We may add, that barks appear ſtill in ſome meaſure retained for *books* in certain of the *northern* countries, as among the *Calmuck Tartars*, where a library was lately diſcovered by the *Ruſſians*, of an unuſual form as well as matter; the *books* were exceedingly long, but no breadth; the leaves were thick, and made of barks of trees, ſmeered over with a double varniſh; the ink or writing being white on a black ground.

By degrees wax, then leather, were introduced, eſpecially the ſkins of goats and ſheep, of which at length parchment was prepared; then lead came in uſe; alſo linen, ſilk, horn; and *laſtly* Paper itſelf.

We learn from ſcripture that the firſt *books* were in form of blocks and tables, under the appellation of *Sepher*, which the *Septuagint* render a ξωνες, ſquare tables, of which form the *book* of the covenant, *book* of the law, *book* or bill of divorce, *book* of curſes, &c. appear to have been. But when flexible matter came to be wrote on, they found it more convenient to make their *books* in form of rolls, called by the *Greeks*, κολλακια, by the *Latins*, *Volumina*, which appear to have been in uſe among the antient *Jews*, as well as *Grecians*, *Romans*, *Perſians*, and even *Indians*. The rolls or volumes, were compoſed of ſeveral ſheets, faſtened to each other, and rolled upon a ſtick, or *umbilicus*; the whole making a kind of column or cylinder, which was to be managed by the *umbilicus*, as a handle; it being reputed a kind of crime to take hold of the roll itſelf. The outſide of the volume was called *frons*, the ends of the *umbilicus*, *cornua*, horns; which were uſually carved; and adorned, likewiſe, with bits of ſilver, ivory, or even gold and precious ſtones. The title, Συλλαβος, was ſtuck on the outſide. The whole volume, when extended, might make a yard and a half wide, and fifty long.

Of ſuch *books* did the libraries chiefly conſiſt, till ſome centuries after *Chriſt*. The form which, obtains among us, is the ſquare, compoſed of ſeparate leaves; which was alſo known, though little uſed among the antients, having been invented by *Attalus*, King of *Pergamus*, the ſame who alſo invented parchment; but it has now been ſo long in poſſeſſion that the oldeſt manuſcripts are found in it. *Montfaucon* aſſures us, that of all the antient *Greek* manuſcripts he has ſeen, there are but two in the roll-form, the reſt being made up much after the manner of the modern *books*.

To the form of *books* belongs alſo the œconomy of the inſide; or the order and arrangement of points and letters into lines and pages, with margins, and other appurtenances; which has undergone many changes. At firſt the letters were only divided into lines, then into ſeparate words; which by degrees were noted with accents, and diſtributed by points and ſtops into periods, paragraphs, chapters, and other diviſions. In ſome countries, as among the Orientals, the lines began from right, to run to the leftwards, in others, as the *northern* and *weſtern* nation, from the left to the rightwards; others, as the *Grecians*, followed both directions alternately, going in the one and returning in the other, called *Bouſtrophedon*. In moſt countries the lines

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run from ſide to ſide of the page ; in ſome, particularly the *Chineſe*, from top to bottom. Again, the page in ſome is entire and uniform ; in others divided into columns ; in others diſtinguiſhed into text and notes, either marginal, or at the bottom ; uſually it is furniſhed with ſignatures and catchwords ; ſometimes alſo with a regiſter, to diſcover whether the *book* be compleat. To theſe are occaſionally added the apparatus of ſummaries, or ſide notes ; the embelliſhments of red, gold, or enamelled initial letters, head-pieces, tail-pieces, eſſigies, ſchemes, maps, and the like. The end of the *book*, now denoted by *Finis*, was antiently marked with a <, called *coronis*, and the whole frequently waſhed with an oil drawn from cedar, or citron chips, ſtrewed between the leaves to preſerve it from rotting. There alſo occurs certain formula's at the beginning and end of *books* : as among the *Jews*, the words, *eſto fortis*, which we find at the end of the *books* of *Exodus*, *Leviticus*, *Numbers*, *Ezekiel*, &c. to exhort the reader to be courageous, and proceed on the following *book*. The concluſions were alſo often guarded with imprecations againſt ſuch as ſhould falſify them ; of which we have an inſtance in the *Apocalypſe*.

Books, with regard to their manufacture, may be divided into *manuſcripts* ; thoſe written with the hand, whether originally by the authors, called *Autographs*, or at ſecond-hand, by *Librarii*, or *Copyiſts*, &c. *Printed*, thoſe wrought off from the preſs. *Books* in *quires*, or *ſheets*, thoſe not bound, or ſtitched. *Books* in *folio*, thoſe wherein a ſheet is folded but once, or makes two leaves or four pages. *Books* in 4*to*, where it makes four leaves ; in 8*vo*, where eight ; in 12*mo*, where twelve ; in 16°, where ſixteen ; and in 24°, where twenty-four.

There have been erected, almoſt ever ſince the firſt invention of *books*, at leaſt from the time they began to increaſe in number, particular places for their receptions, which places, in proceſs of time, have been changed into publick edifices, called libraries, whoſe origin is by ſeveral authors attributed to the *Hebrews* ; from whom the other nations took the hint, and *Oſmanduas*, King of *Egypt* firſt ; who according to *Diodorus*, had a library built in his palace, with this inſcription over the door, Ψυχης Ιατρειον; nor were the *Ptolemy*'s, who reigned in the ſame country, leſs curious and magnificent in *Books*. *Eſdras*, v. 17. ſpeaks of a library of the Kings of *Perſia*, which ſome imagine to have conſiſted of the hiſtorians of that nation, and of memoirs of the affairs of ſtate ; but in effect, it appears rather to have been a depoſitory of laws, charters, and ordinances of the Kings. The *Hebrew* text calls it the *houſe of treaſures*, and afterwards the *houſe of the rolls*, where the treaſures were laid up. We may with more reaſon call that a *library*, mentioned in the ſecond of *Eſdras*, to have been built by *Nehemia*, and in which were preſerved the *books* of the *prophets* of *David*, and the letters of their Kings.

The tyrant *Piſiſtratus* was the firſt, who erected a library at *Athens*, though *Strabo* refers the honour of it to *Ariſtotle*. *Xerxes* tranſported that of *Piſiſtratus* into *Perſia*, which was afterwards brought back by *Seleucus Nicanor* to *Athens*, long after it was plundered by *Sylla*, and re-eſtabliſhed by *Adrian*. *Plutarch* informs us, that under *Eumenes* there was a library at *Pergamus*, containing 200,000 *books*. *Tyrannion*, a celebrated grammarian, contemporary with *Pompey*, had a library of 3000 volumes. That of *Alexandria*, according to *A. Gellius*, contained 700,000 volumes, all in rolls, burnt by *Cæſar*'s ſoldiers. *Conſtantine*, and his ſucceſſors, erected a magnificent one at *Conſtantinople* ; which, in the eighth century contained 300,000 volumes, all burnt by order of *Leo Iſaurius* ; and among the reſt, one wherein the *Iliad* and *Odyſſee* were written in letters of gold, on the ſkin of a ſerpent.

The moſt celebrated libraries of antient *Rome* were the *Ulpian* and the *Palatin*. They alſo boaſt much of the libraries of *Paulus Æmilius*, who conquered *Perſeus* ; of *Lucillius Lucullus*, of *Aſinius Pollio*, *Atticus*, *Julius Severus*, *Domitian*, *Serenus*, *Pamphilus Martyr*, and the Emperors *Gordian* and *Trajan*.

St. *Jerome*, *Anaſtaſius*, and others, inform us, that antiently every large church had its library, which is yet practiſed in ſeveral chriſtian countries ; eſpecially in the Abbeys and other Monaſteries ; each of which has its library, more or leſs numerous. Moſt of thoſe libraries are publick ones ; that is to ſay, that the curious may reſort thither, at any time, and entertain themſelves with what *book* they pleaſe, which can be met with in that library, without coſting them any thing, if even they were to copy whole volumes. The moſt antient, moſt famous, and moſt rich in original manuſcripts, and moſt numerous of the whole world, is that of the King of *France*, at the ſame place, began by *Francis* I. augmented by Cardinal *Richelieu*, and compleated by M. *Colbert*, to which the learned and curious are alſo permitted to reſort.

The next to this is that of the *Vatican* at *Rome*, founded by Pope *Nicholas* in 1450 ; and though it had been deſtroyed ſince by the conſtable *De Bourbon*, in the taking of *Rome*, it was reſtored to its priſtine ſplendor, by Pope *Sixtus* V. and conſiderably enriched with the ruins of that of *Heidelberg*, plundered by Count *Tilly* in 1622.

The Emperor's library at *Vienna*, according to *Lambecius*, conſiſts of 80,000 volumes, and 15,940 curious medals. That erected at *Florence* by *Coſmo de Medicis*, is ſaid to be one of the moſt compleat in *Europe*, over the gate whereof is wrote, *Labor abſque labore*.

The *Bodleian Library*, at *Oxford*, exceeds that of any Univerſity in *Europe*, and even thoſe of all the Sovereigns of *Europe*, except the King of *France*, and the Emperor of *Germany*, which are each of them older by a hundred years. It was firſt opened in 1602, and has ſince found a great number of benefactors; particularly Sir *Robert Cotton*, Sir *H. Savil*, Archbiſhop *Laud*, Sir *Kenelm Digby*, Mr. *Allen*, Dr. *Pocock*, Mr. *Selden*, and others. The *Vatican*, the *Medicean*, that of *Baſſarion* at *Venice*, exceed the *Bodleian* in *Greek* manuſcripts, and the *Bodleian* exceeds them in Orientals. The *Cotton library* conſiſts wholly of manuſcripts, particularly of ſuch as relate to the hiſtory and antiquities of *England*, which, as they are now bound, make about 1000 volumes. It is greatly increaſed by the addition of Sir Hans Sloane's *Muſeum*. Moſt of the *Engliſh* nobility and gentry uſed to have an excellent taſte for learning, and a great number of them have a ſelect *library* of their own, which conſiſt of the beſt authors both antient and modern.

BOOK-BINDING.

BOOK-BINDING, is the art of gathering, and ſewing together the ſheets of a book, and covering it with a back.

The art of *binding* books, when firſt the ſeveral ſheets of the writings of authors were collected together, was not attended with great difficulties; for the leaves were only glued together, and rolled on round pieces, or cylinders of wood; which manner of *book-binding*, whoſe invention is attributed to the *Egyptians*, was continued till long after the age of *Auguſtus*, and is ſtill retained by the *Jewiſh* Synagogues, where they continue to write the books of the law on vellums ſewed together, making, as it were, only one long page, with two rollers, and their claſps of gold or ſilver at their extremities, the whole book being wrapped up in a piece of ſilk, which ſerves as a cover to it.

But as this manner of *binding* books is attended with many inconveniencies, one of the *Attali*, Kings of *Pergamus*, invented the form now in uſe, of ſquare *binding*, or of ſewing ſeveral quires one over another, as more commodious to the reader, who can open and ſhut his *book* in an inſtant, and without the leaſt difficulty, and without the leaves being expoſed to wear out ſo ſoon as when rolled up, eſpecially of books written or printed on paper.

The ſeveral tools or inſtruments belonging to this profeſſion, are, *folding-ſticks*, *hammers*, to beat the leaves, and turn the back, a *ſewing-preſs*, a *cutting-preſs*, *ſheers*, a *plough*, *knives*, a *ſmoother*, *bruſhes*, *dog's-tooth*, *punchions*, and little cylinders of braſs engraven in *relievo*, in various forms and devices, for ornaments; *gold* for gilding, calf ſkins, parchment, whipcord, pack-thread, needles backing boards, &c.

Folding-ſticks are ſlips of ivory, or box, of about two fingers broad, and eight or ten inches long, edged on each ſide, for the conveniency of parting the leaves aſunder, when occaſion requires it.

Cutting-preſs is a machine conſiſting of two large pieces of wood, in form of cheeks, join'd by two ſtrong wooden ſcrews, which being turned by an iron bar, draw together, or ſet aſunder the cheeks, as much as is neceſſary for the putting in of the *books*. The cheeks are placed flat on a wooden ſtand, in form of a cheſt, into which the cuttings fall. Aſide of the cheeks are two pieces of wood, of the ſame length with the ſcrews, ſerving to direct the cheeks, and prevent their approaching or opening unequally upon turning the ſcrew. Upon the cheeks is the ſhaft or fuſt, to which the cutting-knife is faſtened by a ſcrew, which has its key to diſmount it on occaſion, to be ſharpened.

The ſhaft conſiſts of ſeveral parts; among the reſt, a wooden ſcrew, or worm, which catching within the nuts of the two feet that ſuſtain it on the cheeks, brings the knife to the *book*, which is faſtened in the *preſs* between two boards. This ſcrew, which is pretty long, has two directories, or pieces of wood, which both as to their form and effect reſemble thoſe of the ſcrews of the cheeks. To make the ſhaft ſlide ſquare and even on the cheeks, ſo that the knife puſh'd along by the workman may make an equal paring, that foot of the ſhaft where the knife is not fixed has a kind of groove

groove, directed by a thread faſtened along one of cheeks. Laſtly, the knife is a piece of ſteel, ſix or ſeven inches long, flat, thin, and ſharp, terminating at one end in a point, like that of a ſword; and at the other in a ſquare form, which ſerves to faſten it to that ſhaft.

The *book-binder* being furniſhed with all his implements, begins to work firſt with a *folding-ſtick*, to *fold* the ſheets, according to the form, *viz.* into 2 for *folio's*; 4 for *quarto's*; 8 for *octavo's*, &c. being directed therein by the *ſignatures*, or catch-words, at the bottom of the page.

The *ſignature* is a mark at the bottom of each ſheet, to ſhew the number and order of the quires and ſheets. The ſignatures conſiſt of the capital *letters* of the *alphabet*, and change in every ſheet. If there be more ſheets than letters in the *alphabet*, to the capital *letter* is added a ſmall one of the ſame ſort, *i. e.* a little *a* after great *A*, &c. or *fig.* 2, 3, *&c.* which is repeated as often as is neceſſary.

The leaves thus *folded*, and laid over each other, in the order of the *ſignatures*, are beaten on a ſtone with a hammer, to make them ſmooth, and open well, and then preſſed. While in the preſs, they are ſewed upon bands, which are pieces of cord, or packthread, ſix bands to a *folio book*, five to a *quarto*, *octavo*, &c. which is done by drawing a thread through the middle of each ſheet, and giving it a turn round each band, beginning with the firſt, and proceeding to the laſt. The *French book-binders* apply a ſlip of parchment, the length of the *book*, on the inſide of each paſteboard, ſo, however, as that being cut, or indented, in the places againſt the bands, it comes out between the edge of the paſteboard and the leaves of the *book*, to cover the back. They call this *indorſing*, and they are obliged to do it on the penalty of 30 livres, and the *re-binding* of the *book*. It is done in the preſs, where the back being grated with an iron inſtrument with teeth, to make the paſte take hold, wherewith the parchment is firſt faſtened, they afterwards add ſtrong glue to fortify it. After this the *books* are glued, and the bands opened, and ſcraped, for the better fixing the paſteboards; the back is turned with a hammer, and the *book* fixed in a preſs between two boards, called *backing boards*, in order to make a *groove* for fixing the paſteboards; which being applied, holes are made, for fixing them to the *book*, which is preſſed a third time, and then cut by the plough. Then the *book* is put at laſt to the *cutting-preſs*, betwixt two boards, the one lying even with the preſs, for the knife to run upon; the other above it, for the knife to cut againſt; after which, the paſteboards are ſquared with a pair of ſheers.

The next operation is the *ſprinkling* the leaves of the *book*, which is done by dipping a bruſh made of hog's briſtles into vermilion and ſap green, holding the bruſh in one hand and ſpreading the hair with the other; by which motion the edges of the leaves are ſprinkled in a regular manner, without any ſpots being bigger than the others, at leaſt ſo far as to be diſagreeable to the eye.

Some valuable *books* are gilded; which is done by putting the *book* in the preſs between two boards, ſcraping and ſmoothing it, to take off all the ſcratches, and afterwards ſcraping ſome yellow oker upon it, which when ſcraped muſt be wetted with a very ſmall quantity of ſize-water, and rubbed off with ſome clean ſhavings of the *book*. The leaves being again wetted with a bruſh dipped in the ſize-water (made with the white of an egg mixed with water, and well beat together) the gold is laid upon it, and afterwards dried before the fire. When dried, it is burniſhed with *a dog's tooth*, or an ivory nob.

They have found lately a new invention to beautify the *tranchee* of a *book*, which produces as good an effect, or rather better, than *gold* itſelf; which is *marbling* it, in the ſame beautiful manner we do marble paper, thus;

They have a trough of about four fingers deep, of the length and breadth of the largeſt volume, to contain the liquor, which liquor is a quarter of a pound of gum tragacanth macerated four or five days in fair water, and ſtirred from time to time, adding every day freſh water to it, till it be of a conſiſtence ſomewhat thinner than oil, and then they ſtrain it through a cloth into the trough.

When the gum is well ſettled in the trough, they extend a ſheet of paper, and plunge it very ſhallow into the liquor, ſuddenly lifting it out again, in order to ſtir up, and raiſe the ſubſiding gum towards the ſurface, and for the more impregnating of the liquor. Which done, they have all the colours ranged in gallipots on the table, *viz.* for blue, indico ground with white lead; for green, indico and orpiment, the one ground, and the other tempered, mixed and boiled together with common water; for yellow, orpiment bruiſed and tempered; for red, the fineſt lake ground with the raſpings of *Brazil* wood, which has been prepared by boiling half a day. Into all theſe colours they put a little ox or fiſh gall, which is two or three days old; and if the colours dilute not of themſelves ſufficiently, they add more gall; on the contrary, if they ſpread too much, the gall is over-doſed, and muſt be corrected by adding more of the colour without gall. Then they begin, by dipping a bruſh of hog's hair into any colour, commonly the blue firſt, and

ſprinkle

ſprinkle it on the ſurface of the liquor in the trough, (which is alſo upon the table) if the colour were rightly prepared, it will dilate itſelf duly therein This done, the red is applied in the like manner. but with another pencil; and after this the yellow; laſtly, the green. For white, it is made by only ſprinkling fair water, mixed with ox's gall, over the liquor.

When all the colours are thus floating on the liquor, to give them that fine cambletting we admire in marble paper, they uſe a pointing ſtick, which being applied, by drawing it from one ſide of the trough to the other with addreſs, ſtirs up the liquor and fluctuating colours; then with a comb taken by the head with both hands, they comb the ſurface of the liquor in the trough from one extreme to ano ther, permitting only the teeth to enter.

The colours being in this poſture, the *book-binder* takes off his *book* from the preſs, keeping it cloſely tyed betwixt the two back-boards, leſt the colours ſhould penetrate too far into the inſide of the *book*, having moſtened it firſt with fair water, applies each ſide, one after another, to the colours, in ſuch a manner, that the ſurface of the colours, and that of the edge of the *book*, may meet equally on all parts; the operation is done in nine or ten pulſes. Then the *book* is put to dry, and when dried is poliſhed with the *dog*'s *tooth*, the ivory nob, or the like. This is a vaſt addition to the beauty of the *binding*, which being carried thus far, an ornament of ſilk of ſeveral colours, called a *head-band*, is placed at each extreme of the back, a-croſs the leaves, and wove and twiſted, ſometimes about a ſingle, and ſometimes a double piece of rolled paper.

Then remain the *covers*, which are either of *calf*'s *ſkin*, or of *ſheep*'s *ſkin*. Antiently *books* were almoſt all bound in parchment, and moſt of our valuable *books*, even ſince the invention of printing, have no other *binding*: but the beſt *binding* at preſent is in *calf*, though *binding* in *ſheep* makes as good a figure, but is not of ſo long a duration.

The *calf* or *ſheep ſkin* being moiſtened in water, is cut out to the ſize of the *book* with a knife, then ſmeared over with paſte, made of wheat flour, and afterwards ſtretched over the paſteboard, on the outſide, and doubled over the edges within, and after having firſt taken off the four angles, and indented and plaited it at the *head-band*; which done, the *book* is corded, or bound firmly between two boards, with a kind of whipcord, to make the cover ſtick the ſtronger to the paſteboards and the back, as alſo to form the bands or nerves more accurately; then ſet to dry, and when dry, uncorded, and the leaves at each end opened. Afterwards, the *book* is waſhed over with a little paſte and water, and then ſprinkled fine with a bruſh, by ſtriking it either againſt the hand, or a ſtick; unleſs it ſhould be marbled, for then the ſpots are to be made larger, by mixing the ink with vitriol. Then the cover is glazed twice, with the white of an egg beaten, (as painters do their pictures when they are finiſhed) and at laſt poliſhed with a *poliſhing iron*, paſſed hot over the glazed cover.

Thus the binding of a *book*, properly ſo called, is finiſhed, unleſs it ſhould be lettered; for then a piece of red Morocco is paſted on the back, between the firſt and ſecond band, to receive the title in gold letters; and ſometimes a ſecond between the next bands underneath, to receive the number of the volume. The gilder makes the letters on the back, and the roſes, ſtars, *&c.* between the the bands with puncheons, engraven in relievo, which they preſs flat down; and the lines, embroideries, *&c.* with little cylinders of braſs, rolled along by an iron ruler, by means of a double branch; in the middle whereof they are fitted on an iron ſtay or axis, that paſſes the middle of their diameter. But before they apply any of theſe tools, they glaze thoſe parts of the leather, whereon they are to be applied, lightly over with a pencil, or ſpunge; and when half dry, lay over them pieces of leaf-gold, cut out near the ſize; and on theſe ſtamp the punchions, which are beat down with a mallet or hammer, if the figures be large, and require a great relievo, as arms, *&c.* or roll the cylinders, both the one and the other reaſonably hot. The gilding thus finiſhed, they rub off the ſuperfluous gold with a hare's foot; leaving nothing covered with gold, but the places whereon the hot tools have left their impreſſions.

Of BOOK-KEEPING.

BOOK-KEEPING, is the Art of *keeping accounts*, or of recording the tranſactions of one's affairs in ſuch a manner, that the true ſtate of any part, or of the whole, may be thereby known with the greateſt exactneſs, clearneſs, and eaſe; which tranſactions either relate to perſons dealt with, or the things we deal in, which are either *money* or *goods*. As to the perſon we deal with, we muſt endeavour to be always capable to know by our *books* what he owes us, and what we owe him; and as to the commodities we deal in, we must take care to keep an account of the *quantity* and *value* of every kind of effect, we have in our hands, with the *gain* and *loss* on that subject, within the time of the account; as also of any thing whatsoever is received by us, or any way, for our account, by our servants, whether the same be *money* or *wares*; and of every thing whatsoever is delivered from us, upon any account, whether *money* or *wares*.

Books are either kept *single*; as among *retailers*; or *double*, (call'd the *Italian* method) among great merchants. For single *Book-keeping*, two *books* are sufficient, *viz.* a *journal*, or *day-book*, and a *ledger*, or *post-book*. But there are several others rquisite for keeping *books* double, *viz.* three essential, and thirteen auxiliaries.

The essential ones are, the *waste-book*, *journal*, and *ledger*. And the auxiliaries are, the *cash-book*, *debt-book*, *books of numero's*, *of envoices*, *of accompts current*, *of commissions*, *orders*, *or advices*, *of acceptances*, *of remittances*, *of expences*, *of copies of Letters*, *of vessels*, *and of workmen*.

This method of *Book-keeping*, in two parts, which we have learned from the *Italian* merchants of *Florence*, *Venice*, *Genoa*, &c. is universally practised throughout all *Europe*, and in the same manner, as to *substance*; but not as to *coin*; which varies according to the regulation of the *coin* of the state, where the merchants are; for, in *England* the *books* are kept in *pounds*, *shillings*, and *pence*. In *France* in *livres*, *sols*, and *deniers*. In *Spain* in *maravedis*, sometimes in *rials* and pieces of *eight*. At *Lisbon*, and throughout *Portugal*, in *rees* and *crusado's*. Throughout *Germany*, in *florins*, *cruitzers*, and *pennings*. In *Holland*, in *florins*, *patars*, and *penings*. At *Florence*, in *gold crowns*, *sols*, and *deniers*. At *Venice* in *ducats*. At *Messina* and through *Sicily* in *ounces*, *taris*, *grains*, and *picolis*. In *Muscovy*, in *rupees*, *altins*, and *grives*. At *Dantzick*, in *rixdollars*, At *Hamburgh*, in *marks*, *sols*, and *deniers lubs*. And thro' all the the states of the *Grand Seignor*, in *piasters* and *aspers*..

A *pound English*, or sterling is 20 shillings.
A *shilling* 12 pence.
A *penny* 2 halfpence, or 4 farthings.
A *halfpenny* 2 farthings.
A *French livre* is 20 sols, a *sol* 4 farthings, or *liards*.
A *maravedi* is half a farthing *English*.
A *rial* 6 pence 3 farthings.
A *piece of eight* 4 shillings and sixpence.
A *rees* is equal to 3 fifths of a farthing sterling.
A *German florin* is 3 shillings.
A *Dutch florin* is 2 shillings.
A *Patard* 1 halfpenny, 1 fourth of a farthing.
A *Florence gold crown* 5 shillings and 6 pence.
A *Venice ducat* 4 shillings and 4 pence.
At *Naples* the *carlin* is 6 pence.
Thro' *Italy* the *sequin* is 9 shillings and 2 pence.
The *roup* 4 pence 3 farthings.
The *rix dollar* 4 shillings and 6 pence.
A *Hamburgh mark* 1 shilling and 6 pence.
A *piaster* 4 shillings and 6 pence.
And an *asper* something more than an *English* halfpenny.

The WASTE BOOK may be defined a register, containing an *inventory* of a merchant's *effects*, and *debts*, with a distinct record of *all his transactions* and *dealings*, in a way of trade, related in a plain simple style, and in order of time as they succeed one another.

The *Waste-book* opens with the *inventory*, which consists of two parts; first, the effects, *that is*, the *money* a merchant has by him, the *goods* he has in hand, his part of *ships*, *houses*, *farms*, &c. with the *debts* due to him. The second part of the *inventory* is the *debts* due by him to others: the difference between which, and the effects, is what the merchants call *neat stock*. When a man begins the world, and first sets up to trade, the *inventory* is to be gathered from a survey of the particulars that make up his real estate; but ever after is to be collected from the ballance of his old books, and carried to the new.

After the *inventory* is fairly related in the *Waste-book*, the transactions of trade come next to be entered down; which is a *daily* task to be performed as they occur. The narrative ought to exhibit transactions with all the circumstances necessary to be known, and no more. It should contain the *names* of persons with whom the merchant deals upon trust, the conditions of *bargains*, the terms of *payment*, the *quantity*, *quality*, and *prices* of goods, with every thing that serves to make the record distinct, and nothing else.

The *Waste-book*, if no subsidiary books are kept, should contain a record of all the merchant's transactions and dealings, in way of trade; and that not only of such as are properly and purely mercantile, but of every occurrence that affects his stock, so as to impare or increase it, such as private expences, servants fees, house-rents, money gained, &c.

The JOURNAL, or DAY-BOOK, is the *book* wherein the transactions recorded in the *waste-book* are prepared to be carried to the *ledger*, by having their proper *debtors* and *creditors* ascertained and pointed out: whence it may be observed, that the great design of the *journal* is to prevent errors in the *ledger*. Again,

Again, after the *ledger* is filled up, the *journal* facilitates the work required in reviſing and correcting it; for firſt the *waſte-book* and *journal* are compared, and then the *journal* and *ledger*; whereas to reviſe the *ledger* immediately from the *waſte-book*, would be a matter of no leſs difficulty, than to form it without the help of a *journal*.

Laſtly the *journal* is deſigned as a fair record of a merchant's buſineſs, for neither of the other two books can ſerve this purpoſe; not the *ledger*, by reaſon of the order that obtains in it, and alſo on account of its brevity, being little more than a large index: nor can the *waſte-book* anſwer this deſign, as it can neither be fair nor uniform, nor very accurate, being commonly written by different hands, and in time of buſineſs. Hence it is, that in caſe of differences between a merchant and his dealers, the *journal* is the book commonly called for, and inſpected by a civil judge.

In the *journal*, perſons and things are charged *debtors* to other perſons and things as *creditors*: and in this it agrees with the *ledger*, where the ſame ſtyle is uſed, but differs from it as to forms and order; ſo that it agrees with the *waſte-book* in thoſe very things where it differs from the *ledger*; and, on the other hand, it agrees with the latter, in the very point wherein it differs from the former: but in order to ſtate the compariſon betwixt the *waſte-book* and *journal*, we ſhall turn two or three examples of the *waſte-book* into a *journal* form.

WASTE-BOOK:

	l.	s.	d.	l.	s.	d.
June 1ſt.						
Bought of William Pope 40 yards of black cloth, at 14s. per yard, payable in three months,				28	00	00
Bought of James Sloan 100 yards of ſhalloon, at 10d. per yard.						
Whereof paid,	02	00	00			
Reſt due, at two months,	02	03	04	4	03	04
4th.						
Sold William Pope four pipes of port wine, at 27l. 10s. per pipe.						
Whereof received	55	00	00			
Reſt due, on demand,	55	00	00	110	00	00

JOURNAL.

	l.	s	d.	l.		
June 1ſt.						
BLACK-CLOTH Dr. to WILLIAM POPE, 28l.						
For 40 yards, at 14s per yard, payable in three months.				28	00	00
SHALLOON Dr. to SUNDRIES, 4l. 3s. 4d.						
To Caſh paid in part for 100 yards, at 10d. per yard,	02	00	00			
To J. Sloan, for the reſt, due at two months	02	03	04	04	03	04
4th.						
SUNDRIES Drs. to PORT-WINE, 110l.						
Caſh, received in part for four pipes. at 27l. 10s. per pipe,	55	00	00			
Willliam Pope, for the reſt on demand,	55	00	00	110	00	0

It

It may be here obſerved, that every caſe or example of the *waſte-book*, when entered into the *journal*, is called a *journal poſt*, or entrance; thus the examples above, make three direct *poſts*.

A *poſt* is either *ſimple* or *complex*; a *ſimple poſt*, is that which has but one *debtor*, and one *creditor*, as the firſt of theſe above; a *complex poſt*, is either when one debtor is ballanced by one or more *creditors*, as in the ſecond poſt; or when two or more *debtors* are ballanced by one *creditor*, as in the third poſt; or when ſeveral *debtors* are ballanced by ſeveral *creditors*; and then the poſt is ſaid to be complex in both terms.

This being premiſed, the following rules are to be obſerved for writing in the journal.

1. In a *ſimple poſt*, the *debtor* is to be expreſsly mentioned, then the *creditor*, and laſtly the ſum, all in one line; after which, the narrative, or reaſon of the entry, in one or more lines, as in the firſt of theſe three poſts above.

2. In a *complex poſt*, the ſeveral debtors, or creditors, are expreſſed in the firſt line, by themſelves, with their reſpective ſums ſubjoined to them, which are to be added up, and their total carried to the money columns, as in the ſecond and third poſts.

3. The *debtors* and *creditors* ſhould be written in a large letter, or text hand, both for ornament and diſtinction.

Before we proceed to explain the *ledger*, we ſhall previouſly inquire into the nature and uſe of the terms *debtor* and *creditor*, as the whole art of book-keeping entirely depends on a true idea of thoſe terms, the nature and uſe of which will be obvious from the following conſiderations.

Accounts in the *ledger* conſiſts of two parts; which in their own nature are directly oppoſed to, and the reverſe of one another, which are therefore ſet fronting one another, and on oppoſite ſides of the ſame folio.

All the articles of the money *received*, go to the *left ſide* of the *caſh* account; and all the articles or ſums *laid out*, are carried to the *right*. In like manner, the *purchaſe of goods* is poſted to the *left ſide* of the accounts of the ſaid goods, and the *ſale* or *diſpoſal* of them to the right.

Tranſactions of trade or caſes of the *waſte-book*, are alſo made up of two parts, which belong to different accounts, and to oppoſite ſides of the *ledger*, *e. g.* If goods are bought for *ready-money*, the two parts are the goods *received* and the money *delivered*; the *former* of which goes to the *left ſide* of the account of the ſaid goods, and the *latter* to the *right ſide* of the caſh account.

The two parts in any caſe in the *waſte book*, when poſted to the *journal*, are denominated the one the *debtor*, the other the *creditor* of that poſt; and when carried from thence to the *ledger*, the *debtor*, or debtor part, is entered upon the *left ſide* (hence called the *debtor ſide*) of its own account, where it is charged *debtor* to the creditor part: again, the *creditor*, or creditor part, is poſted to the *right ſide* or *creditor ſide* of its account, and made *creditor* by the debtor part.

Hence *Italian book-keeping* is ſaid to be a method of keeping accounts by *double entry*, becauſe every ſingle caſe of the *waſte-book*, requires at leaſt two entrances in the *ledger*, *viz.* one for the *debtor*, and another for the *creditor*.

From what has been ſaid, it is evident that the terms *debtor* and *creditor*, are nothing elſe but *marks* or *characteriſtics* ſtamped upon the different parts of tranſactions in the *journal*, expreſſing the relation of theſe parts to one another, and ſhewing to which ſide of their reſpective accounts in the *ledger* they are to be carried.

Having explained the terms *debtor* and *creditor*, we ſhall now proceed to the *ledger*.

The *ledger* is the *principal book*, wherein all the ſeveral articles of each particular account, that lie ſcattered in other books, according to their dates, are collected, and placed together in ſpaces alloted for them, in ſuch a manner, that the oppoſite parts of every account, are directly ſet fronting one another, on oppoſite ſides of the ſame *folio*.

The *ledger's folios* are divided into ſpaces for containing the accounts, on the head of which are written the titles of the accounts, marked Dr. on the left hand page, and Cr. on the right; below which ſtand the articles, with the word *To* prefixed on the Dr. ſide, and the word *By* on the Cr. ſide; and upon the margin are recorded the dates of the articles, in two ſmall columns allotted for that purpoſe. The money columns are the ſame as in other books: before them ſtand the *folio* column, which contains figures, directing to the *folio* where the correſponding ledger entrance of each article is made: for every thing is twice entered in the ledger, *viz.* on the Dr. ſide of one account, and again on the Cr. ſide of ſome other account; ſo that the figures mutually refer from the one to the other, and are of uſe in examining the *ledger*. Beſides theſe columns, there muſt be kept in all accounts, where number, meaſure, weight, or diſtinction of coins is conſidered, inner columns, to inſert the quantity.

How the ledger is filled up from the journal.

1. Turn to the *index*, and ſee whether the *debtor* of the *journal* poſt, to be tranſported, be written there: if not, inſert it under its proper letter, with the number of the folio to which it is to be carried.

2. Having diſtinguiſhed the *debtor* and the *creditor* ſides, as already directed, recording the dates, complete

complete the entry in one line, by giving a short hint of the nature and terms of the transaction, carrying the sum to the money columns, and inserting the quantity, if it be an account of goods, *&c.* in the inner columns, and the referring figure in the folio column.

3. Turn next to the *creditor* of the *journal post*, and proceed in the same manner with it, both in the index and ledger; with this difference only, that the entry is to be made on the *creditor* side, and the word *By* prefixed to it.

4. The *post* being thus entered in the *ledger*, return to the *journal*, and on margin mark the *folios* of the accounts, with the *folio* of the *debtor* above, and the folio of the *creditor* below, and a small line between them thus $\frac{2}{4}$. These marginal numbers of the *journal*, are a kind of index to the *ledger*, and are of use in examining the books, and on other occasions.

5. In opening the accounts in the *ledger*, follow the order of the *journal*; that is, beginning with the first *journal post*, allow the first space in the *ledger* for the *debtor* of it, the next for the *creditor* the third for the *debtor* of the following post, if it be not the same with some of those already opened, and so on till the whole *journal* be transported: and supposing that, thro' inadvertency, some former space has been allowed too large, you are not to go back to subdivide it, in order to erect another account in it.

Though these rules are formed for *simple posts*, where there is but one *debtor* and one *creditor* yet they may be easily applied to *complex ones.*

As examples, how articles are to be entered in the *ledger*, take the two accounts of Cash and William Pope, so far as mentioned in the above *waste-book* and *journal.*

1759		Cash Dr.	Fo.	l.	s.	d.	1759		Contra Cr.	Fo.	l.	s.	d.
June	1	To port-wine, received in part for four pipes, at 27l. 10s. per pipe	6	55	00	00	June	1	By shalloon, paid in part for 100 yards, at 10d. per yard.	12	2	00	00
		Wil. Pope Dr.							Contra. Cr.				
June	1	To port-wine, as per journal.	6	55	00	00			By black cloth, for 40 yards, at 14s. per yard.	3	28	00	00

The *Cash* Book is the most important of the *auxiliary books*. It is so called, because it contains, in *debtor* and *creditor*, all the *cash* that comes in, and goes out of a merchant's stock. The *receipts* on the *debtor's* side; the *persons* of whom it was received, on *what*, and on *whose* account, and in what *specie*: and the *payments* on the *creditor's* side; mentioning also the *specie*, the *reasons* of the *payments*, to *whom*, and for *what* account they are made.

To your *ledger* you must have an alphabet, for the ready finding every account, whether proper, or factorage, domestic or foreign; as men, wares, voyages, profit, and loss, accounts current, *&c.* the method whereof let be thus, of having a page for, as there is occasion for each letter. Generally it is the letter of a man's surname, and the proper name of the thing, or commodity, that directs its place in the index.

Thus,

C.
Cash — — Fol. 1
Charges of merchandise — 4
George Clifford — — 2
D.
Drugs — — 2
G.
Paul Grove — — 1
H.
Peter Higgs — — — 3
Houshold Expences — 4
N.
Norwich Wares — — 1
Matthew Noble — — — 2
P.
Joseph Price — — 2
Profit and Loss — — 3

R.
James Rowland — — 3
Raw Silk — — 3
S.
Stock — — — 1
William Stubb — — — 2
T.
Peter Trueman, my account current — 4
V.
Voyage to *Aleppo*, consigned to *P. Truman* 1

The *debt book*, or *book* of payments, is a *book* wherein is entered the day whereon all sums falls due, whether to be paid or received by bill of exchange, merchandise, or otherwise; to the end, that by comparing receipts and payments, provision may be made in time for a fund for payments, by receiving bills, &c. or taking other precautions. This *book*, like the *ledger*, must be on two opposite pages, money to be received on the left hand, and that to be paid on the right. Thus,

June	1759 *To pay*	*l.*	*s.*	*d.*
6	To *Matthew Sullivan*, for money lent *Jan.* 1.	500	00	00
	To *Joseph Plumtree*, a note under hand of *May* 2.	200	00	00
8	Remittance of *Trueman*, of *November* 30, to *Grove*	1000	00	00
	My own bill of the 30th of *September* to bearer	800	00	00

June	1759 *To receive*	*l.*	*s.*	*d.*
10	Remittance of *Peter Trueman* of the 20th of *May*	1700	00	00
20	Of *George Dean* for druggs, sold the 30th of *January*	300	00	00
25	Of *Simpson Pickthread* for *Norwich* wares, sold *February* 3.	150	10	03
	Of *Paul Grove*, for money lent *May* 12,	225	11	08
	Of *Peter Price*, for money paid on his account *June* 6.	50	15	00
	Of *Jonah Toms* for 200 *lb.* of opium sold *Jan.* 1.	25	12	00

The *cash-book*, is the *book* wherein are entered all the sums received and paid daily; those received on the left hand, with the person's name of whom received, for what, for whom, and in what specie; those paid on the right, mentioning likewise the specie, the reason why, the person to whom, and for whom the payment is made; and once in a month, or oftener, sum up your account of cash received and paid, carrying the sum to the account of cash in the *ledger*, which account, without, without this book, would swell too big, provided you should enter the particulars there. For Example,

C A S H - B O O K.

June	1759 Cash Debtor.	l.	s.	d.
6	Received for 300*l.* of scammony, sold *George Dean*, in guineas	307	10	
8	Received in part, of *William Short*, in pieces of eight	160		
	Received in full for raw silk, of *Joseph Grove*, in moidores	1337	10	
	Received in full, of *Peter Price*, part in moidores and part in guineas	92		
	Carried to folio 1 in the ledger	1896		

June	1759 Cash Creditor.	l.	s.	d.
7	Paid in full, to *John Baker*, in guineas	150		
12	Paid in part, for *Norwich* wares, to *Paul Grove*, in thirty-six shillings, *Portugal* pieces	80		
15	Lent *Peter Price*, in guineas, at interest for three months	500		
20	Paid *Lewis Stone*, in pieces of eight, by assignation	80		
25	Paid to *ditto Lewis*, in guineas and in full,	29	04	
27	Paid *Charles Stanyan*, in shillings and crown pieces	140		
30	Paid *Joseph Grove*, in part, in pieces of eight	31		
31	By houshold expences this month from folio 1.	149	08	6
	By charges on merchandize, this month, as on folio, 1.	92	15	11
	Carried to the *ledger*, folio 1.	1252	08	05

The *book* of Envoices, is to keep an account of goods, shipt, either for your account, or for others in commission, according to the bills of lading; with the whole charges, till on board; every *envoice* following another, according as they happen, *i. e* entering the goods sent or shipped off to be sold, for your account, with the value, and time when sent, on the left hand *folio*; and entering the same on the right hand *folio*, as you receive advice of their sale: so you may readily see how the account stands in that particular. Thus,

> Envoice *of goods shipped on board the* America sloop, *Burthen* 250 *tuns*, Peter Brown *master*, *bound for* Genoa; *the following goods, consigned to* William Stockwell, *for my account, or by order and the account of* James Price, *and company.*

Book of account current, is kept in debtor and creditor, like the *ledger*; and serves for accounts sent to correspondents to be regulated in concert with them, ere they are entered in the *ledger*. This is properly a duplicate of the accounts current, kept to have recourse to, on occasion.

Book of Acceptances, is destined for the registring all bills of exchange, notified by letters of advice from correspondents; to be able to know, on the bills being presented, whether they have orders to accept them, or not. When they chuse to decline accepting a bill against the article thereof, in the *book*, they put *P*, *i. e. protest*; that on offering the bill the bearer may be told he may protest it: on the contrary, if they accept it, they write against it an *A*, adding the date or day of acceptance. And this, upon being transferred to the *debt book*, is cancelled.

Book of remittances, serves to register bills of exchange, as they are remitted by correspondents, to require the payment thereof. If they be protested for want of acceptance, and returned to those who remitted them, mention is made thereof against each article, by adding a *P* in the margin, and the date of the day when they were returned, then cancelled. The *books of acceptances* and *remittances* have so near a relation to each other, that many merchants

merchants make but one of the two, which they keep in debtor and creditor; putting acceptances on the side of debt, and remittances to that of credit.

The *book of expences*, is a detail of the petty expences, both domestick and mercantile; which at the end of each month are summed up, and make an article for the *cash-book*; and to the profit and loss account in the *ledger*; which is debtor to cash for it. Thus,

Houshold Expences, Debtor.

May	1759	*l.*	*s.*	*d.*
9	To cash paid *Paul Grove*, for one quarter's Rent of my dwelling-house, due at *Midsummer-day* last, in full	40	10	
5	To cash for my poket expences	4	0	
10	To cash paid my wife for apparel, &c.	50	14	
20	To cash paid *Abigale Pilfer*, the house-keeper, for this month	50	4	6
25	To cash paid for my children at school	50		
27	To cash paid to my taylor	15		
30	To cash for my pocket expences	4		
	Carried to cash-book, Folio 1.	214	8	6

Book of numero's, or *wares*, is kept for the easy knowledge of all the *goods* brought in, lent out, or remaining in a warehouse. On the left hand page are entered the quantity, quality, and number or mark of the *goods* brought in; on the right, the discharge of the *goods* out of the warehouse, against the respective articles of the first. Thus,

N° 1.	A bale of white paper, weighs	400 *l.*
2	A piece of crimson damask, ells	63.

March 1.	Sold to *Joseph Grove.*
April 2.	Sent to *Peter Price.*

Besides these *books*, each merchant is to form to himself such other *books* of accounts upon the same principles, as shall best suit his own particular dealings, correspondence and commerce, which are too many and too minute to be inserted in this treatise: therefore it remains only to shew how to close the account, and how to balance our *books*.

To *close* an account, is to make an end, or shut up an account, when you intend to add no more thereto; and is done by ballancing, and drawing a line, &c.

All accounts are closed either with profit and loss, or with ballance, or with profit and loss and ballance, or with stock.

All accounts of goods or wares, where all that was bought is sold, are closed with profit and loss; which, if you gain thereby, is entered on the debtor side of the account, and on the creditor if you lose; of which the account of *Norwich* wares, *Fol.* 1. is an example.

All accounts of men are closed, with ballance, on the debtor side, if you owe to them; or on the creditor side, if they were indebted to you.

All accounts of wares, where all that are bought are not sold, are closed with profit, and loss, and ballance, *i. e.* with profit and loss on the debtor side, for the sum gained by what is sold; and with ballance on the creditor side, for what, the goods remaining unsold cost; as in the accounts of drugs and raw silk.

No accounts are closed with stock, but with profit, and loss, and ballance.

These rules carefully observed, it will not be difficult to ballance, either a single account, or your whole *ledger*, in order to know how much cash, wares, and debts you have; what debts you owe, and what you have gained by trading since your last general ballance.

To ballance any single account, sum up the debtor and creditor sides, and put their total on a piece of waste paper, where take their difference, which is the ballance, and must be entered on the debtor or creditor side, as is taught in closing an account; which done, the sum of the debtor and creditor side shall be equal. But in an account of wares, the said difference is the profit or loss, and must be entered on that side whose sum is least, to make the sums of debtor and creditor sides equal. And to ballance your *ledger*, for the end abovementioned, take a sheet of paper, and on one side write *ballance debtor*; and on the other side write

per

per contra creditor, as the ſheet lies extended before you.

To ballance all your particular accounts, you muſt begin with caſh, (except ſtock, and profit, and loſs) which being done throughout your *ledger*, begin again, at the account of the caſh, and where an accompt is clos'd with ballance, enter the ſame on the contrary ſide of the account of ballance in your paper, as in the account of caſh above-mentioned, caſh is creditor by ballance 2185*l.* 11*s* 7*d* therefore ballance on your paper, muſt be made debtor to caſh 2185*l.* 11*s.* 7*d.*

Likewiſe, where an account is clos'd with profit and loſs, enter the ballance ſum on the contrary ſide of the account of profit and loſs; as in the account of *Norwich* wares, which is clos'd debtor to profit and loſs 26*l.* 12*s.* Therefore profit and loſs muſt be creditor by *Norwich* wares. And where you meet with an account clos'd both with profit and loſs, and ballance, as is that of voyage to *Aleppo*, conſigned to *P. Trueman*, becauſe ballance is on creditor ſide, make ballance on your paper debtor to voyage to *Aleppo*, &c. 150*l.* 12*s.* 6*d.* and becauſe the ſaid account of voyage, &c. is debtor to profit and loſs, make the account of profit and loſs creditor, for the like ſum of 150*l.* 12*s.* 6*d.* And thus having guided you through the ſeveral caſes that may happen, proceed with the reſt of the accounts to the end of your *ledger*, leaving profit and loſs unclos'd till you have clos'd and ballanc'd the reſt of the accounts, except ſtock. Then cloſe the account of profit and loſs, with *debtor* to, or *creditor* by ſtock, and carry the foot to the contrary ſide of the account of ſtock, as in the example of the forgoing account of profit and loſs clos'd with debtor to ſtock 896*l.* 10*s.* 1*d.* Stock muſt, therefore be made creditor, by profit and loſs, 896*l.* 10*s.* 1*d.*

With the difference of debtor and creditor ſide of ballance, *i. e.* with *debtor* to, or *creditor* by ſtock, cloſe the account of ballance, and carry the foot to the account of ſtock, as in the foregoing account of ballance, it is ſo clos'd; *creditor* by ſtock 3546*l.* 0*s.* 1*d.* Therefore ſtock muſt be *debtor* to ballance 3546*l.* 0*s.* 1*d.* Then ſum up the debtor and creditor ſides of the account of ſtock, and if they ballance, or are alike, your *books* have been kept right, otherwiſe you have committed ſome error.

Take this for a general rule for ballance of accounts, that your preſent ſtock, and what you owed when you began the account now ballanced, will be always equal to your ſtock, when you began your accounts, and what you have gained ſince, to the day the general ballance is made. The reaſon of this is plain; for your former ſtock, and what you have gained ſince, muſt be your preſent ſtock; as in the example foregoing of ſtock, your former neat ſtock (debts deducted) is 2649*l.* 10*s.* 0*d.* and you have gained ſince, as appears by the account of profit and loſs, 896*l.* 10*s.* 1*d.* the ſum of which is 3546*l.* 0*s.* 1*d.* = your preſent ſtock; but if you add, as you muſt, your groſs ſtock, when you began trade, to what you have gained ſince; the ſame will, conſequently, be juſt ſo much more than your preſent neat ſtock, as was the ſum you owed when you began trade; which if you therefore add to your preſent ſtock, the ſum muſt be equal to your former groſs ſtock, and the ſum gained; which is evident in the example.

For if 2649*l.* 10*s.* — 510*l.* + 896*l.* 10*s.* 1*d.* be = 3546*l.* 0*s.* 1*d.*

It follows,

That 3159*l.* 10*s.* + 896*l.* 10*s.* 1*d.* is = 3546*l.* 0*s.* 1*d.* + 510*l.*

Note, That (—) is leſs, (+) more, and (=) equal to.

At preſent the moſt conſiderable *ſhop-keepers*, who commonly deal in a few different ſpecies of *goods*, as *drapers*, *mercers*, &c. uſually keep a *ledger* for *perſons* and *wares* diſtinct, without any formal connection or reference of the accounts in their ſeveral articles; whereby there can no regular ballance be made. In the accounts of perſons they uſe the formality of a *debtor* and *creditor* ſtyle, which is mere ſhew, without the real value of a regular account; there being no oppoſite correſponding *debtors* and *creditors* to be found; for their *ledger* of wares, as they call it, contains nothing of this, and is but an imperfect contrivance, which they ſatiſfy themſelves with, to know how much remains; but the worſt is, that in allotting ſpaces for the account of wares, they frequently allow no more than they ſuppoſe may ſerve for the retail of the quantity firſt entered on that ſpace for a new parcel; which, in a quick trade is not only troubleſome, but confuſed, if there be any of the old parcels remaining; unleſs they carry it to the new account.

For *petty traders*, who deal in ſome hundreds of trifling wares, and make ſale to the value of a farthing or halfpenny, they cannot pretend to keep orderly accounts; the beſt they can do is, to be careful that ſervants do not wrong them; for they have no accounts of *goods*; and if they are aſked what of any kind remains with them, they muſt go look, if their memory fail. Theſe can only have a *caſh account*, which they are to charge once a week, with the money received, and diſcharge for what they give out; it is not convenient that they ſhould touch the *caſh-book* or *till*, oftener than once

once a week, when it is compleated; but if they do, they muſt keep a ſeparate accompt of what they take out, to know what was received: beſides which, they ſhould have a kind of *ledger* for the perſons with whom they deal upon credit; in which they give every *debtor* or *creditor* an account, with a debt and credit both on one ſide, either with a double *money-column*, or conſtant deductions, as the debts and credit ſucceed one another. The may alſo, for the ſake of thoſe, have *memorandums*, or *day-books*, wherein all things of this nature are writ down, and then carried into the other.

For *artificers*, *handicraftmen*, and the like, they may keep account of the expences of living; but it will alſo be neceſſary to make a diſtinct account of the charges and profit of their buſineſs, which may eaſily be done, by an exact account of all they pay or owe for the materials and inſtruments of their work, with ſervants wages, and taxes upon their trade; and of all they receive; of what is due for their work. They may conveniently keep account for the materials of their work, to ſatisfy them of the diſpoſal thereof, and ſerve as a check on ſervants, who have acceſs to thoſe things, and they muſt keep accounts for the perſons they deal with, both in buying and ſelling.

For gentlemen of landed eſtate, the books neceſſary to be kept are, 1. A great *waſte-book*, containing a plain narrative of all things, as they occur, as receipts and payments; every thing given and received; and, in ſhort, whatever is done relating to any thing, or perſon they are concerned with: out of which is to be made up, 2. A *caſh-book*, containing in a plain narrative ſtile, upon the debtor-ſide, all receipts of money; and upon the creditor-ſide all payments; and though there be ſeveral articles received or paid together, belonging to the ſame account, which are entered particularly in the waſte, yet they may be ſet down here, in a total ſum; for example, there is paid 26 *l.* for divers pieces of houſhold furniture, all particularly mentioned in the *waſte-book*, yet in the *caſh-book* there needs no more than to ſay paid for houſhold furniture, *&c.* 3. A *book of accounts with tenants*, where in diſtinct places, every one's charger and diſcharge may be fairly written, without any great formality of ſtile, and if it have a ſhew of debtor and creditor-ſide, it will be the more diſtinct. 4. A *book of petty accounts with ſervants and workmen*, &c. 5. A *book of real accounts*; containing an account of cattle, corn, and other ſtock or furniture, to know at all Times what you have, and how it is to be diſpoſed of. If a gentleman advances no nearer to the artificial part of accounting, he muſt keep an account with every perſon with whom he has dealings; which may be done in the ſame book with his tenant's accounts, only allotting diſtinct parts for them; the laſt will take no great room compared with the other. Theſe books of accounts muſt have indexes.

For a perſon in a ſingle ſtate, who has no buſineſs but the receiving at certain times in a year, a ſum of money, which he lays out again for his private and perſonal expences, a pocket-book is ſufficient.

For one in a married ſtate, whoſe fortune conſiſts alſo of money, as he has greater variety of expences, he muſt be careful to keep an exact account of what caſh he receives and pays; and to make this account more diſtinct and orderly, it will be beſt to keep the particulars of the payments in a ſeparate book, and to bring them into a *caſh-book*, once a week, in totals, digeſted under ſuch denominations as he thinks fit, as *bread*, *beer*, *fleſh coals*, *candles*, &c. Things thus brought into the caſh account, may be again drawn into an abſtract, ſhewing the total of each kind of expences for every month, by dividing a page into twelve columns, with the names of the twelve months; and then in ſo many articles on the margin, ſetting the names of the ſeveral heads of expences, and againſt each, under the reſpective month, the ſum of that kind of expences, in that month; then will the ſum of the money in the columns, under each month, be the total expence of that month, and the aggregate of thoſe ſums the year's expences.

For factors, or ſtewards on land-eſtates, a general *waſte book* is neceſſary to contain all matters tranſacted, relating to their maſter's concerns, under their management; out of which let them make a *caſh-book* in the manner above directed; alſo a book of real accounts, that they may know what real effects, beſides money, they have the charge of, and how it is diſpoſed of; particularly the corn rents, which have been delivered by the tenants, and put in the granaries under their charge, to be diſpoſed, and given out according to order.

Of

Of BOOKSELLERS.

A Bookseller is one who trades in *books*, whether he prints them himself, or gives them to be printed by others.

Booksellers are in many places ranked among the members of universities, and entitled to the privilege of students, as at *Tubingen*, *Salisburg*, and *Paris*, where they have always been distinguish'd from the vulgar and mechanical traders, and exempted from divers taxes and impositions laid upon other companies.

The traffic of books was antiently very inconsiderable, in so much, that the book-merchants both of *England*, *France*, and *Spain*, and other countries, were distinguished by the appellation of *Stationers*, as having no shops, but only stalls and stands in the streets. During this state, the civil magistrates took little notice of the *Booksellers*, leaving the government of them to the universities, to whom they were supposed more immediate retainers; who accordingly gave them laws and regulations, fixed prices on their books, examined their correctness, and punished them at discretion.

But when, by the invention of *Printing*, *books* and *Booksellers* began to multiply, it became a matter of more consequence, and the sovereigns took the direction of them into their own hands; giving them *new statutes*, appointing officers to fix prices, and granting licences, privileges, *&c.*

In *London* they were incorporated by the *charter* of Philip and Mary, in deed, and the name of Freemen *of the mystery* or *art of a* Stationer *of the city of* London *and suburbs thereof.*

The preamble to this charter runs in these words. 'WE considering and manifestly perceiving, That several seditious and *heretical* books both in verse and prose, are daily published, stamped and printed by divers scandalous, schismatical and heretical persons, not only exciting our subjects and liegemen to sedition and disobedience against us, our crown and dignity; but also to the renewal and propagating very great and detestable heresies, against the faith and sound catholic doctrine of the holy mother the church; and being willing to provide a proper remedy in this case, DO will, give, grant, *&c.*'

The reason given in this preamble for incorporating the *Booksellers*, shews that they were designed for a *state-engine*, which in the hands of a *popish* sovereign might assist in the reduction of the nation to the obedience of the papacy.

The privileges granted to the *Stationers* by this charter, were very considerable. No bye-law was to be made without the concurrence of the *commonalty* or body of *freemen*, who are thereby empowered to meet for such purpose without molestation. The *commonalty* are allowed to choose a *master* and *wardens* once a year or oftner, from *amongst themselves*, *i. e. Freemen*, for ever; and to *remove* or *displace* the *master and wardens* at their *pleasure*.

No person to exercise the art of printing for sale, unless he be free of the *Stationers* company of the city of London, except *patentees* authorized by his Majesty's special privilege.

The *masters* and *wardens* are empowered to search for, and to seize, take away, tear, burn, or convert to the use of their society, all prohibited books: to imprison offenders for three months: and to levy a fine of five pounds for every offence against the regulations of this charter.

This charter was exemplified and confirmed by Queen *Elizabeth* and King *Charles* II.

It may be proper to observe that *this charter* neither constitutes a *court of assistants*, nor a *livery*.

The *livery* of this company was granted by the city of *London* not till the 2d of *Elizabeth*; and then in such a latitude as not to exclude or refuse any *freeman* able and willing to take it up.

As to the *court of assistants*; the first mention thereof is found in the XXth article of that *arbitrary* charter granted by King *Charles* II. and repealed by act of parliament in 2d William and Mary.

However this *power* has been obtained in the government of the *Stationers* company; the *liverymen* have always insisted upon a right to be chosen into the *court of assistants* according to their Seniority; and in the case of Mr. Giles Sussex (*Anno Domini* 1691) the court of *lord-mayor* and *aldermen* did not only order him to be admitted one of the *assistants* of the said company; but committed the *master* and *wardens* for refusing to admit him, to the *joal of* Newgate.

This company has been favoured with several other royal grants: particularly K. *James* I. being informed of the poor state and condition of many *freemen* of this company, granted the corporation *sole right* to print *primers*, *psalters* and *psalms*; all *almanacks*, *prognostications*, and *books* thereunto tending in the *English* tongue for their *help* and *relief*.

How

How far this bounty of the Sovereign, which is ſtill retained by the Court of Aſſiſtants, extends to the *help* and *relief* of the *poor freemen*, is worthy of their enquiry, who have power to call for the account of that ſtock, which has for many years been divided very largiouſly amongſt the Aſſiſtants, and their relations and favourites.

Should we now conſider the *bookſellers* out of their corporate capacity; and only view them, as individual, each purſuing their private intereſt, we find them greatly indulged by the laws. They are not under the caprice of a licencer, nor reſtrained from publiſhing and ſelling any ſubject, that does not alarm the government. But where ſhall we meet with amongſt us, a *Stephens*, a *Bleau*, a *Plantain*, a *Janſſen*, or a man of genius and letters, except we muſt allow a ſuperior merit to this age for the art of *puffing*, ſtriking out title pages, and imitating mountebanks in the art of ſetting off their ſtock by deceitful advertiſements: ſo that the art and myſtery of bookſelling ſeems at preſent to be dwindled into a crafty device, to impoſe upon the credulity of the people.

Moſt of our *bookſellers* labour under a very great diſadvantage, which is, that very few of them have a liberal education; therefore, tho' their *profeſſion* is one of the moſt genteel and honourable, and very well becoming a gentleman; they, nevertheleſs, have no other advantage above the meaneſt trader, than that of dealing in *books*, while others, deal, perhaps, in *old books*, *oyſters*, *apples*, &c. which makes me compare them to a blind man, introduced into a place adorned with ſome of the inimitable pieces of *Titian*, *Michael Angelo*, *Raphael*, *Rubens*, *Le Brun*, *Coepel*, *Holben*, *Vandike*, *Kneller*, &c. For though he be environed with ſome of the moſt beautiful pieces of painting, he is nevertheleſs an utter ſtranger to it, nor can he judge of their elegance and beauty. Likewiſe, our *bookſellers* are, perhaps, every day amidſt the beſt *authors* every age has produced, and are, nevertheleſs, as great ſtrangers to them, as if they were carried all on a ſudden to the court of *Preſter John*; though ſome of them are very much infatuated with a pretended merit, which it is impoſſible any body elſe ſhould diſcover but themſelves.

I wiſh our *bookſellers* would follow the example of thoſe of *Paris*, where there is not one who has not ſtudied, at leaſt, as far as rhetorick, and conſequently underſtand the *Greek* and *Latin* tongues; and therefore can read moſt of their *authors*, and, if they have any genius, can likewiſe underſtand them: but as the reading is the key to it, how can ours pretend to be judges of a *work*, when they cannot ſo much as read it?

What judgement will our poſterity form of the *bookſellers*, when they find that in their times they have publiſhed nothing but obſcenity and ribaldry? Muſt they not imagine that their minds were very much vitiated, or that our age produced nothing elſe but profligates and blockheads, utter ſtrangers to morality and true learning?

It is true, that the *works* of thoſe *authors* are bought very cheap, conſidering what *bookſellers* gain by it; but thoſe ſorts of *works* have but what *bookſellers* themſelves call a run, and will never bear reading twice; they are like thoſe *Spaniſh olla Podridas*, or *Pots Pouris*, which we have a fancy to taſte once, but which we ſhould be ſorry to ſee every day ſerved at our tables, as a common food; while, on the contrary, thoſe written for our edification, or inſtruction, have always their merit, and are always in requeſt: and if the *bookſeller* is longer kept out of his money, he might, however, conſider it as an eſtate he has purchaſed, not for himſelf only, but likewiſe for his poſterity, and which is to bring him ſeveral times the intereſt and principal, without the fund being ever exhauſted. A depraved taſte is never univerſal, and never reaches the moſt ſenſible part of a nation, which has always the majority on its ſide; and far from being hereditary, it is ſeldom of a long duration: which conſideration muſt be a very great inducement to a *bookſeller* to buy valuable *copies*.

Monopoly is their *favourite* vice; for tho' we can judge, from ſeveral inſtances, that there is no great *cordiality*, or *friendſhip* ſubſiſting between them, they nevertheleſs all reunite in one, (eſpecially thoſe among them, who by their wealth have acquired the greater *reputation*) to *oppreſs* thoſe of their brethren they have ſome pique againſt, which always proceeds from ſelf-intereſt; it ſeems, becauſe they live in *ſplendor* and *opulence*, as if they were determined others ſhould not live at all. I cannot blame them for *oppoſing* thoſe, who contrary to all laws and equity, *rob* them of their *property*, on purpoſe to under-ſell it, and thereby fruſtrate them of the *profit* they could reaſonably expect from it; but it is equally unjuſt in them, to attempt to *engroſs* the *whole trade* to themſelves. What! becauſe they are maſters of a *copy*, which has proved beneficial to them, muſt others be deprived of the ſame advantages which they ſuppoſe they could make of another ſuch *copy*? Muſt no *author* write, but thoſe who write for them? Or is none capable to write, but thoſe who write for them? Or does the whole merit of a *work* conſiſt in their publiſhing it? Are there none *good* but thoſe which are publiſhed by them? Muſt every ſubject be deſerted, which has been once treated of for them? muſt the verſion of the scripture by St. *Jerome* be despis'd because that of the *Septuagint* was the first, and much esteem'd? have the writings of *Tertullian*, *Origen*, and St. *Cyprian*, eclips'd the lustre of those of St. *Augustine*? or those of St. *Augustine* prov'd disadvantageous, or detrimental to those of *Tertullian*, *Origen*, St. *Cyprian*, &c. Must any future poets forbear writing, because Mr. *Pope* has wrote with a general applause? why has Mr. *Chambers* compil'd a *dictionary of arts and sciences*, since *Corneille* had done it before him? what, because he has pyrated *Corneille*, and has made a kind of *Dedalus*, which has neither beginning nor end, with a *monstrous confusion* of unnecessary and inaccurate references, which puzzle the most judicious reader; and because our eminent *booksellers* (as they are pleas'd to call themselves) have publish'd that *work*, must *no body* be permitted to write something better, and dispose it in a more instructive and clearer order?

Of B O T A N Y.

BOTANY (*Greek* Βοτάνη, *Herb*) is a science treating of the *vegetation*, *origin*, *parts*, *nutrition* and *increase* of Plants: also, of their *kinds*, *virtues*, *uses*, *analysis*, *maladies* and *death*.

Let us begin with the *souls* of Plants or their *vegetative life*.

Aristotle defines the *vegetative soul* of a plant, *Causa cur res augeantur et aluntur* (lib. 2. de anima, c. 4.) The cause whereby things are increased and nourished. Which cause is a certain spirituous and mobile substance, whereby a body is inwardly agitated, and the nutritive juice distributed throughout all the parts, by means of certain small pipes, and ducts, form'd by nature.

In the schools, the *vegetative soul* is commonly defin'd, *Actus primus corporis physici organici, potestate, vitam vegetantem habentis*, i. e. the first act of a physical and organical body, which has potentially a *vegetative life*.

Those things have a *vegetative life*, which are nourished, increase, and generate; for by *vegetation* this triple function is understood, viz. *nutrition*, *increase*, and *generation*: therefore a triple faculty is commonly attributed to the *vegetative soul*, viz. *nourishing*, *increasing*, and *generating*.

We will begin with the *generating faculty*, from this commandment, or omnipotent word of God, *Let the earth bring forth grass, the herb yielding seed, and the fruit-tree yielding fruit after his kind, whose seed is in itself upon the earth.*

Plants have their origin from seeds, which being taken from the first plants, have propagated their species, by the Creator's will, as far as our times, and will continue to do so, to the end of the world: which opinion is supported by the above quoted words of the scripture, unless there be a seed which contains already the conformation of the plant, whose parts are unfolded by that fermentation, neither fermentation or motion can give origin to the plant; therefore, *the Lord God made the earth, and the heavens, and every plant of the field, before it was in the earth, and every herb of the field before it grew*, Gen. ii. 4, 5. which makes me conclude, that all plants have their origin from the seed, and which I prove thus:

All plants have their origin from what contains them, actually, or potentially; which must be the seed, since the first rudiments of a plant can be discovered no where else, nor by the naked eye, nor even by the help of a microscope; so that the seed contains not only the coarser matter of the plant, with its organical parts, which have the ratio of a body, but a certain spirit likewise, *i. e.* an active, mobile, and *vegetative substance*, called *soul*; which although, in some manner asleep, in the grain, or seed, is neverthless excited to motion, by the heat of the sun, the warmth of the earth, and with the rain impregnated with particles of volatile salt, whereby it unfolds its parts, and pushes the plant forward. A short *scion*, or *sprig*, is a *seed*; for it being set at a proper time, produces a tree; the smallest *seed* of that *scion* is a grain of the same kind, and hitherto visible to us; and though we cannot discover with the eye the seed of that grain, we nevertheless can form conjectures of it; for if there was not some virtue in those principles, several things, which are not sowed, would never grow.

We have all the reason imaginable to believe, that by the fecundity of the sun, and the culture of the earth, seeds are changed into a better kind, as the poet expresses it, *Georgic*, *lib.* I. in the following verses:

Semina vidi equidem, multos medicare serentes
Et nitro prius, & nigrâ perfundere amurcâ:
Grandior ut fœtus siliquis fallacibus esset.

They likewise can degenerate, through the sterility of the soil, or the negligence of the Husbandman,

bandman, as the ſame poet is pleaſed to inform us in the ſame place.

Vidi lecta diu, & multo ſpectata labore,
Degenerare tamen, ni vis humana quotannis
Maxima quæque manu legeret.

And *Eclog* 5.

Grandia ſæpe quibus mandavimus hordea ſulcis,
Infelix lolium, & ſteriles dominantur avenæ.

It might be objected likewiſe, that ſome plants grow, or from a ſprig or layer ſet into the earth, or from a root or ſcion grafted into another plant; and that therefore all plants do not grow from ſeed.

The anſwer to this objection is, that tho' plants grow from a layer, a root, or a ſcion, that layer, root, or ſcion had their firſt origin from ſeed; and therefore it is certain, that from the creation of the world plants have been propagated, to this time, by a ſeminal virtue.

This *germ*, according to Dr. *Grew*'s *anatom. plant. c.* I. has two parts, *viz.* the *radicle*, which is the embrio, or beginning of the root, and the *plumule*, becauſe in the ſhape of a ſmall bundle of feathers: which in the vegetation forms the ſtalk or trunk, and the branches of the plant.

There are beſides in the body of each ſeed two lobes or parts, which the bud is wrapped in, and whence it draws its *nutrition*, like a chicken from the yolk of an egg, or an embrio from the *placenta.*

From the ſofteſt and more ſpongious part of the ſeed, which Dr. *Grew* calls *Parenchyma*, are formed the marrow and ſkin, and from the moſt ſolid and compact part, the ligneous body.

Having thus examined the ſeed, we will *ſow* it, and examine the proceſs of nature in the *vegetation.*

Vegetation is a fermentation excited in the earth, by its warmth and humidity, and the heat of the ſun, of different ſaline particles proper to unfold the different parts of the plant, contained in the ſeed, as is in an embrio; and by their rarefaction and exaltation form the juices, which ſerve for the *nutrition* and *growth* of the plant.

The firſt thing, which preſents itſelf to my imagination, is the *ſun* and *earth* concerting together, the one by his heat, and the other by her moiſture, how to rid the embrio of that hard tough envelope, it is wrapped in, and which is the greateſt obſtacle to the exploſion of its parts; therefore the earth, which is the firſt agent in this caſe, and which is to do the office of *incubation*, makes uſe, firſt, of its natural moiſture, to ſoften the outward rind or huſk, by having it percolated through the pores or pipes of the ſaid huſk, whereby they are ſo opened and dilated, as to facilitate the introduction of the different ſalts appointed to operate on the whole ſubſtance of the ſeed, by unfolding the different parts it contains, and diſpoſing them ſeverally towards aſſuming their reſpective forms.

The SUN on this occaſion excites, by a gentle warmth, the different ſalts the moiſture of the earth is impregnated with, that they may be capable to conquer the ſtubborneſs of the huſk, by forcing themſelves, firſt into its almoſt imperceptible pores, conquering all the obſtacles, and razing all the obſtructions, which the ſeveral ſubſtances, to be ſent from the womb, for the nutrition and increaſe of the Fœtus, could meet with, to obſtruct their motions.

By this means a free paſſage being opened, for ſuch a quantity of the moiſture of the *Matrix*, as is neceſſary to make a due ſeparation of the huſk from the moſt eſſential part of the ſeed, the ſalts, employed in that operation, being volatilized, or already fixed on that eſſential part, leave the huſk filled with nothing elſe but the *Lympha*, which groweth *turgid*, and being deprived of the nouriſhment it received, when united to the ſubſtance of the ſeed, begins to tend towards its diſſolution.

The thicker is the huſk, and the cloſer the parts it is compoſed of, are coadunated together, the longer time it takes to be impregnated with the vapours and exhalations of the earth, and the longer it adheres to the *pulp*, or *fleſh* of the ſeed. This coadunation of its parts retards, likewiſe, its laceration, which is of an indiſpenſible neceſſity, for the entire exploſion of the firſt rudiments of the plants contained in the *germ*; which laceration does not happen till the continuity, which ſubſiſted between the pipes, or pores of the huſk, by their being extended, or dilated out of meaſure, by the lympha they are filled with, is broken. The huſk or rind, never breaks till all the parts of the plant are unfolded, and the organical veſſels ſo well formed and diſpoſed, as to be capable to aſſiſt each other in their mutual growth; which is evident, being often brought out of the earth adhering yet to the *germ*; as we ſee a young partridge newly hatched running with the ſhell of the egg ſticking yet on his back.

The formation of the plant being ſo far conducted by *vegetation*, and its organs diſpoſed for their reſpective functions, the ſun, by his heat, impregnates the nutritive juices, ſupplied by the earth for the nutrition and increaſe of the plant, with a principle of life, more perfect ſtill than that it had received in the incubation, by exalting and volatilizing their different ſalts, whereby they are rendered capable of circulating through all the parts of of the plant, and rid themſelves of the terreſtrial *fæces*, which could obſtruct that circulation.

The plant increaſing in bigneſs, and its bud, or ſtem, becoming taller, from whitiſh turns greeniſh; the lateral roots, alſo break forth greeniſh, and pyramidal, from the gaping ſheath, which adheres cloſely to the plant, atd the lower root grows longer, and hairy, with many fibres ſhooting out of the ſame: though there are hairs hanging all along on all the roots, except on their tips, and theſe fibres are ſeen to wind about the ſaline particles of the ſoil, little lumps of earth, *&c.* like ivy; whence they grow curled: about the lateral root there now breaks out two other little ones.

On the fourth, ſays *Malpighi*, the ſtem mounting upwards, makes a right angle with the ſeminal leaf; the laſt root puts forth more, and the other growing larger, are cloathed with more hairs, which ſtreightly embrace the lumps of earth; and where they meet with any vacuity, unite into a kind of net-work. The conglobate, or flower-leaf, is now ſofter; and when bruiſed yields a white ſweetiſh juice, like barley cream. By ſtripping it off, the root and ſtem of the plant are plainly ſeen, with the intermediate knot, whoſe outer part is ſolid, like a bark, and the inner more ſoft, and medullary.

The fifth day, in the opinion of our author, the ſtalk ſtill riſing, puts forth a permanent, or ſtable leaf, which is green and folded; the roots grow longer, and there appears a new tumour of a future root; the outer, the ſheath-leaf, is looſened, and the ſeed leaf begins to fade.

The ſixth day the ſtable leaf being looſened, the plant mounts upwards, the ſheath-leaf ſtill cleaving about it like a bark. The ſeed-leaf is now ſeen ſinuous, or wrinkled, and faded; and this being cut, or freed from the ſecundine, or huſk; the fleſh, or *pericarpium*, is found of a different texture, the outer part, whereby the outer part of the ſeed, or grain, is heaved up, being more ſolid; but the inſide veſicular, and filled with humour, eſpecially that part near the navel-knot. All the leaves being pulled off, the roots torn, and the flower-leaf removed, the trunk appears; wherein, not far from the roots, the navel knot bunches out, which is ſolid, and hard to cut: above there is the mark of the ſheath-leaf, which was pulled off; and underneath, as in an arm-pit, where the gem is often hid. The hind-part of the plant ſhews the breaking forth of the roots, likewiſe the faded *placenta*, &c.

After the eleventh day, the ſeed-leaf, as yet ſticking to the plant, is crumpled, and almoſt corrupted; within it is hollow, and about the ſecundine, the mucous, and white ſubſtance of the ſeed, being continued to the navel knot, forms a cavity. All the roots becoming longer, put forth new branches out of their ſides; the ſeed leaf withers, and its veſicles are emptied; the internodes, or ſpaces between the knots, grow longer; new germs appear, and the middle root grows ſeveral inches long. After a month, the roots and ſtalk being grown much longer, new buds break out at the firſt knot, and little tumours bunch out, which at length break into roots.

Thus the plant is hurried in this ſhort ſpace of time, by *Malpighi*, through theſe various changes and mutations, which tho' real, and as ſenſible as he is pleaſed to repreſent them, are not accompliſhed with ſuch celerity in all ſorts of plants, nor even in a grain of wheat, which he takes for example; tho' in ſome ſorts of plants all thoſe variations happen in a ſhorter time.

The plant carried thus far, wants food for the preſervation of its vegetable life, which being deprived of, it cannot ſubſiſt; of which the naturaliſts are ſo ſenſible, that their common opinion is, that *water* is the great vegetable food. Which they endeavour to confirm, by often-repeated experiments; eſpecially by that made on a ſprig of balm, mint, or the like plant; which being ſet in a phial of pure water, without any mixture of earth, grow, and put forth roots, leaves, and branches. But this *hypotheſis* is rejected by others; who are advocates for the earthen ſoil, in which we plant or ſow; for the following reaſons. 1. There is not the leaſt reaſon to ſuppoſe that the humidity, excluſively of all the other ſubſtances the earth is compoſed of, aſcends up the veſſels of the plant for its nutrition, ſince the fluid maſs has no other power to direct itſelf to motion, but what it borrows from the ſaline particles it is impregnated with, of which once entirely diveſted, by evaporation, it remains an unactive, heavy, and dead maſs; 'till by a new fermentation in the earth, or otherwiſe, it be impregnated a-new. 2. That it is not likely nature ſhould make uſe of ſo heavy a vehicle for to ſupply the vegetable body with food, while the earth can furniſh her with ſo many others, and ſo proper for the purpoſe; as are the oleaginous, ſulphurous ſubſtances it is compoſed of, and which are ſo proper for exaltation, and which once put into a ferment, by its natural warmth, aſſiſted therein by the heat of the ſun, can penetrate the moſt compact pores of the *planets*, and unite themſelves to the nutritive juices, between which and them there is ſo perfect an analogy. 3. That it is very likely that thoſe particles and ſalts, in their ſublimation, can carry along with them a ſufficient quantity of the radical humidity, which is abſolutely neceſſary to temperate the too great impetuoſity of the juices in their circulation, but it is abſurd to think that the

the whole food of the vegetable body consists in that humidity; else the plant should be always in a cacochimous condition, as is evident from the various accidents of the animal body, wherein the *lympha* superabounds, is subject to. 4. Humidity is so far from being capable of the operations attributed to it, that when once admitted into the plant, it grows still more imbecile, in being divested by the circulation, or continual rotation of the nutritive juices, of the few elastick particles, it had brought into it, and remains at last like a kind of excrement, or *caput mortuum*, which the most volatile particles usher out, as far as the bark, where they leave it: and therefore, 5. It is not true, that the humidity, in its supposed emission from the plant, carries with it many parts of the same nature with those of the plant, through which it passes, since, as can be proved. that humidity has no elasticity; and, if it was even possible it could be emitted from the plant, divested as it must be then, of its saline particles, it could not enter into the composition of our atmosphere, but must fall of itself, as a dead weight. Those parts which Dr. *Woodward* observes deposited on the surface of the leaves, flowers, and other parts of the plants, which he is pleased to stile the grosser particles of the humidity, impregnated with particles of the same nature, whereof the plants consist, are nothing else but the oleaginous and sulphurous particles, which compose the atmosphere of the plant, and which overburthened with their own weight, as well as with that of the particles of the plant, they have gathered in their ingress and regress through it, rest themselves on the outer parts of the plant; and form our manna's, honey's, and other gummous exudations; which is far more probable than to say, that they consist of humid particles, impregnated with the parts of the plant, since most of those substances ars subject to a liquefaction by heat. 6. If a greater quantity of odours is found exhaling from vegetables in humid weather than in any other, it is not because the air is impregnated with the humid particles, which have passed through the plant, but rather, by the sulphurous ones, which chiefly compose the atmosphere of the plants, and which strike more powerfully our organs of smell in humid seasons, than in any others; because then the atmosphere is more condensated and consequently nearer us than in another season.

Water, however, though it cannot be a vehicle to the vegetable matter, is, nevertheless, very beneficial to vegetation; since the aqueous particles, carried along with the vegetable ones into the plant, moderate the too great impetuosity of the nutritive juices, which, otherwise, by their continual motion, would become adust, and outwardly cool the pores, which, by their friction with the saline particles in their ingress and egress through it, could by the condensation of the most sulphurous and viscous, be obstructed, and thereby the whole vegetable substance be deprived of its food. Therefore water is of the same use in this case, as in the refrigeratory of an alembick, *i. e.* by regulating the percolation of the nutritive juices, which otherwise would flow with too great an impetuosity thro' the organical vessels of the plants, hinder a too copious exaltation of the volatile salts they are impregnated with, which otherwise would cause a too great dissipation of them, and thereby prove very prejudicial to the whole plant.

All *Botanists* are of opinion that there is a certain analogy between plants and animals; since plants like animals are composed of certain parts, moved by a certain vegetative spirit, and are possessed of a greater *apparatus* of organs, for the performance of their vital functions.

Two things are to be carefully considered in plants, *viz.* the sensible and organick body; and the spirit or the subtil and vegetative body, which is the cause of the whole motion, and the principle of all vital functions.

Plants consist of several organical parts, subservient to this motion, *viz.* of a *root*, *trunk*, *branches*, *leaves*, &c.

The Root is the lower part of the plant, whereby it adheres to the earth, whence, by the gentle, inward heat of the earth, the vertical motion of the æthereal substance, and the fermentation, it receives its nutritive juices, which are carried upwards, for its preservation. Therefore the *root* must admit, into its composition, a great number of pores and ducts, through which the juices should ascend for the nutrition of the plant, since it cannot subsist without aliment; for though some plants have no branches, as wheat, or no fruits, as jessamin; they all nevertheless have *roots* to supply them with aliments. This aliment taken by the *root*, as by a mouth, is distributed through the open pores and ducts to all the parts of the plants. *Boerhaave* considers the *root* as composed of a number of absorbent vessels, analogous to the lacteal in animals, and M. *Reaumur* takes it to do the office of all the parts in the *abdomen*, which minister to nutrition; as the stomach, intestines, *&c.*

The marrow, bark, ligneous body, and the *trachæa*'s are parts in the *root*, which are equally distributed to the trunk, and to the branches; but, it is evident that, the marrow and the bark have the same origin; for in the lower part of the *root*, where the bark is thicker, there is little or no marrow; on the contrary, in its superior part, and in in the trunk, the bark is thinner, and the marrow in a greater abundance.

Boerhaave obſerves, that the *root* may have any ſituation at pleaſure, with reſpect to the body of the plant, nor needs to be either loweſt or higheſt. Accordingly in the aloe, coral, moſſes, funguſſes, *&c.* the *root* is frequently uppermoſt, and its growth downwards,

Roots are divided by *Botaniſts* into *fibrous*, which ſend out only ſmall ſtrings from the bottom of the plant, diſtinct from each other. Such are thoſe of moſt ſpecies of graſs. Thick and groſs, on account of their thick and groſs body, either branched out into ſubdiviſions, or elſe ſending out fibres from it all along. Theſe laſt are either *carnous*, which again are either broad and ſwelling, or long and ſlender, which are commonly harder and more woody.

Broad and ſwelling *roots* are either *bulbous*, which conſiſt but of one globe or head, and ſend out fibres from the bottom; and are either *ſquamous* and ſcaly, as lilies, martagons, *&c.* *Coated*, which are involved in ſkins, or coats, as *cepa*, *hyacinthus*, *allium*, &c. *Tuberous*, which are of a carnous, ſolid, and continued conſiſtence; and theſe either, *ſimple*, with but one globe or head. as *rapa*, *crocus*, &c. *Manifold*; as *aſphodelus*, *pœonia*, &c.

Long *roots* are either *ſarmentous*, i. e. twiggy or branching, which ſhoot or creep out tranſverſe, or in breadth; of theſe ſome are geniculated, knotty or jointy; as couch graſs, mints, *&c.* *Cauliformes*, i. e. ſtemmy or ſtalky, which ſhoot down deep directly, though often ſending out fibres and ſtrings from the great ſtem; which, alſo, itſelf is ſometimes divided or branching.

As to the *trunk*, called alſo, in trees, the *ſtem*, and which is that part between the ground and the place, where it divides into branches, is conſidered as the body of the plant, which transfers the humour it receives from the earth, through the *roots* to the ſuperior parts. Outwardly, it is covered with bark, which is a ſkin to it; inwardly, it has marrow, which, commonly, is called the heart of a tree, except when very ſoft, and fungous. As in the *elder*. Between the marrow and the bark is placed what we call the *ligneous body*. And when ſeveral ſtems, and of the ſame equality riſe from the ſame *roots*, they are called *ſhrubs* or *ferments*.

Malpighi in the anatomy of plants, diſtinguiſhes a double order of fibres, or parts in the trunk or ſtem. 1. There are fibres or ſmall pipes collected into bundles, protracted lengthways; then between them in an almoſt horizontal manner is inſerted a certain number of ſmall buds or bunches, which are ſomething like the inſertions deſcribed by Dr. *Grew* in his anatomy of plants.

Beſides theſe *fibres* and *buds*, *Malpighi* has alſo found in the trunk or ſtem, larger veſſels diſpoſed in form of *lamellæ*, or turned into a ſpire; but the parts they are compoſed of are ſo thin, that they might be depreſſed or dilated at pleaſure; therefore he calls them *trachæa* and *ſpiral veſſels*. For he imagines that plants have need of reſpiration, and that the air is carried with the juice not only thro' the ligneous fibres, but likewiſe throughout the ſpiral and ſpiratory veſſels: and he maintains no corporeal ſubſtance can live, nor in the earth, nor in the water, without reſpiration.

The *veſſels* are common, perhaps, to all ſort of plants; but each kind has, beſides its proper veſſels, appropriated to carry ſome particular juice, or aliment, which are apparent in ſeveral, whether they be filled with turpentine, as the terebinth; or with milk, as in the lactiferous; or with roſin, or other liquor, which always ſeems more elaborate than that juice contained in the ligneous pipes or the buds.

The *marrow* is ſuppoſed to be of the ſame uſe in plants, as are the heart and brain in animals; and *Malpighi* believes that the tranſverſe diſpoſitions of *buds* are deſigned for the ſame uſe with the marrow itſelf; for he conjectures that there is a crude juice carried upwards through the ligneous fibres, which gradually falls into the *buds*, and the marrow, where by a longer ſtay, and the fermentation, it is elaborated and perfected, to be ready at hand for the nutrition of the young *buds* and *leaves* at their eruption.

The *branches* of a tree proceed from the trunk, as the members from the animal body; and are of the ſome nature with the trunk; for they are likewiſe covered with bark, have marrow, and a ligneous body. Often the branches, riſe without order, and in confuſion, from the trunk, as in the *elm*, *oak*, and others; and ſometimes in an elegant order, as in the pitch and firr-trees. The branches which grow laſt, eſpecially when the top is cut off, are called ſcions; and thoſe, which grow from the *roots* of the talleſt trees, unprofitable branches.

Laſtly, Every body knows that the leaves, flowers, and ſeeds ſpring like new plants from the principal or maſter plant. The leaves themſelves have alſo their caulicoles, in which the ligneous pipes produced from the trunk, and the branches are aſſembled together with the buds and *trachæa*'s, and diſplayed in all the parts of the leaves to carry the nutritive juice.

From this diſſertation we will proceed to the *oeconomy* or *uſe* of the parts of Plants, with reſpect to their nutrition and increaſe.

The

The *Peripatetics* and *Galenists* define the nutritive power, a faculty of the vegetative soul, by which it changes the aliment into its substance for its preservation. Hence its proper function is called nutrition, which is defined by them, a conversion of the aliment into the substance of what is fed.

We suppose that faculty to be nothing else but the vegetative soul, or the active substance, which being excited by the heat of the sun, as well as by that of the earth, causes a fermentaton in the nutritive juice, or which, perhaps, being taken by the vertical motion of the æthereal substance, brings up through the pores of the *roots*, appropriated to that use, the vegetable matter into the trunk and branches, and which by a kind of circulation, returns again to the inferior parts. For the *roots* of the plants dispersed in the earth, produce certain filaments, and small tubes, through which the exhalations of the earth, or rather the vegetable substance, is forced, by the ambient atmosphere, into the master *roots*, whence it ascends through the ligneous fibres, as it is imagined, as far as the upper extremity of the plant. Then passes afterwards into the buds, whence after it has been elaborated, and fermented a-new, it is distributed to every part of the plant, for the nutrition and increase of the whole vegetable body; for it is impossible that a crude and undigested juice could nourish the plant; therefore when it ascends upwards, if it happens that some parts are more elaborated than others, they serve for the nutrition of the upper parts of the plant; and those which are superfluous, and more crude, after they have been prepared by a new coction, in the buds of the other parts of the plants, and even in the marrow, they return to the inferior for their nourishment likewise.

Therefore as the blood, in animals, flows thro' the arteries, from the heart to the extremities, and returns through the veins from the extremities to the heart; likewise the nutritive juice in plants ascends from the *roots* to the upper parts, and descends back again, from the top, or upper parts, to the *roots*. Which doctrine is not mere conjecture, since it is confirmed by a vast number of experiments.

Therefore they imagine that the air, as well that inclosed in the *trachæa's*, as that mixed in the ligneous fibres, in the nutritive juice, (whether that air exalted from the earth ascends into the fibres and *trachæa's*, or is brought in through the pores of the bark, together with the nitrous spirits) while rarify'd, by the diurnal heat of the sun, accelerate the ascent of the nutritive juice. Whence we are to imagine a certain mechanical structure of the parts, in the ligneous pipes, which can facilitate the ascent of the juice, and render its descent difficult; whether some small fibres be placed so as to have a communication from the inferior part of the plant to the top; or whether we imagine some other disposition of the parts, which could supply the place of valvules in the veins of animals. Though it is inferred from a branch of a tree, planted upside down, shooting forth other branches, that there are no valvules in the ligneous pipes; but no body questions, at present, either the respiration, or the circulation of the nutritive juices in the plants. Therefore plants have their manner of respiration. Which I prove thus:

Those bodies have their manner of respiration, in which the air has its ingress and regress. That the air has its ingress into the plant, is evident, from what we have said already, that it being dilated by the heat of the sun, and mixed with the nutritive juice, it ascends the ligneous fibres of the plants, which it unfolds; and that being received into the *trachæa's*, it dilates them into a larger volume, that they might press the ligneous fibres, for the easier carrying upward the nutritive juice. Which air is expelled from the plant, by the contraction of the ligneous pipes, and spiral vessels; therefore plant; have their manner of respiration.

Likewise, there is a continual circulation of the nutritive juice through the whole substance of the plant; which is also proved in the following manner:

There is a continual circulation of the nutritive juice, if that juice, lifted up by the vertical motion of the æthereal substance, and by the impulsion of the air, is carried from the inferior parts of the plant to the superior, and brought back, through the buds from the superior to the inferior; which must be a true supposition, since,

1. Such circulation is common to all sorts of living bodies, which want aliment, as well for their nutrition, as to repair their exhausted substance. Since the parts of the living bodies can receive no nourishment till that portion of the aliment, which is well elaborated, be separated from what is crude and indigested, which must undergo another coction; whence the *roots* cannot receive any nourishment from the indigested juice, which they receive immediately from the earth: therefore a juice, far better elaborated, must be brought back to them from the superior part of the plant, for their nourishment.

2. Some trees die when they are divested of their leaves, as it happens to mulberry-trees, whose leaves are often torn off to feed silk-worms; which seems to proceed from the impossibility the nutritive juice is then in of being percolated in the leaves, and of being depurated from the crude particles, that when carried back to the *roots*, it might be a food for them.

3. If the vine be diveſted of its leaves during the ſummer, the grapes are never brought to maturity, becauſe deprived of the juice which ſhould have been elaborated in the leaves, and brought back to them for their aliment.

4. When the lacteal plants are tyed in the middle of the ſtem, it ſwells above the *ligature*, which could not happen, was not the nutritive juice ſtopped by the *ligature*, in its deſcent from the upper parts of the plant to the roots.

5. A curious perſon ſelected once two carpine trees from a long row of the ſame, whoſe trunks adhered to one another; he took the pains to cut one of them croſs-wiſe, with a ſaw, very near half a foot under the coheſion, and inſerted a very ſmooth ſtone between the divided parts to ſtop all communication between them. The following year he found that ſmall branches had budded between the coheſion and the ſection, which young branches muſt have received their aliment from the juice coming back from the upper parts of the tree, ſince they could be ſupplied from no where elſe.

Therefore it is plainly evident that the nutritive juice not only aſcends from the roots to the upper parts of the plants, but likewiſe deſcends from the upper to the inferior parts; and conſequently, that both the *nutritive* and *augmentative* faculties of the plants are contained in that motion. For the *augmentative faculty* is defined, in the ſchools; a faculty of the vegetative ſoul, whereby it lives, by taking inwardly the aliment, and by changing it into its ſubſtance, acquires its right form and proportions.

Though plants are almoſt all generated in the ſame manner, and all compoſed of the ſame organick and other parts, have all the ſame vegetable matter for their ſubſiſtence, *&c.* there is, nevertheleſs, the ſame difference between them, as there is between *animals*; ſince there is among them, as ſome imagine, a diſtinction both of *ſex* and *ſpecies:* and they are not only diſtinguiſhed with regard to their ſpecies, into *terreſtrial*, *aquatick*, *amphibious*, *annual*, *biſannual*, and *perennial*; but likewiſe into *male* and *female*.

All plants, which bear no fruits or ſeeds and have only the organ of generation, are conſidered as *males*: and thoſe, which bear fruit, as *females*.

But why ſhould we make a diſtinction of ſexes in the plants, to what end? Have they not the principle of generation within themſelves, from that very moment the creator commanded the earth *to bring forth graſs, the herb yielding ſeed, and the fruit tree yielding fruit after its kind, whoſe ſeed is in itſelf upon the earth.* Gen. i. 11. Is not this better underſtood, and more agreeable to reaſon, than to have recourſe to impoſſibilities for the generation of plants.

From this difficult point we'll proceed to the other diſtinction we have made of plants; into *terreſtrial*, which are thoſe that live only on land, as *oak*, *beech*, *&c.* *Aquatick*, which live either in rivers, as the *water-lily*, *water-plantin*, &c. or in the ſea, as the *fucus*, *coral*, *coralline*, &c. *Amphibious*, which live indifferently either in land or water, as the *willow*, *alder*, *mints*, &c. *Annual*, which are thoſe, whoſe *root* is formed and dies the ſame year, ſuch are the leguminous *plants*, *wheat*, *rye*, &c. *Biſannuals*, which only produce flowers and ſeeds the ſecond, or even third year after their being raiſed, and then die; ſuch are *fennel*, *mint*, &c. *Perennial*, which never die after they have once born ſeed. Of thoſe, ſome are ever-greens, as the *aſarabacca*, *violet*, &c others looſe their leaves one part of the year, as *fern*, *coltsfoot*, &c. *Note*, That this diſtinction is not made with regard to their ſpecies, but only to their age and period.

Plants are alſo diſtinguiſhed, with regard to their magnitude, into trees, ſhrubs, and herbs. *Trees*, are the *oak*, *pine*, *fir*, *elm*, *ſycamore*, &c. *Shrubs*, are the *holly*, *box*, *ivy*, *juniper*, &c. And *herbs*, are *mint*, *ſage*, *ſorrel*, *thyme*, &c.

Mr. *Ray* diſtinguiſhes the trees and ſhrubs of *Engliſh* growth into *nuciferous trees*, which are thoſe, which have their flower disjoined and remote from the fruit, or bear nuts; as the *walnut-tree*, the *hazle-nut-tree*, the *beech*, the *cheſnut*, and the common *oak*. *Coniferous*, or ſuch as bear a ſquammous or ſcaly fruit, of a conical figure, and a woody or hard ſubſtance, in which are many ſeeds; which, when they are ripe, the cone opens or gapes in all its ſeveral cells or partitions, and lets them drop out. Of this kind are the *Scotch* firs, male and female; the pine which in our gardens is called the *Scotch fir*, the common *alder-tree* and the *birch-tree*. *Bacciferous*, or ſuch as bear berries, *i. e.* fruit covered with a thin membrane, wherein is contained a pulp, which grows ſoft, and moiſt when ripe, and encloſes the ſeed within its ſubſtance, which trees Mr. *Ray* divides into four kinds. 1. Such as bear a caliculate, or naked berry; the flower and calx both falling off together, and leaving the berry bare, as the *ſaſſafras-tree*. 2. Such as have a monopynereous fruit, that is, containing in it only one ſeed, as the *arbutus*, *terebinthus*, *lentiſcus*, &c. 3. Such as have a naked but polypyreneous fruit, that is, containing two or more kernels or ſeeds within it, as the *jaſmine*, *liguſtrum*, &c. 4. Such as have their fruit compoſed of many *acini*, or round ſoft balls

balls set close together like a bunch of grapes, as the *uva marina*, *rubus vulgaris*, *rubusidæus* ,and the *rubus minor fructu cæruleo.*

There are also *lanigerous trees*, or such as bear a woolly, downy substance ; as the black, white, and trembling poplar, willows, and osiers of all kinds. *Trees* that bear their seeds (having an imperfect flower) in leafy membranes and cases, as the hornbeam, or hardbeam, called in some places the hornbeech. Such as have their fruits and flowers contiguous, which are either with the flower placed on the top of the fruit, or adhering to the base or bottom of the fruit. Of the former kind, some are pomiferous, as apples and pears ; and some bacciferous, as the sorb, or service-tree, the white, or hawthorn, the wild rose, sweet-briar, currants, the great bilberry-bush, honey-suckle, ivy, *&c.* The latter kind are either such as have their fruit soft, and moist, when ripe ; as, 1. *Pruniferious* ones, whose fruit is pretty large and soft, with a stone in the middle, as the black-thorn, or sloe-tree, the black and white bullace-tree, the common wild cherry, the black cherry, *&c.* 2. *Bacciferous trees*, as the strawberry-tree in the west of *Ireland*, missletoe, water elder, the dwarf or large laurel, the *viburnum*, or way-faring tree, the dog-berry-tree, the sea black thorn, the berry-bearing elder, the privet, barberry, common bramble, and the spindle-tree, or prick-wood.

Also such as have their fruit dry, when ripe ; as the bladder nut tree, the box-tree, the common elm, and ash, the maple, the gaule, or sweet-willow, common heath broom, dyer's weed, furze, or gorse, and lime-tree.

Shrubs, are nothing else but little, low dwarf-trees, or woody plants, of a size less than a tree; and which, besides their principal stems and branches, frequently from the same root put forth several other considerable sets, or stems. Such are the privet, phyllirea, holly, box, honey-suckle, *&c.* *Shrubs* are distinguished, by some, from *sufrutices*, or *under shrubs*, which are low bushes, that do not put forth in autumn, like *trees* and *shrubs*, a kind of buttons, or gems, in the axis of the leaves ; such are lavender, rue, sage, *&c.*

Botanists divide, likewise, the vegetable world into *genera* and *species* ; though they do not all agree upon, from what consideration the division into *Genera* is best taken. *Tournefort*, one of the latest and best writers, after a long and accurate discussion, has chose, in imitation of *Gesner* and *Columna*, to regulate them by the flowers and fruit considered together ; so that all plants, which bear a resemblance in those two respects, are of the same *genus*, (*i. e.* that they all agree in some one common character, in respect of the structure of certain parts, whereby they are distinguished from all other plants) after which, the respective differences, as to root, stem, or leaves, make the different species or subdivisions. He pretends, contrary to Mr. *Ray*'s opinion, that he has never hitherto met but with fourteen different figures of flowers, which are to regulate entirely the *genus* or class of plants, and which is all that is to be retained in the memory, to be car[illegible], extend to six hundred and seventy three *genera*, which comprehend 8846 species of plants ; which is the number of those yet known by land and sea.

Since M. *Tournefort* is of opinion that the different figures of flowers are to regulate entirely the *genera*, or classes of plants ; it will not be improper to examine, in this place, and previously to the distinction of plants made by Mr. *Ray*, not only those different figures of flowers, but also inform ourselves, in a more particular manner than we have done yet, of the structure of those flowers, and first of the definition of flowers.

FLOWER, is defined, by *Botanists*, that part of a plant which contains the organs of *generation*, or the parts necessary for the propagation of the kind.

Doctor *Grew* divides the *flower* into three parts, which are the *empalement*, *foliation*, and *attire*.

He calls *empalement*, or *calix*, the outer part of the *flower*, that environs the two others, which is either of a whole piece, or continued ; as in pinks and carnations ; or divided into several, as in roses. When divided, it resembles small Leonies, as it appears in the *flowers* of the quince-tree, or of primroses. The *calix* of *flowers*, is composed of the same essential parts which form the plant, *viz.* of the skin, or *cortex*, *parenchyma*, and *ligneous* body; as is evident in the *artichoke*, which is but a *flower*, of which, what is vulgarly called the *leaves*, is the *empalement*, or *calix*. It even appears that the skin which covers those *leaves* is all of a piece, from the inner, which are lesser, to the outer *leaves*, which are the greater ; so that what we take to be different *leaves*, is only the same *empalement*, or *calix*, which has several *plits*.

The use of the *calix* is, to support and cover the other parts of the flowers; it covers them while they are yet in buds, and thereby defends them against the injuries of an excessive cold, or of an extreme heat ; and supports them in such a manner, as to keep them always in the most advantageous situation. It is for this reason that *calices*, are different, or more or less strong, according to the diversity of flowers. There are some flowers, which have no *calix*, as tulips ; because their leaves being thick and strong, and each resting on its proper basis, they want no *calix* for their support. On the contrary, carnations and pinks have a *calix*, which, to be ſtronger, is all of a piece; otherwiſe their leaves, whoſe foot is very long and ſlim, would part from each other, and deviate from their natural ſituation, or place. This *calix* is *dentated* a-top, that it may the eaſier ſhut and cover the leaves, while yet too tender; and afterwards open, and ſpread itſelf a little under the ſame leaves, to ſupport them, when the flower is entirely blown. Laſtly, There are flowers, whoſe leaves being very long, and very tender, have *calices* compos'd of ſeveral pieces, the one placed above the other, almoſt like the ſcales of a fiſh, being thereby more proper to ſupport and preſerve thoſe flowers; as is plainly ſeen in *jacees*, and other like flowers.

The leaves of the flower are alſo compoſed of the ſame eſſential parts with the green leaves; for their membranes, pulps, and fibres, are nothing elſe but the ſkin, *parenchyma*, and *ligneous* body, which have ſpread to form them.

Mr. *Ray* divides *flowers* into *perfect* and *imperfect*, and ſubdivides the *perfect* (which, in his opinion, are all thoſe which have the *petala*, though they want the *ſtamina*) into *ſimple* and *compound*. The *ſimple* are thoſe which are not compoſed of other ſmall ones, and, uſually, have but one ſingle ſtyle; and the *compound* have many *foſculi*, all making but one *flower*.

Single flowers are either *monopetalous*, or *polypetalous*. The *monopetalous* have the body of the flower all of an entire leaf, though ſometimes cut, or divided a little way, into many ſeeming *petala's*, * or *leaves*; as in burrage, bugloſs, *&c.* The *polypetalous* are thoſe which have diſtinct *petala*, and thoſe falling off ſingly, and not altogether; as the ſeeming *petala* of the *monopetalous flowers* always do.

Both theſe are further divided into *uniform* and *difform flowers*. The *uniform* have their right and left hand parts, and the forward and backward parts, all alike. But the *difform* have no ſuch regularity; as in the *flowers* of ſage, dead nettle, *&c.*

Monopetalous difform flowers are, likewiſe, further divided into *ſemi-fiſtular*, *labiate*, and *corniculate flowers*. The *ſemi fiſtular flowers* are thoſe whoſe upper parts reſemble a pipe cut off obliquely; as in the *ariſtolochia*. The *labiate*, thoſe either with one lip only, as in the *acanthium* and *ſcordium*; or with two lips, as in the far greater part of the *labiate flowers*. And here the upper lip is ſometimes turned upwards, and ſo turns the convex part downward; as in the *chamæciſſus*, &c. but moſt uſually the upper lip is convex above, and turns the hollow part down to its fellow below, and ſo repreſents a kind of helmet, or monk's hood; ſuch are the *flowers* of the *lamium*, and moſt *verticillate plants*. Sometimes, alſo, the *labium* is entire; and ſometimes jagged and divided. The *corniculate* are thoſe hollow *flowers*, which have on their upper part a kind of ſpur, or little horn; as in the *linaria*, *Delphinum*, &c. and the *corniculum*, or *calcar*, is always impervious at the tip, or point.

Compound flowers, are either *diſcous*, *planifolious*, or *fiſtular*. The *diſcous*, or *diſcoidal*, are thoſe whoſe *floſculi* are ſet together ſo cloſe, thick, and even, as to make the ſurface of the *flower* plain and flat; which therefore, becauſe of its round form, will be like a *diſcus*, which is ſometimes radiated, when there is a row of *petala* ſtanding round in the diſk, like the points of a ſtar; as in the *matricaria*, *chamæmelum*, &c. and ſometimes naked, having no ſuch radiating leaves round the limb of its diſk; as in the *tanacetum*. The *planifolious* are thoſe compoſed of plain *flowers*, ſet together in circular rows round the center, and whoſe face is uſually indented, notched, uneven, and jagged; as the *hierachia*, *ſonchi*, &c. The *fiſtular* are thoſe, which are compoſed of many long hollow, little *flowers*, like pipes, all divided into large jags at the ends.

Imperfect flowers are ſuch as want the *petala*, and are called, likewiſe, *ſtamineous*, *apetalous*, and *capillaceous flowers*. *Tournefort* calls *amentacious* thoſe *flowers* which hang penduloufly by fine threads, like the *juli*; we call them *cat's-tails*.

The other diviſions of *flowers* are into *campaniform*, *cruciform*, *infundibuliform*, *cucurbitaceous*, *ſtamineous*, *leguminous*, *papilionaceous*, *umbelliform*, and *verticallate flowers*. The *campaniform* are thoſe in ſhape of a bell. *Cruciform*, thoſe conſiſting of four *petala*, or *leaves*, the *calix*, alſo, containing four *leaves*; and the piſtil always producing a fruit: ſuch as thoſe of the clove-tree, cabbage tree, *&c.* *Infundibuliform*, are ſuch as reſemble the figure of a funnel, *i. e.* are broad and ample a-top, and contracted into a neck at bottom: ſuch is that of the *auricula*. *Cucurbitaceous* are ſuch as reſemble the *flower* of the gourd, or have the ſame conformation therewith. *Stamineous* are ſuch as have no *petala*, but conſiſt wholly of *ſtamina* or threads, with *apices* a top. The *leaves* placed round the *ſtamina*, are not to be eſteemed as *petala*, but a *calix*, in regard they afterwards become a *capſula*, or cover, including the ſeed; which is the office of the *calix* alone. The *leguminous* are thoſe of *leguminous plants*; they bear ſome reſemblance to a flying butterfly;

* Petala are the coloured leaves of a *flower*.

terfly; for which reason they are also called *papilionaceous*, which consist of four or five *leaves*, whereof the uppermost is called *vexillum*, or standard; and the lowest *carina*, as resembling the bottom, or keel of a boat. Those between the two are called *lateral leaves*, or *alæ*; from the bottom of the *calix* arises a pistil, which is encompassed with a sheath, or cover, fringed with *stamina*; this pistil always becomes the fruit, and is usually called the pod, in *Latin siliqua*. *Umbelliform*, are those with several *leaves* double, and disposed in manner of a rose, and whose *calix* essentially becomes a fruit of two *seeds*, joined before they come to maturity; but afterwards easily separated again. They are thus called, because they are usually sustained by a number of threads, which proceeding from the same center, are branched all round like the sticks of an *umbrello*; of this kind are the *flowers* of *fennel*, *angelica*, &c. And the *verticillate* are those ranged, as it were, in stories, rings, or rays, along the stems; such are those of the horehound, clary, *&c.*

From the *flowers* we'll pass to the *fruits*, which are composed of the same essential parts described already in the other parts of the plants; that is to say, of the skins, or membranes; of the pulps, or *parenchyma*; and of the *fibres*, or *ligneous body*. The most common, and principal, to which all others might be reduced are *apples*, *pears*, *prunes*, and *blackberries*.

Apples are composed of four parts, which are the *skin*, the *pulp*, the *fibres*, and the *capsulæ*, which contain the *seed*. The skin is a continuation of that of the branch extended as far as the *fruit*. The *pulp* is likewise nothing but the *parenchyma* of the tree, which extends itself and swells, which appears manifestly, when we examine an apple, yet very small, and newly formed; and that pulp, hard, and of a coarse juice, at first, becomes, in process of time, tender, delicate, and grateful to the taste, the same as the marrow, which is commonly pretty hard, and of an acerb taste, becomes tender and sweet in some roots, as in parsnips, turnips, carrots, and others.

The *fibres* are but the *ramifications* of the *ligneous* body, which penetrate the *parenchyma*, and whose bigger joins together, as in the *leaves*, by the interwoving of the smaller. There are commonly in apples fifteen large *fibres*, ten of which are distributed throughout the whole substance of the pulp, and at last join together towards the *umbillic*, or the eye of the apple; and the five others pass in a right line through the *pedicle*, as far as the said eye of the apple, where meeting with the first ten, they mix, and unite with them: these last five have their origin from a single one, which having extended itself all along the *center* of the *pedicle*, and even in one part of the pulp, is divided, at last, into five branches, to which are tyed the *kernels* of the apple. Therefore though originally those *fibres* cross in a right line the whole pulp of the *fruit*, and penetrate as far as to the *flower*, to which they carry the sap which makes it grow; nevertheless, in process of time, the *fruit*, which grows bigger, drawing to itself all the juice which passes in those *fibres*, the *flower* withers, and falls, and those five *fibres* are no longer of use, but to the *fruit*. Whence it may be concluded, that of the fifteen large *fibres* discernible in the apple, ten serve to carry the sap into the pulp, or *parenchyma*, and five are destined for the nutrition of the *kernel* or *seed*.

The *capsula* proceeds from the marrow; for as soon as the pulp begins to grow big, the juice, finding room enough, enters into it, and quits the marrow, which withers, and thus forms the *capsula*.

Pears are composed of five parts, which are the skin, or *cortex*, *parenchyma*, ramification, stone, and *acetarium*. The three first are very near like those of *apples*, with this single difference, that the *fibres*, which run in a right line in the *pear*, and serve for the nutrition of the *kernels*, are in greater number; for commonly there are found ten.

The *Stone* observ'd chiefly in choaky pears, is not an essential and vital part like the others, but is only a congeries of stony corpuscles, dispers'd throughout all the whole *parenchyma*, but in the greatest plenty, and closest together, about the *center*, or *acetarium*. It is form'd of the stony, or calculous parts of the nutritious juice of the *parenchyma* extravasated in masses.

The *Acetarium* is a substance of a tart, acid taste, of a globular figure, inclos'd in an assemblage of several of the stony parts above-mention'd. 'Tis of the same substance with the *parenchyma* and the marrow, though 'tis almost impossible to determine from which of those two parts it proceeds immediately.

As for the origin of the *stone*, the various stony corpuscles 'tis compos'd of are nothing else but several parts of the juice, indurated, and coagulated, by precipitation, like those we see often in the *sediment* of *urine*, in *wine-casks*, &c.

In the plumb, cherry, *&c.* there are four parts, *viz.* a coat, *parenchyma*, ramification, and stone, or *nucleus*. The coat, *parenchyma*, and *fibres*, have the same origin, and are form'd in the same manner, as in apples and pears; but the *fibres* have a different disposition. There are in all sorts of plumbs five large *fibres* extended over the surface of the ftone, from the bafe to the point; four on one fide, and one on the other. The fame number is found in apricots, with this difference, that the *fibre* which is fingle on one fide, is not extended on the furface of the ftone as in plumbs, but penetrate into the ftone. On the other fide there are likewife found between the four large *fibres* heretofore mention'd, two or three fmall *fibres*, which, after having, like the others, a little extended themfelves on the furface of the ftone, penetrate into the pulp, and are difpers'd therein. Laftly, there are in all the parts of *peaches* a very great number of thefe fmall *fibres*.

But notwithftanding the different difpofition of thefe *fibres*, obferv'd in the *fruits* here mention'd, that which is fingle is difpos'd in the fame manner in all, *i. e* that it enters the ftone, at the bafe, and after it has extended itfelf in the very fubftance of the ftone, it enters the middle cavity, through the point, where the *kernel* is fufpended by its *envelope*.

The ftone is a compos'd body, though at firft it appears fimple. Its inner part is the thinneft, and is alfo whiter, denfer, and more polifh'd than the reft. It derives from the *medulla*, and the manner 'tis form'd is very curious, but not eafily obferv'd. For as the *fibre* of the *feed* does not penetrate it directly through the bafe, but only through the point, it carries along with it a confiderable part of the *medulla*, which gathers round it, and forms a kind of *parenchyma*; fo that penetrating into the cavity of the ftone through the point, that *medulla*, or *parenchyma*, which furrounds it, enters likewife, and being there coagulated forms in the whole extent of that cavity a kind, of white lining, hard, and polifh'd.

The external part of the ftone, which is the thickeft, is compos'd of feveral parts, which are precipitated and coagulated, as in pears; with this difference only, that in plumbs, and other fuch *fruits*, the precipitated parts are ftill nearer to one another, and are not only contiguous, but form, likewife, a contin[u]'d ftone, and all of a piece. It is fo very true that the *ftones* are form'd thus, that even in pears the *ftone* is the fame, efpecially toward the eye of the pear; and it is alfo in the fame manner that in animals fome parts of the *urine*, which are precipitated, form a gravel, and afterwards ftones. But we muft obferve, that as in the ftones of pears there is a *parenchyma* mix'd with the ftony corpufcles; there is one, likewife, in the ftones of plumbs, mix'd with the precipitated and coagulated parts. 'Tis true, that the ftone being form'd, thofe parts are not fo eafily diftinguifh'd; but, notwithftanding, the foundation of all ftones is nothing elfe but a perfect *parenchyma*, which by thofe precipitations and coagulations, which gather round it, fuffers fuch alteration, as to become dry and hard; fo that it is impoffible to diftinguifh it from thofe parts, which are c[o]agulated.

The *nut*, analogous to which is the *acorn*, confifts of a fhell, *cortex*, and *medulla*. The Shell confifts of a coat and *parenchyma*, deriv'd from the bark and wood of the *tree*. The *cortex* is alfo a body compos'd of feveral different fubftances; its furface is a duplicature of the inner tunick of the fhell, which, towards the bafe, folds itfelf, and extends on the *cortex*, which it covers almoft entirely; of which we are eafily convinc'd, when we examine it. For we fee then that the bafe of the *cortex* is continu'd with the *parenchyma* of the coat, from which it is not feparated by the fkin. Whence it enfues, that the fuperficial part, which covers almoft the whole *cortex*, and which is but a continuation of the fkin of the coat, is not found in the bafe, whereby the *cortex* and coat are join'd. The inner part of the *cortex*, which is the thickeft, is not a *parenchyma* femblable to the coat, but mix'd with feveral precipitated and coagulated parts; as in the ftones I have defcrib'd already, and are even intermixed with feveral *fibres*, or branches of the *ligneous* body; with this difference, that in the *cortex* the *external fibres*, which are not appointed to nourifh the *feed* or *kernel*, are in a confiderable number, coming from the *parenchyma* of the coat, to enter into the *cortex* through the bafe, are feparated in round like the threads of a puff, and thus extend themfelves on the *circumference* of the *cortex*, as far as the point, between the fkin and the inner part of that *cortex*, which is nothing elfe but a coagulated *parenchyma*. As for the *inner fibre*, which ferves to nourifh the *feed*, tis always fingle, and coming from the *coat* between the two others, it enters through the bafe of the *cortex*, and is not extended in the body of that *cortex*, as in the body of the ftones of plumbs, to go and unite itfelf to the *kernel* by the point, but paffes directly through the *center* of the bafe, into the *medulla*, which it penetrates and runs throughout its whole length, as far as the point of the *cortex*, to which the fkin of the *kernel*, or *feed*, adheres. But whether the *medulla*, or pulp of the *kernel*, arifes from the pith of the *tree*, or the cortical part of the *fruit*, is not agreed.

Berries, as *Grapes*, &c. are compos'd of three parts, befides grains of a ftony nature, *viz.* the coat, *parenchyma*, and *fibres*.

The origin of the coat is the fame, as in the other *fruits* heretofore mention'd; but there are found in thefe, two forts of *parenchyma*: the firft, call'd *external parenchyma*, is adherent to the coat; and as it is of an extreme acidity, 'tis commonly

fpit

ſpit out, when thoſe *fruits* are eaten. It derives from the *parenchyma* of the *cortex* of the branch: and the pores of both, as well as of the *medulla*, are viſibly diſpos'd in the ſame manner. The other, call'd the *inner parenchyma*, is that which is commonly eaten; its taſte is ſo grateful, and itſelf ſo tender and delicate, that it ſeems but as a thicken'd juice, though it be a true *parenchyma*, whoſe pores are very large, and full of liquor, like thoſe of oranges and lemons.

There are alſo in theſe *fruits*, like in the others, two ſorts of *fibres*. The *external* ones are extended in curve lines, between the coat and *external parenchyma*, from the *pedicle* to the baſe of the flower; and though they be not always in the ſame number towards the *pedicle*; however, there are ten found towards the baſe of the flower; five of which ſerve to the five leaves of the flower, and the five others to the leaves of the *calyx*. As for the inner fibres two are commonly found diametrically oppoſite to each other, which, towards the baſe of the flower, are mixed with thoſe already mentioned, and being divided afterwards into ſeveral ſmaller, each of theſe ſmall *fibres* has a grain tied to it, into whoſe coat it enters by two filaments, one whereof anſwers to the baſe, and the other to the point of the grain. Thoſe *fibres* are all white and big enough for us to ſee eaſily; when cut obliquely, they are hollow, and true ſpermatick veſſels, ſince they have very near the ſame figure, and the ſame uſe as thoſe of animals.

From the *flowers*, and *fruits* of plants, I'll proceed to the diſtribution of plants by Mr. *Ray*, into twenty-five *genera*, or claſſes, under the following denominations (ſee the PLATE of BOTANY.)

The firſt claſs contains *imperfect* plants, ſuch as appear to want the flower and ſeed, as *corals*, *ſponges*, *truffles*, *moſs*. The ſecond produce plants of an imperfect flower, and whoſe ſeed is too ſmall to be diſcerned by the naked eye; ſuch are *fern*, *polypody*, *&c.* The 3d, thoſe whoſe flowers want *petala*, as *hops*, *hemp*, *nettles*, *docks*, &c. 4th, Thoſe with a compound flower, and which emit a milky juice, when cut, or broke, as *lettuce*, *dandelion*, *ſuccory*, &c. 5th, Thoſe of a compound flower of a diſcous form, and whoſe ſeed is winged * with down, as *coltsfoot*, *flea-bane*, &c. The 6th contains *herbæ capitatæ*, or thoſe whoſe flower is compoſed of long fiſtulous flowers gathered into a round head, and covered with a ſcaly coat, as the *thiſtle*, *great burdock*, *blue bottle*, &c. 7th, *Corymbyferous* † plants, with a diſcous flower, but no down, as the *daiſy*, *yarrow*, *corn-marygold*, &c. The 8th contains plants with a perfect flower, but only one ſeed to each flower, as *valerian*, *agrimony*, *brunet*, &c. 9th, *Umbelliferous*, or thoſe of five *petala*, ſpread out like an *umbrella*, and two ſeeds to each flower. This is a very large genus of plants, which are diſtinguiſhed by the ſame author into ſeven ſpecies, *viz.* thoſe with a broad flat ſeed, like a leaf, as wild garden *parſnips*; with a longiſh and larger ſeed ſwelling in the middle, as *cow-weed*, and *wild chervil*; with a ſhorter ſeed, as *angelica*; with the tuberous *root*, as the *earth nut*; with a ſmall ſtrait *ſeed*, as *caraways*, *ſaxifrage*, and *brunet*; with a rough hairy *ſeed*, as *parſly* and *wild carrot*; with entire leaves ſubdivided into *jags*, as *ſanicle*, and *thorough-wax*. The 10th contains *ſtellate* plants, whoſe leaves grow round the ſtalks at certain intervals in form of ſtars, as *mug-weed*, *wild madder*, *croſs-wort*, *mollugo*, *aſperula*, or *wood-ruff*, *gallium*, or *ladies bed ſtraw*, *aparine*, or *cleavers*, *rubia tinctorum*, or *dyer's madder*; to which may be added, as a-kin to this genus, the *naſturtium indicum*, *indian creſs*, or *yellow lark-ſpur*. The 11th, *rough-leav'd* plants, which have their leaves placed alternately, or in no certain order along the ſtalks, as *hound's-tongue*, *mouſe-ear*, &c. 12th, *Suffrutices*, or *verticellate* plants, whoſe leaves grow by pairs on their ſtalks, one leaf right againſt another, the flower being monopetalous, and uſually in form of a helmet. The ſame author makes two ſpecies of theſe *verticillate* plants. 1. The *fructicoſæ*, of ſuch whoſe ſuperficies is perennial; theſe again have either a plain flower, as the *chamædrys vulgaris*, *thucrium*, and the *marum ſyriacum*, or a flower with a lip, called *labiated flower*; or one ſomething in the form of a helmet, called *galeated*, as the *ſacra ſtæchos*, *hyſſopus*, *roſmarinus*, *ſatureia*, *marum vulgare*, *thymum vulgare*, and the *polium montanum*. 2. The *herbaceæ*, or ſuch whoſe,

* Winged ſeed are ſuch as have down or hairs on them, whereby the wind taking hold, blows them to a diſtance.

† *Corymbus*, among the antient *botaniſts*, was particularly uſed to expreſs the bunches, or cluſters of ivy-berries. Some alſo call the top of the ſtalk of a plant, when ſo ſubdivided, and adorned with flowers, or fruits, as to make a round ſpherical figure, by this name; as the tops of *leeks*, *onions*, and the like; and others confound the word with *umbrella*, which expreſſes the flowery tops of ſuch plants as have their branches and flowers ſpread round, into the form of an *umbrella*. But among the modern *botaniſts*, *corymbus* is chiefly uſed for a compound diſcous flower, whoſe ſeeds are not pappous, *i. e.* do not fly away in down, nor blown any where about with the wind.

ſtalks,

ſtalks are not perennial; theſe are the *menthæ*, *verbena*, *dictamnus*, *creticus*, *origanum*, *majorana*, *ocimum*, *horminum galeopſis*, *nepeta*, *betonica*, *prunella*, *ſtachys*, *clinopodium vulgare*, *lamium*, *molucca*, *hedra terreſtris*, *galericulata*, *calamintha*, *meliſſa*, *marrubium commune*, *nigrum*, & *aquaticum*, *chamæpitys*, *ſcorodonia*, *ſcordium*, *bugula*, *ſyderitis*, *cardiaca*.

The 13th contains the *polyſpermous* plants, which are thoſe, which have more than four ſeeds ſucceeding each flower, without any certain order or number. Theſe are alſo ſubdivided into.

1. Such as have a *calyx* or *perianthium*, conſiſting either, firſt of three leaves, and the flower *tripetalous*, as *plantana aquatica*, and the *ſagittaria*, both water-plants, or the flower *polypetalous*, and the *calyx* falling with it, as the *chelidonium minus*; or remaining after the flower is dropped, as in the *hepatica nobilis*. *Secondly*, Of five leaves, in ſome deciduous with the flower, as in the *ranunculus*; in others *perennial*, as in the *helleborus niger ferulaceus*; or *annual*, as in the *flos adonis*. *Thirdly*, of eight leaves, as the *malva* and *alcea*. *Fourthly*, of ten leaves, as the *caryophylla*, *fragaria*, *pentaphyllum*, *tormentilla*, *argentina*, *althæa*, and *pentaphylloide*.

2. Such as have no *calyx*, or *perianthium*, as the *clematitis*, *filipendula*, *ulmaria*, *anemone-nemorum*, *pulſatilla*, &c.

In the fourteenth, are the bacciferous plants, or ſuch as bear berries, as *briony*, *honey-ſuckle*, *ſolomon-ſeal*, *lily of the valley*, *nightſhade*, *aſparagus*, &c. The 15th contains the *multiſiliquous*, or *corniculate* plants, which after each flower, produce ſeveral long, ſlender *ſiliquæ*, or caſes, wherein their ſeed is contained, as *orpine*, *navel-wort*, *bears-foot*, *columbines*, &c. The 16th, *vaſculiferous* plants, with a *monopetalous* flower, and which after each flower have a veſſel beſides the *calyx*, containing the ſeed; which is ſometimes divided into cells. They have their *monopetalous flower*, either uniform, or difform. The former have all their ſeeds divided, 1. Into two partitions, as the *hyoſcyamus*, *incotiana*, *priapeia*, and the *gentiana*. 2. Into three partitions, as the *convolvulus*, *ſpeculum veneris*, *trachelium*, *repunculus*, or *campanula*, *repunculus corniculatus*, &c. 3. Into four partitions, as the *ſtramonium*. Thoſe of the latter kind, which have a difform *monopetalous* flower as the *linaria pinguicula*, *antirrhinum*, *ariſtolochia*, *ſcrophularia*, *digitalis*, *pedicularis*, *melampyrum*, *euphraſia*, &c. Mr. *Ray* makes three claſſes of this *vaſculiferous* plants, which I have reduced here into one; and therefore proceed to the 20th, which contains the *leguminous* plants, or ſuch as bear pulſe, with a papilionaceous flower, conſiſting of four parts, joined at the edges, as *peaſe*, *beans*, *vetches*, *tares*, *lentil*, *liquorice*, *trefoil*, &c. The 21ſt, plants with a true *bulbous root*, as *garlick*, *daffodil*, *hyacinth*, *ſaffron*, &c. The 22 thoſe whoſe *roots* approached nearly to the *bulbous* form, as *flower-de-lis*, *cuckow-pint*, *baſtard hellebore*, &c. The 23d, *culmiferous* plants, with a graſſy leaf, and an imperfect flower, having a ſmooth, hollow-jointed ſtalk, with a long, ſharp-pointed leaf at each joint, and the ſeeds contained in a chaffy huſk, as *wheat*, *barley*, *rye*, *oats*, and moſt kinds of *graſs*. The 24th, plants with a graſſy leaf, but not *culmiferous*, with an imperfect or ſtamineous flower, as *ruſhes*, *cats-tail*, &c. And in the 25th are contained plants, whoſe place of growth is uncertain, chiefly *water-plants*, as the *water-lily*, *milk-wort*, *mouſe-tail*, &c.

Before we attempt to enumerate, to make the *analyſis*, and diſcover the virtues of the plants, contained in the ſeveral claſſes, or *genera* above-mentioned, which M. *Tournefort* reduces to fourteen, as leſs burthenſome to the memory, it is proper to define certain *terms*. which are to be uſed in the ſequel, and inform the reader of the rule obſerved in the diſcovery of theſe ſeveral things.

By the chemical *analyſis* of plants is underſtood, the ſeparation of their principles, by fire and convenient veſſels, to effect which, freſh plants are diſtilled in alembicks, in *balneo mariæ*; or elſe before they are diſtilled, they are put into fermentation or digeſtion for ſome time, according to the nature of the plants, and the deſigns of the artiſt. The ſubſtances extracted from them are to be divided into portions, of five or ſix ounces each. That their reſpective character may be examined ſeparately; by that means are extracted their flegma, ſpirituous water, or *ardent ſpirit of* plants. When the diſtillation is ended, the grounds left are put into a *cornue*, whence by a graduate fire, are extracted from almoſt all plants an urinous ſpirit, a concrete volatile ſalt, and a *fœtid oil*. From the *caput mortuum* lixiviated, is ſeparated by filtration and evaporation, the ſalt which was mixed with the earth. Without this operation it would be impoſſible to diſcover which ſort of ſalts are contained in plants, and which ſalt is predominant; which muſt be neceſſarily known to diſcover the virtues of plants, and before they can be employed with any appearance of ſucceſs in medicine.

To proceed with ſome order in that diſcovery, we muſt previouſly know what's underſtood by the different ſalts found in *plants*, ſince they all contain ſome of thoſe ſalts, more or leſs; therefore,

1. By *alkaly* and *acid ſalt*, are underſtood thoſe two ſorts of ſalts, to which our modern phyſicians and chemiſts have given thoſe names; and which are eaſier underſtood than defined.

2. By *eſſential ſalt* is underſtood that formed by the cryſtalliſation of the juice of plants.

3. By *volatile salt* is understood the salt, which by the distillation through the *cornue*, adheres at the top of the vessel.

4. By the *fixed* or *fixt salt*, is understood the *salt* extracted by elixiviation, from the ashes of burnt plants, or from the *caput mortuum*, of those which are analysed.

This, 'tis true, informs us of the difference of those several salts; but how shall we know if they are all contained in the plant, or only in part; or which is the predominant? By the following means.

1. The *acid salt* is discovered, by being mixed with salt of *tartar*, or spirit of *sal armoniack*, or like matters, with which acids ferment commonly. The acids are also discovered by the blue paper, which they change red by degrees, from a very pale red to a very high one.

2. The spirit of *nitre*, of *salt*, of *sulphur*, of *vitriol*, and other *acids*, are employed with success, to discover the *salt alkaly*; for those acids ferment with the *alkaly*.

3. As the *sal-armoniack* is easily discovered, by its urinous volatile salt, *Botanists* and chemists make use of the oil of *tartar* to discover if there is any armoniack salt in plants, for then they exhale an urinous spirit; like to that exhaled from urine, or the armoniack salt itself.

4. As the character of *nitre* is discovered by *detonation*, 'tis thought, that the surest expedient to know nitrous substances, is by throwing them upon burning coals.

5. Every body knows that the chief quality of vitriol is to turn black the infusion of galls, therefore the matters under examination are to be mixed with that infusion.

6. To know if there is any sulphur in some matter, that matter must be put into digestion, in a very strong spirit of wine. If the same matter burn easily, 'tis a certain sign that they contain abundance of sulphurous particles. The *elaterium*, when dry, burns at the candle, and the *sedum majus vulgare* of *C. Bahinus*, does not burn, therefore the former contains a sulphurous matter, not to be met with in the latter oleaginous substances, when mixed, makes a lather when with oil of tartar.

We'll proceed now to the *enumeration* of the plants, and to the discovery of their several *qualities* and *virtues*, in an *alphabetical order*, contenting ourselves with the description of a few, which are better known, and more useful.

ALTHÆA, (see the plate,) *Marshmallow*. *Morison* and Mr. *Ray* have taken the flower of this plant to be of five *leaves*, though M. *Tournefort* says, that it is all of a piece. The *leaves* of *marshmallows* are glutinous, insipid, and do not change the *blue* paper. The *roots* have the same taste, but change a little the *blue* paper. The glutinous juice of this plant appears to be a mixture of a great deal of phlegm, of a considerable portion of earth, acid, and sulphur.

All authors agree that this plant sweetens the blood, and is *emollient*. It not only blunts the corrosive salts, but likewise softens the *fibres*, when too much strain'd, and restores them to their natural motion, and thereby appeases pain. In diet-drinks, or *ptisans*, they are an excellent *remedy* for a violent cough; and in the *nephritick* for the *retention* of urine, attended with inflammation. 'Tis also administer'd, for the same maladies, in syrups, tablettes, or lozenges; in lohochs, in clysters for the inflammations of the abdomen; in *unguentum* for the sciatick and rheumatism; to resolve tumours with inflammation; in poultices with milk, to bring those tumours to suppuration when the matter is dispos'd for it, &c.

AGRIMONIA, *Agrimony*, is of a stiptick taste, a little salt, and mix'd with some acrimony, and changes *blue* paper a little; which makes one believe that it contains a salt which approaches very near the vitriolated tartar, or the salt of coral made with spirit of *verdigrease*. This salt in *agrimony* is mix'd with a great deal of sulphur, and with much earth; therefore 'tis *astringent*, *detersive*, *vulnerary*, and *aperitive*. *Agrimony* is very good in chronick maladies; for it absorbs and incises the thicken'd *lympha* which occasions them. 'Tis us'd in diet-drinks, decoctions, and in aperitive, cooling, and vulnerary draughts, or juleps. This is of a very great succour in the spitting of blood, in the bloody flux, and in the inflammation of the liver. Apply'd *externally*, it is vulnerary, and proper to resolve the tumours of the *scrotum*, or purse; and of all other parts where there is inflammation. *Targus* assures us, it is boiled in *lees* of wine, with bran of wheat, and apply'd on the part.

ALKEKENGI, *Winter cherry*. Its *leaves* are acerb, and bitter; they do not change the *blue* paper, but the fruit changes it very much. It appears, at first, sourish, and afterwards bitter; which makes one conjecture, that in the fruit of that plant there is a salt approaching very near the *oxysal angeli salæ*, mixed with a small quantity of fœtid oil. In the *leaves* that salt is too well wrapped up in sulphurous and terrestrial particles to be felt. The *alkekengi* is very *aperitive* and *diuretick*. *Dioscorides* used to give it for the *green-sickness*, and *retention* of *urine*. *Arnaud de Villeneuve*, and *Cesalpinus*, advised the dropsical, and those who had a *retention of urine*, to drink wine wherein had been bruis'd three or four fruits of this plant. The fruit of *alkekengi* is prepared into *troches*.

AQUI-

Aquilegia *sylvestris*, *Celandine*, is *aperitive*, *diuretick*, and *sudorifick*. *Tragus* assures us, that a drachm of the powder of the *root* taken in *wine*, cures the cholick. *Camerarius* relates, that in *Spain* they eat every morning, for the *calculus*, a small quantity of that *root*. For the *angina*, and the *ulcers* in the throat, *Pena* and *Lobel* prize gargarisms made with the seeds of this plant. Some use it in the scurvy. Some pretend, that taken in wine it *accelerates* the birth. *Pauli* us'd to give half a drachm, or a drachm of it, in a glass of water of *fumiterre*, or of *carduus benedictus*, for the small-pox and measles.

Artemesia, *vulgaris*, *Mugwort*, or *Motherwort*, has a small taste of salt, and changes a little the *blue* paper, which indicates that its salt has something of the nature of *sal ammoniac*, but united with a great deal of sulphur and earth. All its principles render the plant very *aperitive*, and proper to regulate and provoke the natural evacuations in women For the vapours, the *leaves* and *flowers* of *mugwort* are taken, instead of *tea*.

Betonica, *Betony*. The *leaves* of this plant have the taste of herbs, are a little salt, and a little aromatick. The *flowers* change blue paper a little, as well as the *roots*; which, besides, are very bitter. The *betony* is full of sulphur, mixed with a small quantity of oily, volatile salt, and some earth. By the analysis are extracted from this plant a great deal of oil, a little earth and fixed salt, no concreted volatile salt, but a small quantity of urinous spirit. *Betony* is *vulnerary*, *aperitive*, *diuretick*, proper for the maladies of the head, and of the abdomen. It is used in lieu of *tea*, for the vapours, sciatica, the gout, head-ach, jaundice, and for the palsy. The diet-drink made of *betony-leaves*, the water it has been macerated in, the conserve of its *flowers* and *leaves*; the juice and extract of its parts, have the same virtues. These *remedies* procure the expectoration of purulent matter; they consolidate the inward ulcers, restore the functions of the *viscera*, promote the urine, and carry off the obstructions of the *viscera*. Of the *leaves* of *betony* is made a plaister, and particularly those of the head. The *roots* have not the same virtues.

Bryonia *aspera*, *sive alba*, *baccis rubris*, *Bryony*, *hip*, *white vine*. The leaves of this plant are insipid, glutinous, and do not change the blue paper; the root changes it much, it is bitter, and of a bad smell; whence it is conjectured that the acid of ammoniack salt, which is predominant in that plant, is more unfolded in the root than in the leaves, where it is wrapped up in a great deal of sulphur. By the analysis these roots give a great deal of acid liquor, and a considerable quantity of concreted volatile salt. The root, tops, and seeds of *bryony*, are a strong purgative, and carry off the most obstinate obstructions; therefore this plant is of great service in the dropsy, gout, epilepsy, asthma; in the vapours, palsy, vertigos, and in the most tedious maladies. The root is given in powder, from one scruple to two; the juice is given to drink, from a drachm to half an ounce; and the decoction from half an ounce to an ounce, and an ounce and a half. But in whatever manner this root is used, it must be corrected with cream of tartar or vegetal salt.

Bursa *pastoris major*, *folio sinuato*, the *shepherds-purse*, or *pouch*, tastes a little salt, and is detersive; the juice of these leaves changes a little the blue paper; whence it is conjectured, that in that plant the ammoniack salt, which is in the natural salt of the earth, predominates the other principles. This ammoniack salt is dissolved into a considerable portion of phlegm, and is temperated by much earth and little sulphur. This plant gives no acid by the chemical analysis, and all extracted from it is almost alkaly. Very few plants give so much concreted volatile salt, more lixivial fixed, and more earth. These principles mixed render the *bursa* proper to melt the blood, when too much thickened by the heterogeneous acids, which obstruct the circulation. The juice of its leaves drank from four ounces to six, is of a great help in losses of blood, and even in fluxions, accompanied with inflammation. Its water distilled has little or no virtue, it is only the phlegm separated from the other principles. This plant is found during the whole year, because it sows itself towards the end of the summer.

Calamintha *humilior*, *folio rotundiori*, *Ground-ivy*. *Cardus* has described this plant under the name of *chamæcluna*. Its leaves are very bitter, a little aromatick, and scarce change the blue paper. By the analysis this plant gives no concrete volatile salt, but a small quantity of urinous spirit; all the rest is acid, alkaly, oil, and earth; and these two last parts are found in it, in a reasonable quantity. The *ground-ivy* is very aperitive, detersive, and vulnerary. *Camerarius* and *Cesalpinus* esteem it much to provoke the urine, and force the *calculus*. *Lobel* used it, in the gout, by way of prevention.

Carduus Stellatus, *starry thistle*. Its *leaves* are very bitter, and the *root* tastes of *artichoke*. It contains a salt which approaches very near the natural salt of the earth; for its solution is very bitter, and loaded with *sal ammoniac* and *nitre*. The *carduus* is *febrifuge*, *vulnerary*, and *aperitive*. In an *intermittent fever* five or six ounces of the juice of this plant is given at the beginning of the paroxism. The same juice carries off the spots in the eyes, and cures the wounds. M. *de Lamoignon*,

moignon, intendant of *Languedoc* in *France*, has communicated to the publick a remedy which had cured him of a violent *nephretick*; which *remedy* is as follows.

28th day of the moon, in every month, the patient muſt drink early in the morning a large glaſs full of very good white wine, in which has been macerated a drachm of the firſt bark of the root of *carduus*, gather'd toward the end of *September*, and dry'd from the ſun, and powder'd very fine. This bark is a very ſmall and thin ſkin, brown outwardly, and white inwardly. The day this *remedy* has been taken, muſt be put towards the evening into half a pint of water, a handful of parietary, a drachm of ſaſſafras, as much aniſeed, and half a drachm of cinnamon, in powder: the whole is boil'd on a clear fire for the ſpace of half a quarter of an hour. The veſſel is taken off the fire, and plac'd, cloſely cover'd, on the hot embers; the next day 'tis put again on a clear fire, that it may boil for another half quarter of an hour; after which, the liquor is pour'd over two ounces of powder'd ſugar-candy put into a porrenger, or other ſuch veſſel; the infuſion ſtrain'd through a linnen cloth, with expreſſion of the ground. When the ſugar is melted, the patient drinks it as hot as he can, and muſt take nothing elſe for three hours after, no more than when he has taken the firſt *remedy*.

CHAMÆDRIS *minor*, *repens*, *Germander*; the *leaves* of the *germander* are bitter and aromatick, and do not change the blue paper; which ſhews that it contains principles different from thoſe of the *centorie*. Its ſalt does not differ from the natural ſalt of the earth, which is a mixture of ſea ſalt, nitre, and *ſal ammoniac*. 'Tis acerb, very bitter, and very aperitive. There is an appearance that that found in this plant has loſt its acrimony by the mixture of a great deal of eſſential oil, which renders the *germander* aromatick. 'Tis *febrifuge*, *ſtomachick*, *aperitive*, and *diaphoretick*. A handful of its *leaves* are macerated for a whole night, from the fire, in a glaſs of wine, together with a drachm of vegetable ſalt, which muſt be drank faſting, for the green-ſickneſs. A drachm of the extract made with its *leaves* and *flowers*, with two drops of oil of cinnamon, is preſcrib'd for the ſame malady. Its *leaves* are uſed in infuſion, in the manner of thoſe of tea, for the gout and ſciatica.

CHAMÆMELUM, *vulgare leachantemum*, *Camomile*. This plant is bitter, aromatick and changes much the blue paper. It ſeems that it contains a *ſal ammoniac* loaded with a great deal of acid, and wrapp'd up in a great Quantity of ſulphur and earth. The *camomile* is *aperitive*, *diuretick*, and *februfuge*. In *Dioſcorides*'s time, the powder of *camomile flowers* was uſed in *intermittent fevers*. *Rivierus* preſcribes it on the ſame occaſion. The infuſion of the ſummits, or tops of *camomile*, and of melilot, give eaſe to thoſe troubled with the *nephritick*, and with a *retention* of *urine*. It appeaſes the gripes, which often happen after a delivery. *Pauli* prizes much the wine in which *camomile flowers* have been macerated, for the pleuriſy; but there muſt be applied, at the ſame time, on the part where the pain is felt, bladders filled with the decoction of the ſame plant, heating the decoction, from time to time. It is employed likewiſe in clyſters, fomentations, cataplaſms, and in the half baths, for the gout, ſciatica, and hemorrhoids, or piles. Its oil is very uſeful on the ſame occaſion. For the rheumatiſm it is mixed with equal parts of oil of *St. John's-wort*, and of camphorated ſpirit of wine, for a liniment, covered afterwards with a hot cloth.

CHELIDONIUM *majus*, *vulgare*, *Celandine*. The *celandine* is bitter, acerb, and burning, eſpecially the root, which gives more orange-coloured juice than the other parts of the plant. It changes but very little the blue paper, and ſmells like rotten eggs; which makes me believe that its juice is, as it were, phagenedical, ſemblable in ſome manner to the liquor which reſults from a mixture of ſolution of corroſive ſublimate and of lime-water. The *celandine*, by the analyſis, gives enough of that ſalt fixed, as well as volatile; but it is wrapped up in a great deal of ſulphur and earth. This plant taken inwardly, is very *aperitive*; for the dropſy, an ounce of its root, and half an ounce of tincture of *Mars*, are infuſed, or macerated during four and twenty hours, in a pint of white wine; the infuſion is ſtrained through a cloth, two ounces of which are taken twice a day. The following preparation is very good for the vapours, and for the conſumption. There muſt be put in digeſtion, during eight days, twelve pounds of the whole plant ſlightly pounded, three dozen of craw fiſhes cut in pieces, and two pounds of honey; then the alembick muſt be luted, and the matters contained in it diſtilled in *balneo mariæ*. The diſtilled water is very good for the vapours drank from two ounces to four. It carries off the inflammation of the eyes, and dries up the ulcers of thoſe parts. The herbs pounded cure the wounds of horſes.

COFFEE, is the fruit of a plant very common in *Arabia Felix*. That of the *Levant* is moſt eſteemed, being greener, heavier, and appearing riper than that from *Moka*, which is larger, lighter, and whiter.

This is what *Dominicus de Farcy*, doctor in phyſick of the faculty of *Paris*, ſays of *coffee*, in a theſis held in the college of phyſicians of that metropolis,

tropolis, *Anno* 1695. ‘The volatile salt with which the *coffee* berry abounds, agitates the spirits, whose velocity hinders sleep; besides the adust particles, of which there is a great quantity in the *coffee*, as we may judge by the smell and taste, insinuate themselves first into the blood, then into the texture of the nerves, to which, by the disproportion of their figure, and their continual motion, they add a stimulation; whence the spirits are forwarded in the latent ducts of the brain, in their usual operations. From the abundance of these salts the blood is freed from the viscous humour it is wrapped up in within the substance of the lungs, as well as the brunchia of their sordes. However, a considerable quantity of the blood is resolved into a serosity, which being filtrated through the reins, fall into the bladder.’

Coffee produces these effects, particularly with people of a pretty corpulent habit; being found hurtful to those who are thin, lean, dry, and of a bilious temperament, as it dries up the nerves, and inclines them to tremors. It is said to be prejudicial, likewise, to those who digest too fast, where the circulation is too quick, or where there is a spitting of blood arising from the mouths of any of the veins and arteries being too open, or the blood too thin and sharp.

The oily matter, which separates from the *coffee*, and appears on its surface when roasted, and its particular smell, which distinguishes it from peas, beans, rye, &c. which some substitute in lieu of *coffee*, are to be the real indications of its effects. If considered with regard to the oil drawn with the retort, this, as well as that, contains volatile principles, as we have already observed, both saline and sulphurous. It is to the dissolution of its salt, and the mixture of its sulphur in the blood, that its chief faculty of promoting watchfulness is to be attributed; hence also its property of promoting digestion, of precipitating foods, of preventing eructations, and correcting acrimonies of the stomach, when taken after meals. Hence also that fermentation in the blood serviceable to corpulent people; hence also its diuretick virtue. By experience it is found of service to drink a glass of water before *coffee*, to render it laxative; to mix it with milk, or cream, to extinguish its sulphur, embarrass its saline principles, and render it nourishing.

The tree that produces the *coffee* is a kind of *Arabick* jessamine; the berry, when ripe, is as hard as horn.

The preparation of *coffee* consists in roasting, or giving it a just degree of torrefaction, on an earthen or metalline plate, till it has acquired a brownish hue, equally deep on all sides; it is then ground in a mill, as much as serves the present occasion; a proper quantity of water is next boiled, and the ground *coffee* put into it; after it has just boiled, it is taken from the fire, and the decoction having stood a while to settle and fine, they pour and decant it into dishes, and drink it as hot as possible, with sugar.

Coral, (*See* the *figures* of sea-plants in the copper-plate Botany,) is a production of the sea, usually ranked among the number of *marine plants*; though the antients took it, without hesitation, for a stone; most of the moderns hold it a vegetable; of late days one maintains it partly a plant, partly stone; while another curious and able naturalist, who has much studied the production of the sea, almost ranks it in the number of animals; as imagining it the work of certain sea-insects. This opinion is now so well established, that all other sentiments seem almost precluded. Father *Kircher* supposes entire forests of it at the bottom of the sea; and M. *Tournefort* maintains, that it evidently multiplies by seed, though neither its flower nor seed be known. However, the Count *De Marsigli* has discovered some parts therein, which seem to serve the purpose of seeds and flowers.

Coral, then, being established a plant, has, in that quality, roots, wherewith it is fastened to the rock wherein it grows: These roots are covered with a bark beset with starry pores, which traverse them from top to bottom. Above the root is the ligneous, or woody part of the plant, if we may call a substance so, that rather seems to resemble stone than wood. It is divided into branches like other plants, having white streaks therein, which seem to represent a kind of fibres. The extremities of the plant are soft, and rounded with little bowls, ordinarily divided into six cells, filled with a humour somewhat like milk, fatty, sharp, and astringent. Lastly, these bowls are esteemed a kind of pods, or *capsulæ*, containing the seed of the *coral*; it is even said, that in what place, or on what matter soever this juice be shed, it carries fecundity with it, and produces a plant of *coral*: whence it is, that in the cabinets of the curious we find some of it on dead men's skulls, pieces of earthen ware, and other kinds of solid bodies, which chance, and the working of the sea, have thrown into some of father *Kircher*'s forests.

Coral, the Count *de Marsigli* observes, grows chiefly in grottos, whose mouth or aperture is towards the south, and their vault or concave arch nearly parallel to the surface of the earth. For its growth, it is necessary the sea be as quiet as a pond: it it vegetates the contrary way to all other plants; its foot adhering to the top of the grotto, and its branches ſhooting downwards. The foot takes the exact form of the ſolid it grows to, and even covers it like a plate, to a certain extent; which Monſieur *de Marſigli* thinks a proof that its ſubſtance was originally fluid: And what confirms the thought is, that the ſame ſubſtance ſhall ſometimes line the inſide of a ſhell, which it could never have entered but in form of a fluid.

All its organiſm, (according to *Marſigli*) with regard to vegetation, conſiſts in its rind; that the tubules of this rind filtrate a juice which fills the cellules, and runs along the canals as far as the extremities of the branches; and that this juice being petrified, both in the cells encompaſſing the *coralline* ſubſtance, and in thoſe of the extremities of the branches, whoſe ſubſtance is not yet formed, makes the plant grow, both in height and bulk.

There are properly but three kinds of *coral*, *red*, *white*, and *black*: the white is the rareſt and moſt eſteemed; but is is the red is ordinarily uſed in medicine. It muſt be choſen thick, ſmooth, and ſhining, and of a beautiful red, not covered with any tartarous matter. There is a kind of *white coral* pierced full of holes; and a *black coral*, named *antipates*; appearing of a different nature from the reſt; but theſe are of no uſe. The chymiſts draw a magiſterial tincture from *coral*, and a ſalt.

The virtues attributed to *coral*, and its preparations, are, that it is cardiack, and therefore of uſe in diarrhœas, too large fluxes of the *menſtrua*, and flooding; of ſervice in the *fluor albus*, and to prevent miſcarriages; beſides its uſe in common, as a teſtaceous powder, in children's diſeaſes, &c.

The time for gathering this plant is from *April* to *July*; the places are the *Perſian Gulf*, *Red Sea*, coaſt of *Africa*, towards the baſtion of *France*; the iſles of *Majorca* and *Corſica*; and the coaſt of *Provence* and *Catalonia*. The method of gathering *coral*, is nearly the ſame in all places; that uſed at the baſtion of *France*, where there is an eſtabliſhed fiſhery, under the direction of a company at *Marſeilles*, is as follows:

Seven or eight men go in a boat, commanded by the patron or proprietor; the caſter throws his net, if we may ſo call the machine wherewith he uſes to tear up the *coral* from the bottom of the ſea, and the other ſix manage the boat. The net is compoſed of two beams tied a-croſs, with a leaden weight, to preſs them down: to the beam is faſtened a great quantity of hemp looſely twiſted round, among which they mix ſome ſtrong nets. In this condition the machine is let down into the ſea; and when the *coral* is pretty ſtrongly embarraſſed, in the hemp, and the net, they draw it out by a rope; which they unwind according to the depth, and which ſometimes requires half a dozen boats to draw; if the rope happen to break, the fiſhermen are in great danger of drowning. Before the fiſhermen go out, they agree on the price of the *coral*, which is ordinarily, at the rate of 4*s*. 6*d*. *per lb*. When the fiſhery is over, which in a ſeaſon uſually amounts to 25 quintals of *coral*, each boat, it is divided into thirteen parts; the patron whereof, or maſter-coraller, has four, the caſter two, and each of the ſix companions one, the thirteenth being reſerved for the company, &c.

CYNOGLOSSUM *majus*, *vulgare*, *Dog's-tongue*. The leaves of this plant are white and ſilky; its flowers are, at firſt, purple, which become blue afterwards. The bark of its root is a little bitter, ſalt, ſtiptick, and glutinous; it changes the blue paper. It appears that the *ſal-ammoniack*, which is in the natural ſalt of the earth, is predominant in the *cynogloſſum*, where it is temporated by much phlegm, earth, and fœtid oil. Therefore its root is proper to ſtop all ſorts of fluxions, and ſweeten the acrimony of the humours. Its leaves are vulnerary and deterſive.

DENS LEONIS *latiore folio*; *Lion's tooth*. The leaves of this plant are very bitter, and change a little the blue paper. The roots change it a great deal more, they are bitter, ſtiptick, deterſive. The whole plant is aperitive, diuretick, vulnerary, and febrifuge. *Targus* preſcribes the water of *dent de lion*, in the internal inflammations. *Barbet* adviſes to take the juice, it purifies the blood by urine. To appeaſe an exceſſive cough, and cure a cold, a quarter of a pint of milk is drank at night, with which is mixed, boiling hot, as much of the decoction of *dent de lion*, adding to it a ſmall quantity of ſugar candied. The extract of this plant is given from half a drachm to a drachm and a half.

EUPATORIUM *cannabinum*, a kind of *Agrimony*; in *French*, *Eupatoire*. The juice of the leaves of this plant, or a drachm of its extract, and the diet-drinks prepared of it, drank by glaſſes, are very proper to carry off the obſtructions of the *viſcera*, eſpecially thoſe which ſucceed to intermitting fevers; the uſe of its leaves, in infuſion, in the manner of tea, relieve the dropſicals: it muſt be preſcribed after the punction, or tapping, and the legs muſt be fomented with the decoction. For the green-ſickneſs, for the itch, and all other cutaneous diſtempers, it is mixed with the fumiterre in whey, or diet-drinks. The ſummities loaded with flowers are very vulnerary. The roots are both emetick and cathartick.

Fumaria *officinarum & Diſcoridis*, *Fumitory*. This plant though very bitter, changes nevertheleſs the blue paper: therefore, it is conjectured that it contains a ſalt like the natural ſalt of the earth; but in which the *ſal ammoniack* predominates the nitre and marine ſalt; beſides, the ſalt of *fumitory* is joined with a great deal of ſulphur and earth diſſolved in a conſiderable quantity of phlegm. By the analyſis the fumitory gives a great deal of concreted volatile ſalt, a great deal of fixed ſalt, very lixivial, and a great deal of a very thick oil. All theſe principles render this plant laxative, diuretick, proper to purify the blood, and for the deſopilation of the parts. It is eſteemed a ſpecifick in all cutaneous diſtempers; in the hypochondriacal melancholy; in the cachexy and dropſy. Its juice is adminiſtered from two ounces to ſix. The infuſion in whey from ſix ounces to ten or twelve. The diſtilled water from a glaſs to two. The ſimple ſyrup; two or three ounces in a diet-drink; the compound ſyrup from one ounce to two, if the patient is to be purged. The water of *fumitory* is alſo deterſive, and proper to dry the ulcers of the mouth.

Geranium, *ſtorkſbill*. This plant is ſtiptick, ſalt, and ſoweriſh: it ſmells of *bitumen*, and changes the blue paper. There is ſome appearance that it contains a ſalt like the alum, mixed with a ſmall quantity of fœtid oil, and a very little of *ſal-armoniack*. By the analyſis it gives a great deal of acid, very little of oil, no concreted volatile ſalt, but a ſmall quantity of urinous ſpirit. The *Geranium* is very aſtringent, and very vulnerary; the wine, wherein the leaves bruiſed have macerated for a whole night, ſtops all ſorts of hemorrhages.

Hyoscyamus *vulgaris*, *Henbane*. The *leaves* of this plant are inſipid, and of an ill ſmell; it taſtes of artichoke. It is conjectured that the *ſal ammoniac*, which is in it, is wrapped up in a great deal of ſulphur and earth; for by the analyſis its *leaves* give a concrete volatile ſalt, and a great deal of oil. The *henbane* is ſoporiferous, reſolutive, and ſweetening; it is ſeldom uſed in internal *remedies*. *Helidæus* valued much its *ſeeds*, which he mixed with conſerve of roſes, for the ſpitting of blood. *Tragus* aſſures, that the juice of *henbane*, or the oil made by the infuſion of its *ſeeds*, cured the pains in the ears, by ſyringing it into thoſe parts. The *henbane* is employed in anodyne cataplaſms, to reſolve the tumours. For example; two handfuls of *leaves* of *henbane*, as much of thoſe of *mandragora*, and an ounce of ſeeds of *henbane*, and of poppies, are boiled in a certain quantity of milk; the whole is ſtrained through a cloth. There muſt be added to it the yolk of an egg, and ſome ſaffron. Some content themſelves with boiling only the *leaves* of *henbane* in milk, and apply them on the places where the gout is felt. Others ſoften the *leaves* of *henbane* under the hot embers, and apply them on the breaſts to expel the milk from them, or to diſſipate it when knotted. For chilblains, they are expoſed over the ſmoke of *ſeeds* of *henbane*, burned on the coals.

Juniperus *vulgaris*, the *Juniper-tree*. By the analyſis are extracted from this plant ſeveral acid liquors, a ſmall quantity of fixed ſalt, but no volatile. We muſt obſerve, that the ſalt of this plant is wrapped up in a very great quantity of ſulphur, and ſome terreſtrial particles. The wood of *Juniper*, beſides an æthereal oil, gives a great deal of thick oil, in the conſiſtence of a ſyrup. The berries give a great deal more, and the ſummits a little leſs. All theſe principles render the *juniper* proper to reſtore the functions of the ſtomach, to diſſipate the wind, and griping matters, to free the lungs, and diſengage them of that thick *lympha*, which often obſtructs the reſpiration. This plant is, alſo, ſudorifick, cephalick, and hyſterick. It provokes the *menſes*, carries off the obſtructions of the *viſcera*, reſtores their ſprings, and helps the evacuation of urine. Uſe is made of the wood, ſummits, and berries. The decoction of the wood volatilizes the blood, and purifies it by the inſenſible perſpiration. A half bath is prepared with this wood, which proves very beneficial to thoſe who have the gout. The wine in which the ſummits of *juniper* are boiled is very diuretick. *Tragus*, *Matthiolus*, *Hartman*, and *Simon Pauli*, aſſure us, that they have cured ſome dropſical perſons with this ſort of wine. *Tournefort* ſays, that he has ſeen ſeveral perſons very much eaſed by the pills made of two parts of aloes, and one of *juniper-berries*. From theſe berries are extracted an ardent ſpirit, a tincture, an elixir, and an extract; and of them are prepared a *ratifia*, and a ſort of honey. The tincture is made by macerating the berries in their ardent ſpirit; the infuſion of the ſame berries in their ſpirit or in common water evaporated to the conſiſtence of honey, is called elixir, or extract of *juniper*. The honey of *juniper* is nothing elſe but common honey boiled with *juniper-berries*. It is good in clyſters, in the *dyſenteria*, and *teneſma*. The *ratafia* of *juniper* is made by macerating its fruit in brandy, or champaign wine, adding to it ſome ſugar and cinnamon. The pulp of *juniper-berries*, freed from its grains, and mixed with ſugar, makes a conſerve, which has all the virtues of thoſe prepara-

tions

tions heretofore mentioned. Laſtly, the fruit is burned to expel the bad air, and macerated in vinegar, in the time of the plague, to waſh letters, linnen, and even plates.

MELILOTUS, *Melilot*. This plant is acerb, bitter, ſtiptick, and odoriferous; whence it is conjectured, that its ſalt is much like the natural ſalt of the earth, but mixed with much eſſential oil, and terreſtrial particles; for by the analyſis, the *melilot*, beſides much acid phlegm, gives alſo a great deal of oil and earth, enough of urinou ſpirit, of volatile concrete ſalt, and of very lixivial ſalt; therefore that plant is diuretick, reſolutive, and ſweetening. The diet-drink made with its ſummits, and thoſe of camomile, is excellent in the inflammations of the abdomen, the cholick, and in the retention of urine, in the rheumatiſm, and generally in all occaſions where the courſe of humours is to be facilitated The water diſtilled from the flowers of *melilot* is of a grateful ſmell. The *melilot* is uſed in the carminative clyſters, and in the reſolutive cataplaſms. For clyſters, the flowers of *melilot*, and thoſe of camomile, are boiled in tripe's broth, and to the decoction, after it has been ſtrained through a cloth, are added ſome drops of oil of anniſeed. For cataplaſms, two roots of lillies are boiled with half a handful of flowers of *melilot*, and two handfuls of leaves of henbane; the whole is ſtrained through a ſieve, to which are added ſome drops of fœtid oil of tartar. The juice of the flowers of *melilot*, or the infuſion of its parts in boiling water, appeaſe the inflammation of the eyes; eſpecially if after it is taken off the fire there be added to it ſome camphorated ſpirit of wine; the whole being ſtrained through a cloth, to ſeparate the needleſs camphire.

PAPAVER *Erraticum majus*, *Poppy*, in *French Coquelicoc*. The flower of this plant, which is the principal part employed in medicine, is glutinous, and changes a little the blue paper, like the ſolution of *opium*; whence it is believed that it has a ſalt analogous to it. But in the *opium*, that ſalt, which approaches near the *ſal ammoniac*, is mixed with a great deal of fœtid oil, whereas in the *poppy* there is a great deal leſs of oil, and much more viſcous phlegm; ſo that the flowers of this plant are ſweetening, and proper to help ſpitting in the fluxions of the breaſt, in colds, and in dry coughs They ſtop the hemorrhages, and are a little ſudorifick. The water diſtilled from the flowers of *poppies*, is preſcribed from three ounces to ſix; the tincture is taken by glaſſes, in the fluxions of the breaſt. The following diet drink is excellent for a dry cough: you muſt boil three ounces of roots of *bugloſs*, and as much of thoſe of *gramen*, or *graſs*, in two pints of water, and pour the boiling decoction upon an ounce of flowers of *poppies*, and upon three heads of *white poppies*, cut ſmall, and tyed up in a little ſack. The dryed flowers of *poppies* are uſed like tea. A conſerve and a ſyrup is made of them.

POLYPODIUM *vulgare*, *Oke-form*. The root of this plant analized gives ſeveral acid liquors, a ſmall quantity of urinous ſpirit, no concrete volatile ſalt, a great deal of oil, and ſome earth. The antients believed this root purgative. *Menardus* is the firſt, among the moderns, who diſcovered that it purges but ſlightly; and *Dodoneus* confeſſes that it does not purge at all, unleſs it be boiled in the broth made of an old cock, with mallows and leeks. The *oke-form* ſweetens the blood, and carries off the obſtructions of the *viſcera*. It muſt be uſed for a dry cough, when the *ſaliva* is ſalt; in the aſthma, ſcurvy, and hypochondriacal affections.

PULEGIUM *latifolium*, *Penny-royal*. This plant is very bitter, very acerb, of a penetrating ſmell, and changes much the blue paper; whence it is conjectured that it has an aromatick and oily volatile ſalt, yet loaded with acid; whereas in the artificial volatile ſalt this acid is ſtopped by the ſalt of tartar; therefore this plant is aperitive, hyſterick, proper for the maladies of the ſtomach, and thoſe of the breaſt, when 'tis wanting to diſſipate thoſe glutinous matters which obſtruct the *bronchia*, and *veſicles* of the lungs; eſpecially when boiled with honey and alloes: for then, as *Dioſcorides* obſerves, it purges, and helps the expectoration. *Tragus* ſays, that the juice of this plant clears the ſight, and carries off the rheum. For the diſtempers of the eyes, *Montanus* preſcribed the powder of *penny-royal* mixed with equal parts of vinegar, honey, and water. The conſerve of the flowers and leaves of this plant are good for dropſical perſons, and for thoſe who have the yellow jaundice. Mr. *Ray* aſſures us, after Mr. *Boyle*, that a ſpoonful of the juice of *penny-royal* is a good remedy to appeaſe the convulſive cough of children. *Cheſneau* preſcribed a glaſs of the decoction of this plant for hoarſeneſs, and adviſed to take it at night, going to bed.

QUINQUEFOLIUM *majus repens*, *Cinquefoil*. Mr. *Ray* has very well deſcribed the fruit of this plant. The taſte of its *leaves* has ſomething glutinous, they change a little the blue paper, but the roots change it more; they have ſome acidity, and are ſtiptick, which makes us believe, that amidſt a great deal of earth and ſulphur, they contain an aluminous ſalt modified with a ſmall quantity of *ſal ammoniac*, which, in the *leaves*, is very much embarraſſed in a viſcous phlegm. This plant is vulnerary, and aſtringent. By the analyſis it gives a ſmall quantity of concreted volatile ſalt. Beſide the

the extract prepared of the roots, they are alſo ſucceſsfully employed in diet-drinks, and in the aſtringent broths, for the ſpitting of blood, the hemorrhodal flux, for the heat of urine, and for all ſorts of hemorrhages. The gargariſm made with the decoction of this plant, cures the ulcers of the mouth and ſore throats. It is aſſured, that a drachm of the powder of the ſame root taken in a glaſs of water, before the paroxyſm, carries off intermittent fevers.

Ruscus *Myrtifolius*, *Butcher's-broom*. The root of this plant is one of the five common aperitive roots, proper to carry off the obſtructions of the *viſcera*, and to accelerate the paſſage of urine. For the dropſy, cachexy, jaundice, calculus, and the retention of urine; it is preſcribed in broth, diet drinks, and apozems: for ſcrophulous tumours half a pint of white wine, in which has been macerated a drachm of the powder of the roots of *ruſcus*, with equal quantity of thoſe of *ſcrophularia*, and *filipendula*, muſt be drank for ſeveral days ſucceſſively. The conſerve of the berries of *ruſcus* is very good for the exceſſive heat of urine. The ſeeds of *ruſcus* are employed in the compoſition called *benedicta laxativa*.

Sambucus, *fructu in umbella nigro*, *elder-tree*, The leaves of this plant have at firſt a ſalt taſte; and, afterwards, they are bitter. The fruit is ſweetiſh.

By the analyſis the leaves, beſides ſeveral acid and alkaline liquors, give a concrete volatile ſalt, much oil, and much earth. Therefore there is appearance, that this plant operates by a *ſal armoniack* more loaded with acidity than common; and mixed with a great deal of fœtid oil and earth. The ſalt, which is in the fruit of *elder*, approaches nearer the *allum* than the *ſal-ammoniack*. There is but a very ſmall quantity of urinous ſpirit extracted from its parts, but much of acidity, oil, and earth. *Bauhin*, and Mr. *Ray* have taken the flower of this plant for a flower of five leaves, though *Tournefort* has found it of a ſingle piece. *Hippocrates* uſed the *elder* to purge, and to help the evacuation of urine. *Dioſcorides* ſays, that the decoction of its ſummities purges the ſeroſities, and eaſes the dropſical, as well as the wine, in which the roots have been boiled. Theſe parts, according to the ſame author, are good for the bite of vipers, and for the hyſterick paſſion, as well as the fruit drank in wine. *Dioſcorides* adds, that the leaves of *elder* appeaſe the inflammation, cure the burnt ulcers, the bite of a mad dog, and the gout. *Tragus* and *Dodoneus* ordered to drink the juice of the middle bark of *elder*, to purge the bile, and the ſeroſities, or had it macerated in wine or milk, after it had been pounded. *Geſner* preſcribed the decoction of that bark, for an excellent ſudorifick in the plague. *J. Bauhin* ordered the dropſical to drink three times a day, an ounce and a half of the water of the middle bark of *elder*, *viz.* the firſt in the morning, the ſecond at noon, and the laſt at night. The flower of this tree fried with eggs, purge well enough, but they muſt be freſh gathered, for they loſe their virtue in drying. The whey wherein thoſe dry'd flowers have been macerated, is of a great ſuccour to thoſe who have the ſmall-pox and the ereſipele. They muſt drink a glaſs of it morning and night and have their face waſhed with two parts of the water of the flowers of *elder*, and a part of good *ſpirit of wine*. A conſerve and a ſyrup are made of thoſe flowers. They are put in vinegar, and boiled ſlightly with honey, to be uſed in clyſters. Of *elder-berries* are prepared the rob, extract, ſpirit, wine, ſyrup and oil. For the rob a pound of the juice of *elder-berries*, with half a pound of ſugar, is thickened on a ſlow fire. The extract, according to *Quercetan*, is made in the following manner. The fruits of *elder* dried from the ſun, muſt be put into a matraſs, pouring over it the beſt *ſpirit of wine*, which muſt riſe about five fingers breadth above the fruit, adding to it ſome ſpirit of ſulphur, and leaving the whole in digeſtion during five or ſix days; which expired, the tincture muſt be filtrated, which is very good for the hyſterick: the doſe is half a ſpoonful, or a ſpoonful. To make the extract, the *ſpirit of wine* is drawn off by diſtillation, and the extract remains at the bottom of the cucurbit. The doſe is a ſcruple, or even a drachm, for the ſame diſtemper, and for the diarrhœa. The ardent ſpirit of *elder-berries* is a very great ſudorifick, as well as the juice of thoſe berries, which is eaſily preſerved, or with oil, or mixing with it one third of the beſt *ſpirit of wine*. Of the grains of thoſe berries is extracted an oil, which apppeaſes the gout. For the ſame malady another ſort of oil is uſed, made by the reſolution of the leaves of *elder*, whoſe ribs are bruiſed, and afterwards put into an earthen pot, which being very cloſely luted, with plaiſter, is buried very low in the ground; at the end of a year is found in the bottom of that pot a ſort of oil, very good for the gout. The leaves of *elder* boiled in ſtrong wine are very reſolutive; they carry off the ſwelling of the legs of the dropſicals, eſpecially if a vaporous bath be made of them, or frequent fomentations, and the leaves are applied in cataplaſms, it is proper to mix with it the leaves and flowers of tanſy. *Mathiole* gives the deſcription of an excellent *unguentum* for a burn. He will have a pound of the middle bark of *elder* boiled into two pounds of oil of olive; the oil is ſtrained through a cloth; when the bark is become black, and ſeems to be done enough, there are added

ded to it two ounces of new wax, and as much of the juice of the tenderest branches of *elder*, which is boiled to the consumption of the juice. This done, the vessel is taken off the fire. Then must be added to it two ounces of *turpentine*, four ounces *olibanum*, and two hard yolks of eggs. The *unguentum* is preserved in an earthen pot for the gout, for the inflammation of the piles, and for burns. It suffices to boil the middle bark of the branches of *elder* in oil of *olives*, or in that of *walnuts*, and to give it the consistence of *unguentum*, with a sufficient quantity of new wax, and yolks of eggs; nothing can ease more those who have been burnt with gunpowder, than to apply immediately on the burnt part the common honey, and afterwards the oil of *walnuts*, with which has been boiled the *elder*.

SAXIFRAGE *rotundifolio*, *Saxifrage*. This plant is esteemed a very grand diuretick. The infusion of its roots in *white wine*, or in *cinnamon-water*, is its usual preparation. *Facchius* assures us that it provokes the *menses*, and that it purges the lungs of that thick *lympha*, which hinders their motion.

SCABIOSA *pratensis hirsuta quæ officinarum*, *Scabious*. The figure which *Tabernæmontanus* gives of this plant is very good. The *scabious* is bitter, and changes, a little, the blue paper; whence it is conjectured that it contains a salt which approaches near the *sal-armoniack*, mixed with great quantity of fœdid oil and earth; for by the analysis, besides several acid liquors, there are extracted from this plant much sulphur and earth, a small quantity of urinous spirit, and of a concrete volatile salt. The *scabious* is sudorifick, aperitive, detersive, vulnerary, proper to help the expectoration, when the *brunchia*, and the vesicles of the lungs are stuffed with a thick and glutinous phlegm. The juice of this plant is prescribed from three ounces to six, in which is dissolved a drachm of *teriake*, and ten grains of *camphire*, when the patient must be sweated. This remedy is good in malignant fevers, in the small pox, the measles, and the pleurisy, after the use of the antimonial remedies. The water of *scabious*, and that of *carduus benedictus*, are commonly mixed in expectorative and sudorifick juleps A syrup is made of the juce extracted from the whole plant, which is very proper for all cutaneous distempers. But, mean while, the parts be washed with the decoction of *scabious*; with every pint of that decoction are mixed three spoonfuls of camphorated brandy; the whole is strained through a cloth, to separate the *camphire* chilled on the decoction. Drank by spoonfuls, it is good for vapours. *Tabernæmontanus* says, that the juice of *scabious*, mixed with some *borax* and *camphire*, carries off those spots seen often on the *cornea*.

SERPILLUM, *wild betony*; there are different species of this plant, but they all become alike by the culture. *Wild betony* is a little bitter, acerb, stiptick, odoriferous, and changes the blue paper. There is appearance that it abounds with aromatick and oily volatile salt; but this salt retains yet part of the acidity of the *sal ammoniac* of the earth, when as in the artificial oily and aromatick volatile salt, the acid part of the *sal ammoniac*, has been stopt by the salt of tartar, therefore the *wild betony* is cephalick, stomachal, and proper for the vapours. It destroys the explosive matter which causes the convulsive motions. It furnishes the blood with spirituous particles: it restores the natural functions, and carries off the obstructions. The spirit of this plant and the water distilled from it, are very proper for soporous affections, and for the vapours. Its essential oil, and the water extracted from its flowers, macerated in brandy, and distilled afterwards, are esteemed for the epilepsy. For a cold, or an old cough, two large handfuls of *wild betony*, are thrown into a pint of boiling water. Then the pot is taken off the fire, and covered: afterwards two spoonfuls of white honey are dissolved in the infusion; which the patient must drink, very hot, at night in going to bed. The conserve made of the flowers of this plant, is a remedy for the epilepsy.

TABACUM, *tobacco*, is a a plant that was brought into *Europe* from *America*; and may be cultivated with success in any part of *Europe*.

If *tobacco* be used with judgment and moderation, it may justly claim the precedency of all other remedies; for if thrust whole, or in powder, into the nose, when necessity requires, it pricks the membrane which lines the innermost parts of the nose, and the bones which enter into its composition; that membrane being thereby contracted, presses the *papillæ* and small gland found in its texture, and from them, as from sponges squeezed with the hands, forces out the snot. which being purged, streams of serosities following the same motion, like water running through a cock, are continually flowing from the adjacent vessels and glands. A like thing happens when *tobacco* is chewed or smoked; for the maxillary glands, and salivary ducts, being likewise thereby irritated by a repeated contraction, discharge a considerable quantity of that *saliva*, which causes the fluxions; and by the successive contraction and extension of the membranes, the lungs purged of a viscous *pituita*, are free from asthma, cough, catarrh, and other dangerous affections. *Tobacco* appeases, likewise, by its sulphur, the excruciating pain of the teeth; nay, it has even the excellent qualities of the *Nepenthes*

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of *Homer*; for it makes us forget the cares of this life, renders us happy in the moſt extreme poverty, carries along with it, into our veins, the moſt flattering hope; eaſes our mind, and even ſupplies the want of victuals; for by its means, an abundance of *pituita* falls into the ſtomach, which renders hunger ſupportable, and having ſtupified the ſenſe of the nerves, appeaſes the craving ſtomach. *Tobacco* is not only a remedy to our internal indiſpoſitions, but cures, likewiſe, gnawing ulcers, and by eating the putrid and fungous fleſh, cicatrizes thoſe which have rendered abortive the virtues of the beſt remedies. But as much as *tobacco* is capable to produce all theſe ſalutary effects, it is as certain, that it can alſo be attended with very dangerous conſequences, when taken to exceſs, or without judgment: for as it has a corroſive faculty, whereby it mundifies the moſt filthy ulcers, and corrodates the ſwelling and cadaverous proceſſes, to the quick fleſh; what dangerous effects will it not produce, by its burning ſalt, if too often taken in ſnuff, or ſmoaked? for then, wounding the tendereſt membranes, it renders the nerves of the throat and ſtomach convulſive, and throws the whole nervous mechaniſm into diſorder. Of what detriment muſt be the *ſaliva*, if falling into the ſtomach, impregnated with that ſalt, it communicates to the aliments, already changed into chyle, that dangerous acrimony, to have it carried through the whole body by means of the circulation of the blood? &c.

Tea. M. *De Farcy* ſpeak thus of *tea*: This precious leaf, Tea, contains two ſubſtances, one fixed, and the other terreſtrial, which render its infuſion bitter; but the other abounding with volatile ſalt, communicates a grateful ſmell to the ſame infuſion, which infuſion produces the following good effects: it diſſipates ſoporous affections, and keeps one awake; it cures ebriety, or exceſſive drinking, and ſtrengthens the ſtomach; it raiſes the obſtructions of the ſpleen, or milt, cures the cholick, and cleanſes the reins of a viſcous *Lympha*; it appeaſes the excruciating torments of the rheumatiſm and gout, and perhaps might render the cure perfect.

Tormentilla, *ſylveſtris*, *Tormentille*. The flower of this plant is of four leaves. The root of *tormentille* is ſtyptick, very bitter, and changes a little the blue paper; the leaves change it leſs; they have a glutinous taſte. By the analyſis, this plant gives only an urinous ſpirit, no volatile concrete ſalt, much acid, oil, and earth; therefore there is appearance that it contains an aluminous ſalt, wrapped up in a great deal of ſulphur, and mixed with very little *ſal ammoniac*. This plant is vulnerary, aſtringent, and deterſive.

Tussilago *vulgaris*, *Fole foot*, *colt's-foot*, *horſe-foot*. The leaves of this plant are green a-top, lanuginous, and white underneath; they are bitter, glutinous, a little ſtyptick; they taſte of artichoke, and change very little the blue paper. It ſeems as if there was in this plant a ſalt like that of coral, wrapped up in ſulphur, and much viſcous phlegm. The leaves, and flowers of *colts foot* are ſweating, moderately aperitive, and dedicated (if I may uſe the expreſſion) to the maladies of the breaſt, cauſed by acrimonious and ſalt ſeroſities. Aſthmaticks are ordered to ſmoak the leaves, inſtead of *tobacco*. Mr. *Boyle* adviſes to mix the flowers of brimſtone with thoſe of *colt'-foot*, and aſſures us, that it has cured ſeveral Phthiſicks. In *Dioſcorides*'s time, thoſe ſort of patients were made to receive, by the mouth, the ſmoke of the leaves of *colt's-foot*. The leaves and flowers are uſed in pectoral decoctions, and in the loches proper to facilitate expectoration; a ſyrup and a conſerve are made of thoſe flowers. The following diet-drink is very good for a dry cough: four pints of boiling water are poured over four handfuls of the leaves of *colt's-foot*, and a half a handful of its flowers, half a handful of the ſummits of hyſſop, an ounce of dry'd raiſins, and three ſpoonfuls of the beſt honey; the whole is left to boil for the ſpace of two minutes, then it muſt be taken off the fire, and covered, and the diet-drink ſtrained when it is cold.

Valeriana *ſilveſtris*, *valerian*, or *ſtewal*. The leaves of this plants have no ſmell, but they have a taſte of ſalt herb, bitter, and change the blue paper; the roots change it but little; they are bitter, ſtyptick, of an aromatick ſmell, but penetrating, and which has ſomething unpleaſant. This plant has an aromatick and oily volatile ſalt, loaded with part of the acid of the *ſal ammoniac*, whereas in the artificial oily volatile ſalt that acid has been ſtopped by the ſalt of tartar. Therefore the *valerian* is anti-epileptick, ſudoriſick, hyſterick, and proper to provoke the menſes. It eaſes much the aſthmatick, and thoſe who are ſubject to vapours. *Camerarius* eſteems it for the jaundice, and *Columna* for the epilepſy. This author pretends to have cured epilepſies in uſing theſe roots. He adviſes, to gather it before it ſhoots forth the ſtems, to reduce it into powder, and take half a ſpoonful of it in wine, water, milk, or other liquor. It may be given to children, and to all thoſe who are ſubject to convulſions. For the hyſterick, and the moſt violent paroxyſms of the aſthma, a pint of boiling water muſt be poured over an ounce of the roots of this plant, and the veſſel being taken off the fire, and covered, the infuſion is taken by glaſſes. The extract of theſe roots is good for the ſame maladies. The doſe is a ſcruple, with a grain

of

of laudanum, or the laudanum is mixed with the powder.

VIOLA *martia*, *purpurea*, *flore ſimplici*, the *Violet*. The root of this plant is a little ſalt, glutinous, and deterſive; it does not change the blue paper, no more than the leaves, which are inſipid, and more glutinous. The freſh ſeeds change it a little, and are ſalter than the roots. There is in the *violet* a glutinous ſap, which wraps up the other principles, and ſtops their activity; for by the analyſis are extracted from this plant ſeveral acid liquors, much oil, a ſufficient quantity of concrete volatile ſalt, enough lixivial fixed ſalt; but it is not ſurprizing if it be ſweetened by its phlegm, and its oil, and if it is diuretick, and laxative by the mixture of the other principles. The ſalt of the *violet* participates of the *ſal ammoniac*, ſince it is compoſed of an urinous part. The infuſion of two ounces of the roots of this plant, is both emetick and cathartick; the leaves are emollient and laxative, they are employed every day in clyſters, fomentations, and cataplaſms; the flowers are looſening. *Poterius* aſſures us, that a drachm of their powder purges well enough. Of them are prepared three ſorts of ſyrup; the ſimple, whoſe colour is very beautiful, provided it be not boiled; the compound, which is the invention of *Cheſve*; and the purgative, of which *Lemery* gives the deſcription. The ſimple, and the compound, are very proper for the maladies of the breaſt, cauſed by acrimonious and ſalt humours; thoſe ſyrups are cooling. The purgative ſyrup is proper for the ſame diſtempers, when a purgative is wanted; for the ſeeds and *calices* of the flowers uſed in that ſyrup, purge very well. The roots could very well be added to it. *Etmuller* relates, that *Timæus* uſed to prepare a very good laxative conſerve of the flowers of *violets*, by giving to *manna* the conſiſtence of conſerve, with the juice of theſe flowers; that conſerve kept the body open. The doſe was from a drachm to half an ounce. A ſort of *ratifia* is prepared in the following manner, for thoſe who are coſtive: in ſix pounds of the juice of the flowers of *violets* muſt be diſſolved, on a clear and gentle fire, a pound and a half of *manna*, the whole to be ſtrained through a cloth, adding to it a pint of very good ſpirit of wine. A ſpoonful or two of this *ratifia* muſt be taken, if neceſſary, morning and night. For the nephritick, and the retention of urine, the following emulſions are prepared: let an ounce, or an ounce and a half of ſeeds of *violets* be pounded in a ſtone or marble mortar, adding to it ſix ounces of the water of *gramen*; ſtrain the emulſion through a cloth, and mix with it an ounce of ſyrup of *violets*.

Vegetables, like animal bodies, are ſubject to an infinite number of diſtempers, proceeding from internal or external cauſes.

Among the exterior cauſes of the maladies of plants, *blaſting* deſerves the firſt place, which, proceeding from a ſort of viſcous humour, corrupts the ſubſtance of the plants, eſpecially the legumns and corns, in which it is found. Hence, *Virgil*, *lib.* I. *Georgic.*

> *Mox & frumentis labor additus, ut mala culmos,*
> *eſſet rubigo.*

The vines are alſo ſubject to this malady.

Next to *blaſting* is the *dew*; when by a too great abundance of rain, the flowers of the vines are beat down, as well as young plants, which have not yet ſhot forth roots ſtrong enough to ſhelter them from ſuch accidents.

Then follows the *cold blaſt*, of which *Pliny*, *lib.* 18. *Nat. Hiſt. c.* 28. ſpeaks thus, *Carbunculare*, ſays he, *vites dicuntur*, *ut quodam uredinis carbone exuſtæ*; for plants are imagined burnt, when the phlegm, by the cold nights, is contracted in the bud of the vine; or when, by the exceſſive heat of the ſun, the fibres of the leaves, and of the cluſters of grapes, are torrified, and thereby obſtruct the circulation of the nutritious juice. Theſe, and other-like maladies, which proceed from the air, are called *ſyderation*.

Vermiculation, which *Pliny* mentions, *lib.* 17. *c.* 24. is nothing elſe than an irruption of worms into trees, by whom they are corroded, eſpecially thoſe which bear the ſweeteſt fruits, as *apples*, *pears*, &c. for the acerbs, if the oil be excepted, are not ſo much expoſed to this malady.

Plants are ſubject to ſeveral other diſtempers, proceeding from external cauſes, *viz.* ſcabs, ringworms, and decortication, occaſioned by a certain acrimonious humour, intercepted between the bark and the ligneous body, which diveſts trees of their bark, eſpecially in the *ſpring*.

Trees can alſo be wounded, but their wounds are not all mortal; for the *pine*, the *fir-tree*, and the *terebinth*, are eaſed by their wounds, which procure the evacuation of part of their fat, which otherwiſe would be very troubleſome to them. Others, eſpecially young plants, die, not only by *ſection* and *terebration*; but likewiſe by contuſion and convulſion, whereby the texture of the fibres is lacerated: and therefore the circulation of the nutricious juice is intercepted alſo by the bite of animals, which affects the ſame nutritious juice. This is called a violent death.

Plants suffer likewise, and sometimes die, thro' too great a heat, or an excessive cold.

There is, almost, but one sole internal cause of the maladies of plants, *viz.* when trees, worn out with age are deprived of aliment, by their vessels being contracted, or when they cannot retain it, nor distribute it to the several parts they are composed of, through the imbecillity of their organs: which is an infallible prognostick of their approaching death.

B R E W I N G.

IN the art of *brewing* two principal things are to be considered. *First*, the preparation of the *barley*, of which the *malt* is made, and then the manner of extracting the *liquor* from the *malt*.

Malt, is *barley* prepared, to fit it for making a potable liquor called *beer*, or *ale*, by stopping it short at the beginning of vegetation.

In making *malt* from *barley*, the usual method is to steep the grain in a sufficient quantity of water, for two or three days, till it swells, becomes plump, somewhat tender, and tinges the water of a bright brown, or reddish colour. Then this water being drained away, the *barley* is removed from the steeping cistern to the floor, where it is thrown into what is called the wet couch; that is, an even heap, rising to the height of about two feet. In this wet couch, the capital part of the operation is performed; for here the *barley* spontaneously heats, and begins to grow, shooting out first the radicle, and if suffered to continue, then the plume, spire or blade. But the process is to be stopped short at the eruption of the radicle, otherwise the *malt* would be spoiled. In order to stop it, they spread the wet couch thin over a a large floor, and keep turning it once in four or five hours, for the space of two days, laying it somewhat thicker each time. After this, it is again thrown into a large heap, and there suffered to grow sensibly hot to the hand, as it usually will in twenty or thirty hours time; then being spread again, and cooled, it is thrown upon the kiln, to be dried crisp without scorching.

This is the general process of *malting*, in which almost every malster has his secret, or particular way of working. But to render the operation perfect, the following cautions must be observed: 1. That the *barley* be newly thrashed, or at least newly winnowed. 2. That it be not mixed, or made up of different sorts. 3. That it be not over steeped in the cistern, or so long as to make it soft. 4 That it be well drained. 5. That it be carefully looked after in the wet couch, so as to stop the first tendency of the blade to shooting. 6. Another caution is, to turn the wet couch inside outermost, if the *barley* comes, and shoots more in the middle of the heap than on the sides. 7. To keep it duly turning, after it is out of the wet couch. 8. To give it the proper heating in the dry heap. 9. To dry and crisp it thoroughly upon the kiln, but without a fierce fire, so as to be several days in drying a kiln of pale *malt*. And if these directions be carefully observed, the *malt* will always be good.

The method of malting *Indian* corn or *Virginia* wheat, is much less laborious. For, if this corn be buried two or three inches deep in the earth, and covered with the loose mould, dug up to make room for it, in ten or twelve days time the corn will sprout, and appear like a green field; at which time being taken up, and washed or fanned from its dirt, it is immediately committed to the kiln, and by this means it becomes good *malt*. It is observable of this corn, that both its root and blade must shoot to a considerable length, before it will make *malt*; and, perhaps, this is the case in all large bodied grain.

The *importation* of *malt* from beyond the seas is prohibited: and on its being exported, it is not only freed from paying the excise of 6*d.* a bushel, but a bounty is allowed by act of parliament.

Malt-liquors, from the different methods of preparing the *malt*, are distinguished into *pale* and *brown*; and from the various methods taken in brewing the liquors, they are divided into *ale* and *beer*, strong and small, new and old. The colour of the liquor, and many of its effects, depend on the manner of *drying* the *malt* it is brewed with; that which has the palest tinge, is made with *malt* but *slenderly* dried; whereas that which is high coloured, is made with *malt* that is *high* dried, or roasted, as it were, in comparison of the other; and *amber-ale* is made of a *mixture* of both.

Another difference in the preparations of *malt-liquors* consists in the larger quantity of *hops* in *beer*, and the smaller in *ale*; for *hops* add something of an *alkaline* nature to the liquor, and not only render it more easy of digestion, and secretion in the body, but while it is in the liquor, prevent its running into such cohesions, as would make it ropy, vapid,

vapid, and four: for this reafon Dr. *Quincy* is of opinion, that for one conftitution injured by *beer*, there are numbers fpoiled by *ale*, which is apt to ftuff the veffels with flime and vifcidity, to make the body unweildy and corpulent, and to pave the way far *cachexies*, the *jaundice*, *afthmas*, and the *dropfy*.

The different degrees of *ftrength* in *malt-liquors*, alfo make them produce different effects. The ftronger they are, the more vifcid parts they carry into the blood: they are therefore in general the more wholefome for being fmall; that is, of fuch a ftrength as to carry fome degree of warmth into the ftomach, but not fo as to prevent their being proper diluters of our neceffary food. Indeed people of robuft conftitutions, who labour very hard, may difpenfe with reafonable quantities of the ftrongeft; efpecially as their food is frequently poor and flender enough, the deficiencies of which this fupplies; and their continual exercife and ftrength of body, digefts and breaks the vifcidities of the drink into convenient nourifhment: though in perfons of another habit, and way of living, they would only produce obftructions and ill humours. As to the age of thefe liquors, it has fomewhat the fame effect as hops, for thofe that are the longeft kept, are certainly leaft vifcid: for age, by degrees, breaks their vifcid parts, and by rendering them fmaller, makes them fitter for fecretion.

The fpirit of *malt* is thus obtained; make choice of good water. They that regard the ftrength more than the colour of their liquor, prefer ftanding waters in a flat ground, if clear and fweet, to fpring or pump waters. But Sir *John Moor* found by experience, that the beft *malt* liquor is made with water fupplied by a rivulet, or brook undifturbed by navigation, fording, or floods of rain.

All waters that are not greafy, and will bear foap and lather without breaking, are good. But the beft *pale malt liquor* is brewed with fpring and well waters: and *Thames* water taken up near *London* makes the beft beer called *Porter*.

The *Brewer* to malt and water adds a third ingredient called *hops*.

In the ufe of *hops* confifts chiefly the differences of *malt liquors*; for thofe *hopped* are called *beer*, and thofe *unhopped*, *ale*. The difference made by *hop* is beft difcovered, from the nature and qualities of the *hops* themfelves; thefe are known to be a fubtile grateful bitter, in their compofition, therefore with this liquor, they add fomewhat of an alkaline nature, *i. e.* particles which are active, fublime, and rigid; by which means the ropy, vifcid parts of the *malt* are more divided, and fubtilized; and are, therefore, not only rendered more eafy of digeftion and fecretion in the body; but alfo, while in the liquor, prevent it from running into fuch cohefions, as would make it ropy, vapid and four. For want of this, in *unhopped drinks*, that clammy fweetnefs, which they retain after working, foon turns them acid, and unfit for ufe; which happens fooner or later, in proportion to the ftrength they receive from the *malt*, and the comminution they have undergone by fermentation.

The proportion of *hops* may be half a pound to an hogfhead, of ftrong ale; one pound to a hogfhead, of ordinary ftrong beer, to be foon drank out; and two pounds to a hogfhead of *March*, or *October* beer; and for the after-worts, which are not to be kept long, what comes from the firft wort, will ferve well enough to boil again with them. If a greater proportion of *hops* be put into the firft wort, and boiled all the while the wort boils, they will make it bitter.

Regard is to be paid not only to the materials, but to the feafon in which we brew, and to the time employed in the mafhing tub, in boiling the worts, and in working them in the tun.

As to the feafon: the beft time to brew in is from *Michaelmas* to *Lady-day*; efpecially *March* and *October*, for *ftrong beer*, intended to be kept the year round or longer. In hot weather the liquor will frequently grow acid in the mafhing tub, which will always be the cafe, if the liquor be left on the grains till their earthy particles ferment.

The ftronger the worts, and the longer they are intended to be kept: the more they require to be boiled.

As for working the worts in the tun or vat, care ought to be had always to barrel them up as foon as the barm at top begins to fink.

Five gallons of drink muft be proportioned to every bufhel of *malt*, i. e. (avoiding fractions) eleven bufhels of *malt*, to every hogfhead of *ale* or *beer*. But it muft be obferved, that in fo great a difproportion of *malt-drink*, as eight to five, almoft a third of the liquor, in the firft wort, will be abforbed by the *malt*, never to be returned; and that an allowance is to be made of about a fixth part, to *evaporate* in boiling: fo that if it be expected to clear a hogfhead of drink, that is, fifty-four gallons, from the firft wort, there muft be put into the *mafh-tub* near ninety gallons of liquor; but for the fecond and third wort, the goods being wet before, no more liquor is wanted, but what is intended to make drink, except an allowance of about a tenth part for wafte, this not boiling fo long as the firft wort; and of this fecond wort may be made a hogfhead of good middle *beer* or *ale*, as ftrong as the common ale-houfe drink in *London*. The third wort will make one hogfhead of good *fmall beer*. In ordinary *brewing*, fix or feven bufhels of *malt* will make one hogfhead of good ftrong, and another of *ſmall beer*; and in ſuch caſe, two *moakſes* will as well take out the ſtrength of the *malt*, as three in the other.

The neceſſary *utenſils* for *brewers*, are a *copper*, *maſh-vat*, *receiver*, or *under-back*, *rudder*, *lead*, or *pump*, *hand-jet*, *coolers*, or *cool-backs*; *tubs*, *tuns*, &c.

All theſe *utenſils* ſhould always be kept very clean, eſpecially the *maſh-vat*, *coolers*, *tuns*, *tubs*, &c. and waſhed well with cold water, which is better than hot; for boiling water drives back into the wood, a certain ſour, fulſome quality, which the former wort has left behind; which ſourneſs communicates itſelf to the next wort, and impregnates it with that ſharp quality called *pricks*, which is often the occaſion why brewers *ale*, in hot ſeaſons, will not keep above four or five days, or thereabouts; which inconveniency could be eaſily prevented, by keeping the veſſels clean. Thoſe that *brew* only for their own private family, ſhould have their *maſh-vat*, and *coolers*, *tinned* over; which, in ſome meaſure, would prevent the ſouring or *pricking* of their *ale*, in ſummer.

For *March*, or *October* beer, it is adviſeable to have large veſſels bound with *iron hoops*, containing two, three, or four hogſheads, according to the quantity intended to be made, putting all into one veſſel; that ſort of drink digeſting, and mellowing beſt, in the largeſt quantities. If the veſſels were not *iron hooped*, the *March* beer would be in danger to be loſt, or ſpoiled.

Being provided with all the implements neceſſary for *brewing*, we will begin the operation by putting our liquor into our *copper*; which done, we will ſtrew a handful or two of bran, or meal, upon it, not ſo much to ſtrengthen our liquor, as to make it heat quickly; for ſimple water, alone, is long ere it boils.

Some put their *malt* firſt in the *maſh-vat*, and then pour in their liquor for the firſt wort; but as we follow Sir *J. Moor*, we will pour in our liquor firſt, for our firſt wort; and let our liquor remain in the *maſh-vat* till the vapour from it be ſo far ſpent that we may ſee our face in the liquor; and then pour in the *malt* upon it; we have this further advantage, that we can keep our liquor longer hot, and it will ſink gradually, diſtributing its ſtrength to the liquor equally, without matting; and if it does not deſcend faſt enough itſelf, we will preſs it down with our hands or *rudder*, with which we uſe to ſtir our *moaks*. This muſt be done by degrees, always remembering that we ſhake our ſacks before we remove them, over the ſides of the *maſh-vat*, to get out the flower of the *malt* which ſticks to them. And after all the *malt* is ſettled, and the liquor appears above it, we muſt put into the *maſh-vat* as much more hot water out of the *copper*, as will make in all ninety gallons for one hogſhead; then we will ſtir it, almoſt without ceaſing, till it has been in the *maſh-vat* about two hours from the firſt putting up the *malt*.

After this, we will pull out the *rudder*, and putting a little dry *malt* a-top, we will cover it cloſe, and leave it to ſtand half an hour undiſturbed, that it may run off clear, and the *malt* being ſunk to the bottom, the liquor a-top will run through it all again, and bring away the ſtrength of it. After this, we muſt liſt up our *tap-ſtaff*, and let out about a gallon into the long-handle jet, and put it back again, ſtopping the *tap-hole*: we will do this two or three times, till we find it runs clear, which it will not do at firſt, though our *tap-hole* is never ſo well adjuſted.

In the *North* of *England*, where much the beſt *malt-drink* is made, they are ſo careful of making their drink fine, that they let their firſt *wort* ſtand in the receivers till it is very clear, all the groſs parts being ſunk to the bottom; this they continue to do about three hours in ſummer, and ten or twelve hours in the winter, as occaſion requires, which they call *blinking*; after which, leaving the ſediment behind, they only lade out the fine into the *copper*; which cuſtom is peculiar to the *North*, and wholly unpractiſed in other parts.

When all is run out into the receivers, or under-back, we will lade, or pump out our ſecond liquor, ordered ſo as to be juſt then ready to boil, on our *moaks*; and putting the firſt *wort* into the *copper* again, we will let it boil reaſonably faſt (which boiling will be accelerated by the *hops* put on it) for about an hour and a half, for *March*, or *October* beer, to be kept long; and an hour for ſtrong *ale* to be drank new. But *wort* muſt rather boil reaſonably faſt, than to ſtand long to ſimmer; becauſe common experience ſhews, it waſtes leſs, and ferments better, after ſo long boiling, than ſimmering.

Our firſt wort being thus boiled, muſt be *pumped*, or laded off into one or more *coolers*, or *cool-backs*, in which we'll leave the ſullage behind, and let it run off fine; the more *coolers*, and the thinner it ſtands, and the ſooner it cools, (eſpecially in hot weather) the better. We'll let it run from the *cool backs* into the *tun*, very cool, and will not ſet it there to work, in ſummer, till it is as cool as water; in winter it muſt be near blood-warm; at leaſt the bowl, in which we put the yeaſt, to ſet the reſt on working, muſt have a mixture of wort hot enough to make it all ferment. When we find that it begins to work up thick to a yeaſt, we'll mix it again with our *hand-jet*, and when it has worked itſelf a ſecond time to a yeaſt, (if we deſign it for *ale*, and ſpeedy drink, and *hop* it accordingly) we'll beat in the yeaſt every five hours, for two days together, in ſummer, or more, according as the weather is; and for three or four days in winter; covering the *vat* cloſe, that it falls not into the working tun. When the yeaſt begins to work ſad, and upon turning the concave of the bowl downward, ſticks faſt to the inſide, ſkimming off, then, the yeaſt firſt, we muſt clean the reſt into the veſſel, leaving all the dregs in the bottom of the tun, and putting only the clean up. After it has a little fermented in the veſſel, we'll find it, in a few days fine, and fit to drink; though, according to the quantity of the *hops*, we may proportion it for longer keeping. If we *brew* in *March*, or *October*, and have *hopped* it for long keeping, we muſt then, upon its ſecond working to a yeaſt, (after once beating in) cleanſe it into the veſſel with the yeaſt in it, filling it ſtill, as it works over, and leaving, when we ſtop it up, a good thick head of yeaſt to keep it.

Some make their firſt wort in this manner: they make their liquor near boiling hot, as above mentioned, then pour juſt ſo much into their *maſh-vat* as will wet their *malt*, which they ſtir, and let ſtand half an hour, which they pretend prepares the *malt* the better to communicate its ſtrength to the liquor; they afterwards pour the whole quantity of liquor over the *malt*, and let it ſtand an hour and a half, or two hours, if they want to have their firſt wort very ſtrong, and the ſeaſon be not too hot: then they put what quantity of *hops* they think proper into their receivers, and let their wort run to them; and after their *hops* have infuſed an hour and a half in their wort, they ſtrain it off into the *coolers*, and thus pretend to have perfected their firſt wort. Then they put upon the *malt* their ſecond liquor, near as hot as the firſt, rather cooler, if there be any difference, which they let ſtand on the *malt* no longer than an hour, at moſt; then take what quantity they pleaſe of freſh *hops*, which they put into their receivers as before, and let the ſecond wort run to them; then take both ſecond wort, and *hops* together, and put it into the *copper*, where they let them infuſe till the wort is near boiling, and then ſtrain this, alſo, into the *coolers*.

Others boil a quantity of water, which is left to cool till the height of the ſteam be over; then pour ſo much to a quantity of *malt* in the *maſhing-tub*, as makes it of a conſiſtence ſtiff enough to be juſt well rowed up: after ſtanding thus a quarter of an hour, a ſecond quantity of the water is added, and rowed up, as before. Laſtly, the full quantity of water is added, and that in proportion as the liquor is intended to be ſtrong, or weak. This part of the operation they call *maſhing*. The whole now ſtands two or three hours, more or leſs, according to the ſtrength of the wort, or the difference of weather, and is then drawn off into a receiver, and the maſhing repeated for a ſecond wort, in the ſame manner as for the firſt; only the water to be cooler than before, and not to ſtand above half the time.

They then mix the two worts, add the intended quantity of *hops*, and cover the liquor cloſe, boiling it in a *copper* for the ſpace of an hour, or two; then they let it into the receiver, and the *hops* ſtrain'd from it into the coolers; when cold, they apply the yeaſt, or barm, and leave it to work, or ferment, till it be fit to tun up.

It is pretended, that *March* is the beſt month for *brewing*, and the water, then, better than in *October*; but Sir *J. Moor* ſays, that he has always found, that the *October beer*, having ſo many cold months to digeſt in, proves the better drink by much; and requires not ſo much watching, and tending, as the *March beer* does, by being obliged to open and ſtop the hole on every change of weather. He ſays, again, that he always broached his at about nine months end; his *March beer* at *Chriſtmas*, and his *October* at *Midſummer*; at which time he ſuppoſes it generally the beſt; and likewiſe, that it would keep very well in bottles a year or two more.

The veſſel, where the *beer* is kept in, muſt be ſtopped cloſe with cork, not clay; and there muſt be made near the bung-hole a little vent-hole, ſtopped with a ſpile, which is never to be pulled out till we bottle or draw off a great quantity together; by which means it is kept ſo cloſe ſtopped, that it fluſhes violently out of the cock, for about a quart, and then ſtops on a ſudden, and perles, and ſmiles in a glaſs like any *bottled beer*, though in Winter; but if once the vent-peg is pulled out to draw a quantity at once, it will ſenſibly loſe this briſkneſs, and be ſome time before it recovers it.

For *ſmall beer*, there is a third *maſhing*, with the water near cold, and not left to ſtand above three quarters of an hour, to be *hopped* and *boiled* at diſcretion.

But the beſt *ſmall*, or *table beer*, is made by adding a larger proportion of liquor to the *malt*, (according as one would have it) and then mixing the firſt and ſecond wort equally together.

Sir *J. Moor* ſays, that the reaſon why publick and common *brewers* ſeldom or never *brew* good drink is, that they wet more *malt* at once than it is poſſible they can have veſſels and ſervants enough to work, and ſet it cool enough to ferment kindly; and withal *brew* ſo often, that they cannot ſufficiently, between one *brewing* and another, cleanſe and ſcald their *brewing-veſſels* and barrels, giving them due time to dry; but that they will retain

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ſuch a ruſt (as I have obſerved already) as will always *char* and *ſour* their liquor. My *brewers*, ſays he, have been ſo cautious in this particular, that if any ſervants had, by accident, made uſe of any *long-handed jet*, *hand-jet*, or *pail*, waſhed with cold water, during the *brewing*, they would ſcald it a-new, and let it dry, before they would uſe it again.

Of CANDLE-MAKING.

CANDLES are made of various kinds of materials. A candle conſiſts of an outward and an inward matter. The *outward* matter is either *wax*, *ſperma-ceti*, *tallow*, or *fat* of beaſts. The *inward* matter is either twiſted *cotton*, *tow*, or *ruſhes* properly prepared.

As to the form of candles; they are made of various ſizes, both as to length and thickneſs; and their common figure is cylindrical; and they are commonly of an even ſuperficies; but the moſt genteel are fluted.

Wax is the produce of bees, and the beſt way to chuſe it is by its colour, ſmell and ſubſtance: for the beſt is that of a *high colour*, an agreeable ſmell, brittle, and which does not ſtick to the *teeth* when *chewed*.

This ſort of *wax* is *bleached*, or whitened, by reducing it firſt into little bits, or grains, by melting it, and throwing it, while hot, into cold water; or elſe by ſpreading it into very thin leaves, or ſkins. This *wax*, thus granulated, or flatted, (though it is beſt to be granulated) is expoſed to the air on linen cloths ſtretched tight on a frame. raiſed three or four feet above ground, and expoſed in an open place, or garden, to the moſt powerful beams of the ſun; the granulated *wax* is ſpread thin over it, where it reſts night and day, having equal need of ſun and dew. Then it muſt be melted, and granulated over again, ſeveral times, ſtill laying it out to the air in the intervals between the meltings. When the ſun and dew have at length perfectly *blanched* it, we'll melt it for the laſt time, in a large kettle, out of which we'll caſt it with a ladle upon a table, covered over with round cavities, of what bigneſs we pleaſe to form our *wax* into cakes; having firſt wetted thoſe *moulds* with cold water, that the *wax* may be the eaſier got out. Theſe cakes muſt be laid out to the air, for two days, and two nights, more or leſs, according to their *thickneſs*, to render it more tranſparent, and drier.

Our *wax* thus prepared, we'll go to work, beginning with *tapers*. *Tapers* are of a conical figure, ſtill diminiſhing from the bottom, which has a hole to receive the hook of the candleſtick; and are made either with *a ladle*, or *with the hand*.

To make *tapers* with the *ladle*, the *wicks* muſt be cut of the proper *length*, and a dozen of them tyed by the neck, at equal diſtances, round an iron circle, ſuſpended directly over a large baſon of copper tinned, and full of melted *wax*; then a large *ladle* full of this *wax* is poured gently, by inclination on the tops of the *wicks*, one after another; ſo that running down, the whole *wick* is thus covered, the ſurplus returning into the baſon; where it muſt be kept warm, by a pan of coals underneath it. We muſt thus continue to pour on the *wax* till the *taper* arrives at its deſtin'd bigneſs; ſtill obſerving, that the three firſt *ladles* be poured on at the top of the *wick*. the 4th at the height of $\frac{3}{4}$, the 5th at $\frac{1}{2}$, and the 6th at $\frac{1}{4}$; by which means, the *taper* arrives at its pyramidal form: which done, the *tapers* muſt be taken down hot, and laid a ſide of each other in a feather-bed folded in two, to preſerve their warmth, and keep the *wax* ſoft; then they are to be taken and rolled one by one, on an even table, uſually of walnut-tree, with a long ſquare inſtrument of box, ſmooth at the bottom, the roller having been before moiſtened with water, to hinder the *wax* from ſticking to it. The *taper* being thus rolled and ſmoothed, its biggeſt end is cut off, and a conical hole made in it with a peg ſhaped in that form, which muſt be alſo moiſtened with water, and the *taper* rolled all the while the ſaid peg is thruſting into it, to facilitate its introduction. While the *taper* is yet warm, roſes, and other figures may be made upon it, with pincers made of *box*, and may be adorned with gold leaves. This firſt manner of making *tapers*, has been for a conſiderable time almoſt out of uſe, by reaſon of its being too tedious, too precarious, and becauſe *tapers* thus made are very fragile, or eaſily broken, even when expoſed to the leaſt heat.

Therefore the moſt practiſed method of making *tapers* at preſent, is, by the *hand*; which is done thus: the *wax* being cut into pieces, and each piece weighed, according to the intended weight of each *taper*; thoſe pieces are put into hot water contained in a braſs cauldron tinned, very narrow and deep, to be ſoftened; which is not done by the hot water alone, but the *wax* muſt be worked with the *hands* ſeveral times in the hot water, to reduce it to a due ſoftneſs, that it may be worked with eaſe, and without being brittle: We muſt obſerve, likewiſe, that the water ſhould not be too *hot*; for then it would make the *wax* run, and ſtick to the *hands*; but it muſt be of ſuch a moderate heat, as the workman may bear his hands in it to take out the *wax*; which being brought to a competent ſoftneſs, the workman hangs an end of his *wick* on a hook fixed on ſome place and at a moderate height; then takes out a piece of the *wax*, which he works for the laſt time in his *hands*; then having given it the ſhape of a little channel, fixes it on the *wick* at that end tyed to the hook; then greaſing his hands with oil, or lard, but moſt commonly with oil, diſpoſes his *wax*, by little and little, round the *wick*, beginning with the biggeſt end, and diminiſhing gradually, till he arrives down to the lower end, which is to be the neck of the *taper*, and where he cuts its *wick*; and then carries his *taper* to the table to be rolled, and perforated, as thoſe made with the *ladle*. *Tapers* made in this manner are ſtronger, and burn a great deal longer, and in *hot weather* will rather bow than break.

Cylindrical wax candles, are either *for the table*, or *drawn*. The firſt kind are made of ſeveral threads of cotton looſely ſpun, and twiſted together, covered with the *ladle*, and rolled, as the conical ones, but not pierced.

Drawn wax candles, are ſo called, becauſe actually drawn, in the manner of wire, by means of two large rollers, or cylinders of wood, turned by a handle; which turning backwards and forwards ſeveral times, paſs the *wick* through melted *wax* contained in a braſs baſon, and at the ſame time through the holes of an inſtrument like that uſed for drawing wire, faſtened at one ſide of the baſon; ſo that by little and little the *candle* acquires any bulk at pleaſure, according to the different holes of the inſtrument through which it paſſes. By this method may four or five hundred ells length be drawn running,

TALLOW is a ſort of animal fat melted down, and clarified. There are ſcarce any animals but a ſort of *tallow* may be prepared from; but thoſe which yield the moſt, and whereof the moſt uſe is made, are the horſe, bullock, ſheep, hog, goat, deer, bear, *&c.* But the beſt *tallow* for *candles*, muſt be half ſheep's, and half bullock's; that of hogs making them gutter, gives an ill ſmell, and a thick black ſmoke. *Candles* made of dripping or other kitchen-ſtuff as they call it, are of little or no ſervice; for beſides that, they give but a very bad light, they are almoſt as ſoon burnt as they are lighted.

The beſt *tallow* is that which is hard, has a blueiſh caſt, and when handled does not feel greaſy. This *tallow* is made by cutting the *fat* of the animal, *viz.* of bullocks and ſheep into pieces, (though *tallow* made wholly of *ſheep's fat* be the beſt, and makes finer *candles*) and throwing it into a pot or boiler, while it is melting it muſt be ſkimmed of all its impurities; and when entirely melted, it is ſtrained through a ſieve made for that purpoſe, to free it of the impurities which could have eſcaped the ſkimmer; which is a great deal better method than that of throwing water into it to precipitate thoſe impurities; for the water communicates a certain humidity to the *tallow*, which hinders the *candles* from burning well, and is the cauſe why they ſo often crackle and ſpit in the burning. Though it be the common practice here in *England*, where, after the *tallow* is melted, they empty it, thro' a ſierce, into a tub, having a top for letting it out as occaſion requires; and uſe it after it has ſtood three hours.

The liquid tallow is drawn off from the tub, which has a tap for letting it out into a veſſel called the mould, ſink, or abyſs, of an angular form, like a priſm, except that it is not equilateral; the ſide on which it opens being only ten inches high, and the others which makes its depth, fifteen. On the angle, formed by the two great ſides, it is ſupported by two feet, and is placed on a kind of bench, in form of a trough, to catch the droppings, as the *candles* are taken out each dip. In *France*, their *mould*, ſink, or abyſs, is a ſtone veſſel, glazed within and without, of about two feet long, a foot and a half deep, and four or five inches broad a-top. This they fill up from the copper, or *poile*, as they call it, wherein they keep their tallow melted over a very ſlow fire, to keep it always in a due conſiſtence, that they may be capable to ſupply the ſtock in the mould, when it begins to be too much diminiſhed. Before the artiſt ſets his mould for the operation of dipping, he has all his *wicks* ſinged over a flame, to ſinge off all the nap, which would be upon them, which is ſo often the occaſion why *candles* run and ſlear; and after they are thus ſing'd, they are rubbed again with a piece of cloth, to make them ſmooth. Then they are all put upon five or ſix broaches, more or leſs, according to their quantity, and each broach immerged once, the *wicks* being all in a heap upon each broach; after which immerſion the *wicks* are all parted, one by one, ſmoothed and ſtraitened with the fingers, and then ſtrung on other broaches, by ſixteen, if the *candles* be eight in the pound; by twelve, if of ſix in the pound, *&c.* In my opinion, this firſt dipping contributes much towards making the *candles* ſtrait, as well as facilitating the firſt immerſions, which otherwiſe would be attended with ſome difficulty, each *wick* without it being too light to be immerg'd with eaſe; while,

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on the contrary, being render'd heavier by the *tallow* they have gather'd in that first immersion, that weight helps towards their precipitation into the *tallow*, and keeping at a due distance from each other.

The *wicks* being thus disposed upon the *broaches*, they are hung on a rack, and then the workman. sitting at a due distance from his mound, takes two *broaches*, at a time, and holding them equidistant, by means of the second and third fingers of each hand, which he puts between them, he immerges the *wicks* two or three times for their first lay, and holding them sometimes over the top of the vessel, to let them drain, strikes gently the ends of the *candles* against the said top, to make it round, (which striking is repeated every time the *candles* are immerg'd, and till they are quite finish d, which saves the trouble of passing them, after they are made, over a flat brazen plate, heated to a proper pitch by a fire underneath, to take off their peak'd ends, or bottoms) then he places again the *broach* on the same rack he has took it from, which, for greater conveniency, should be placed on his right hand, beginning at the end next to him, and proceeding thus to the further end, that when he has immerg'd all his *broaches*, he may come back to the first *broach* he had begun with, and so on to the others successively, that each *broach* may have time to dry before 'tis dipp'd again; which dipping is to be repeated as often as the workman judges it proper to bring the *candles* to the thickness proposed; with the last dip the *candles* are naked, *i. e.* plung'd below that part of the *wick* where the other lays ended. During the whole operation, the *tallow* is to be stirred from time to time.

We'll proceed to the making of *mould candles*; which to perform, we have provided ourselves with brass and tin *moulds*, which are the best, which *moulds* consist of three pieces, the neck, shaft, and foot. The shaft is a hollow cylinder, of the diameter and length of the *candle* proposed; at the extremity of this is the neck, which is a little cavity, in form of a dome, hav ng a moulding within side, and pierced in the middle with a hole big enough for the *wick* to pass through. At the other extremity is the foot, in form of a litle tunnel, through which the liquid *tallow* runs into the *mould*. The neck is soldered to the shaft, but the foot is moveable, being applyed when the *wick* is to be put in, and taken off again when the *candle* is cold. A little beneath the place where the foot is applied to the shaft, is a kind of string of metal, which serves to support that part of the *mould*, and to prevent the shaft from entering too deep in the table, to be mentioned hereafter. Lastly, in the hook of the foot is a leaf of the same metal, soldered within-side, which advancing into the center, serves to keep up the *wick*, which is here hooked on precisely in the middle of the *mould*.

Having thus described the *mould*, we'll proceed to the operation, by introducing, first, by a piece of wire, the *wick* into the *mould*, through the aperture of the hook, till it comes out at the neck, to which it must be tyed, so that in drawing the wire back the *wick* comes along with it, leaving only enough a-top for the neck; the other end is fastened to the hook, which keeps it perpendicular. Then we'll dispose the *moulds* in the table abovementioned, pierced full of holes, each an inch in diameter: These holes receive the *moulds* inverted as far as the string in the foot. Being thus placed perpendicularly, we'll fill them with melted *tallow*, (prepared as before) by pouring it into the foot with a pot, or ladle. After the *moulds* have stood long enough to cool, for the *tallow* to have arrived at its consistence, the *candle* is taken out, by taking off the foot, which brings the *candle* along with it. This sort of *candles* is more agreeable to the sight, light better, and last longer, than the dipped ones, and cost but a trifle more.

All these candles and tapers are made of *cotton* or *tow*.

The *cotton* is bought in skeins, ready spun, by chandlers. In the countries where that commodity is not easily come at, its want is supplied by *tow*, which being spun and whitened, makes as good wicks as cotton itself. The threads, either of *cotton* or tow, are winded of three or four together, according to the intended thickness of the *wicks*, into bottoms or clues, whence they are cut out with an instrument, contrived for that purpose, into pieces, for the length of the *candle* required. If the threads be made of *tow*, care must be taken, in cutting the *wicks*, to pick out and free it of all the small rushes which could have been left in it, and which otherwise would make the *candle* flear, and run; each *wick*, after it is cut, must be slightly twisted, and rubbed, with a coarse piece of cloth, else it would not keep on twisted. Then they must be put on the sticks or broaches, then hung up to dry, in some place near the fire, or in a stow; for unless the *wick* be thoroughly dry, the *candle* will never give a good light.

The *candles*, whose *wicks* are made of *rushes* are called *rush-lights*, and are generally used by poor people, or to burn steady instead of a lamp in a bed-chamber, where a light is required.

There is another sort of *candles* called *flambeau*.

Flambeaux are made square, usually of four *wicks*, or *branches*, of an inch thick, and about three feet long, made of a coarse hempen yarn half

half twisted. They are made with the *ladle*, much the same as *tapers* are, *viz.* by first pouring the melted wax on the tops of the several suspended *wicks*, and letting it run down to the bottom: this is repeated twice. After each *wick* has thus got its several cover of *wax*, they are laid to dry, then rolled on a table, and four of them joined together by being soldered with a red hot iron. When joined, more *wax* is poured on them, till the *flambeau* is brought to the size required, which is usually a pound and a half, or two pounds. Their form, or outside, is finished with a kind of polishing instrument of wood, by running it along all the angles formed by the union of the *branches*.

The *flambeaux* of the antients were made of wood dry'd in furnaces, or otherwise. They used divers kinds of wood for this purpose; the most usual was pine. *Pliny* says, that in his time they frequently also burnt oak, elm, and hazel. In the 7th book of the *Æneid*, mention is made of a *flambeau* of pine; and *Servius* on that passage remarks, that they also made them of the cornel-tree. *Flambeaux* are sometimes made of *white wax*, and sometimes of *yellow*; but those made of *white wax* are finer, light best, and are of a less offensive smell; though in all *flambeaux*, let them be made of *white*, or *yellow wax*, both sorts of *wax* are always more or less sophisticated. They serve to burn a-nights in the streets, as also at funeral processions, illuminations, &c.

Of CHIRURGERY, *or* SURGERY.

CHIRURGERY, or SURGERY, is that branch of *medicine*, which teaches the method of *curing* WOUNDS of all kinds, and performing a variety of *manual operations* necessary in *dislocations*, *amputations*, *cutting* for the stone, *fractures*, *phlebotomy*, the *Cæsarean section*, &c.

It is derived from the *Greek* χειρ, *a hand*, and εργον, *operation*, and it is divided into *speculative* and *practical*, one whereof does that in effect, which the other teaches to do.

All the operations of *Chirurgery* are reduc'd under four kinds; 1. the *synthesis*, 2. *diæresis*, 3. *exæresis*, and 4. *prothesis*.

The SYNTHESIS is that, which reunites all the divided parts; as are the *wounds*.

The DIÆRESIS is that, which divides and separates the parts, whose union hinders the cure of maladies; as is the *continuity* of the *skin*, and of the flesh in abscesses, which must be open'd to procure the evacuation of the *pus* contain'd therein.

The EXÆRESIS is that, which extracts from the body all, which could be hurtful to it; as *bullets*, *arrows*, *pus*, &c.

The PROTHESIS is that, which supplies, artificially, the want of some parts; as, of *legs*, *arms*, &c. when the natural ones are lost. It adds, besides, some instrument, to help the weak parts; as *pessaries*, to keep the *matrix* in its place, when it falls; *crutches* to help walking, when a person is weak, &c.

The foundation of *Chirurgery* consists in three things, *viz.* in the knowledge of the *human body*; of the *maladies*, which want the *operation of hands*; and of the proper *remedies*.

The knowledge of the *human body* is acquir'd by the study of *Anatomy*, of which we have given an accurate treatise under the letter *A*. That of the *maladies*, 1. By reading good books, and the lessons of the best masters in *Chirurgery*; and, 2. By a constant and assiduous practice.

The *maladies* which fall under the consideration of a *Chirurgeon*, are tumours, impostumes, wounds, ulcers, fractures, dislocations, and generally all maladies, which can be the subjects of operations.

The MEANS and INSTRUMENTS us'd in *Chirurgery*, to cure those *maladies*, are the *hand*, *bandages*, *medicaments*, *iron*, and *fire*.

The INSTRUMENTS are *portative*, and *non-portative*.

The *portative instruments* are those, which a *Chirurgeon* carries in his case, together with his box of *unguentums*, as a good pair of scissars, a razor, a *bistouri*, strait and bow'd, a *spatula*, a great *lancet* for the abscess, smaller ones for bleeding, a *hollow probe*, of silver or steel, several other *probes*, strait, bow'd, &c. of several sizes; a silver *canule*, or pipe, to carry the button, or knob of fire to a distant part without any danger of burning the neighbouring ones; another *canule*, or pipe, for a case for needles, made like a whistle at one end, for the *sutures*; a big triangular needle, call'd *carlet*, a *myrtle-leaf*, a *small file*, instruments for tooth-drawing, a lenticulary, an *erbina*, &c.

The *instruments non-portative*, are the *trepan*, to open the bones of the head, or other parts; the *algabus*, or *probes*, for men and women in the stone, and difficulties of urine; large bow'd cutting knives, a saw for amputations, great three-square needles for *setons*, small needles for the ablation of the cataract, small plates and buckles.

From the *instruments*, we'll proceed to *compresses*; *bands*, *splinters*, *fanons*, *tents*, and *lint*.

A BAND is a long and large string made of linen, wherein the parts and *apparatus* are wrapp'd up, and contain'd.

A BANDAGE is the *band* apply'd on the part. There are as many different sorts of *bandages*, as there are parts to be ty'd; therefore they are either *simple* or *compound*.

The COMPRESSES must be made even, soft, and in proportion to the bigness of the part, or of the wound. They must be garnished in uneven places, that the bandages may be the easier rolled over them, and humected with some liquor proper to the malady.

The different MALADIES which fall under the inspection of a *Chirurgeon* are *tumours* in general.

A TUMOR or *tumour*, is a particular rising, or eminence, on any part of the body; otherwise, it is a solution of continuity, arising from some humour collected in a certain part of the body, which disjoins the continuous parts, insinuates itself between them, and destroys their proper form.

This gathering of humours in the parts of the body, is call'd *depositum*, which *depositum* is made either by *fluxion*, or *congestion*.

A *Depositum* by *fluxion* is that, which forms the *tumour* all on a sudden, or in a very short time, by the fluidity of the matter. And a *Depositum* by *congestion* is that, which produces the *tumour* by degrees, and almost insensibly, thro' the slowness and thickness of the matter.

The most dangerous of all *tumours* are those made by *congestion*; because their coarse and thick matter renders their cure very difficult.

The general rules which a *Chirurgeon* is indispensibly oblig'd to observe before he undertakes the cure of *tumours*, are these: 1. He must examine the nature of the *tumour*; because that which is natural, is otherwise treated than that which is *ankisted*, critical, or malignant. 2. The time of its formation, *i. e.* its beginning, increase, state, and declension; in which different periods there must be apply'd different remedies. And, 3. Its situation, that the *Chirurgeon* may avoid, in the opening of the *tumour*, the encounter of a neighbouring artery or tendon.

We must observe, also, that all *tumours* terminate, or are remov'd by *suppuration*, or *resolution*. The safest manner to cure a *tumour*, is by *resolution*, except when the *tumours*, or *abscesses*, are critical and malignant; for, then the *suppuration* is not only the surest way, but must be procured even by opening it; without waiting for a perfect maturity. In such opening, the *Chirurgeon* must take a great deal of care not to cut the fibres of the muscles, and ought not to procure an entire evacuation of the *pus* at once, especially in great *abscesses*, for fear the patient should faint away; neither is such opening to be made, always, longitudinally, or according to the straitness of the fibres; for when the *tumours* are large, and there is a *cystis*, the incision must be *crucial*, or made cross-wise.

To proceed in the cure of *tumours*, let us begin with the *phlegmon*.

The PHLEGMON, from the *Greek* φλέγειν, to burn or inflame, is a *tumour* attended with redness, tension, renitency, pulsation, and great pain; which when occasion'd by an extravasated blood, good and laudable, but only peccant in quantity, is call'd, *true phlegmon*; but if that blood be adulterated with bile, or *pituita*, it is call'd *bastard phlegmon*.

There are two sorts of remedies proper for the cure of *phlegmons*, the one general, and the other particular. The general remedies, which carry off the antecedent cause, are bleeding, and an exact diet. Purgatives cure sometimes the *phlegmon* in its *antecedent cause*, by diminishing the plenitude, heat, and alteration of the blood. Fomentations, cataplasms and plasters, cure it in its *conjoint cause*, by procuring the resolution, or suppuration; all which different remedies ought to be administred in order, and with judgment, *v. g.* Bleeding is to be done in the beginning and augmention, or increase of the *phlegmon*. The resolutive and anodyne remedies are necessary, such as those prepared with *chervil* boiled in whey, to which is to be added some saffron, to wash the tumour with, which must be wrapt in cloths dipped in the same liquor. The sperm of frogs alone, or lime and soap water mixed together; or else oak and plantain leaves bruised and applied on the part, are also very good remedies for the *phlegmon*; avoiding above all things cold remedies, oil, and grease, which are pernicious in great inflammations. These are the remedies by which we must begin the cure.

But in the augmention of the *tumour*, and of the pain, it must be softened by resolution; and for that purpose a cataplasm is composed with leaves of elder, with mallows, camomile, and melilot, to which is added pounded linseed, boiling the whole in whey, adding to a pound of it the yolk of an egg, twenty grains of saffron, a quarter of a pound of honey, and crumbs of bread, till it has acquired a due consistence for a cataplasm, which must be renewed every twelve hours at least.

When the *phlegmon* is arrived at its height, if it could not be brought to a resolution, its suppuration might be procured, by adding to the aforesaid cataplasm, garlick, the roots of white lilies broiled under the embers, whey and basilicon: Or else we'll take only a glass of whey, in which we'll melt an ounce of soap, to dip cloth in it, which we'll apply on the tumour, reiterating it often. The plaister *diasulphuris* is very excellent alone.

When the malignity is conquered, and the *phlegmon* is on its declension, the ulcer must be dried by degrees with the plaister *diasulphuris*, or the *diachylum*, afterwards we'll use those of *ceruse*.

If, during the inflammation, the gangrene should happen

happen, there must be dissolved in an ounce of the best vinegar, a drachm of white vitriol, with the same quantity of *sal-ammoniac*, to bathe the tumour with, or else we'll take the tincture of myrrh, and of aloes, with some *Ægyptiac*, and we will make afterwards a digestive with terebinth, yolks of eggs, and honey, mixing with it some spirits of wine, or brandy, if any purulent matter was left behind.

Bastard phlegmons, otherwise *phlegmonous tumours*, are *buboes*, *carbuncles*, *furuncles*, *antrax*, *phigeton*, *phyma*, &c.

All these *tumours* are cured with emollient, resolutive, and suppurative cataplasms and plaisters, applied with judgment, and in proportion, as 'tis done to the *phlegmons*.

The same cannot be said of the *gangrene*, which is distinguished into *gangrene* and *sphacelus*, though they be but one and the same thing; the *gangrene* being a mortification begun, while yet the part retains some sense of pain, and a share of natural heat; and the *sphacelus* a thorough mortification, where there is no sense or warmth left.

The *gangrene* is a disease in the flesh of the part, which it corrupts, consumes, and turns black; spreading and seizing itself of the adjoining parts: it proceeds from a stoppage or interception of the circulation of the blood, which by this means fails to furnish the part with the nutritious and spirituous juices, necessary to preserve its warmth and life.

To stop the progress of the *gangrene*, Physicians prescribe, internally, sudorificks and alexipharmicks: Externally, decoctions of quick lime, either simple, or with the addition of *sulphur*, *mercurius dulcis*, and *spirit of wine* camphorated. In a severe stage of the distemper we scarify deep to the very quick; and afterwards apply hot liquors, cataplasms, &c. Some recommend horse-dung boiled in wine, or urine: The *unguent Ægyptiac* also comes into use. *Belloste* prescribes the following as the most efficacious remedy known for *gangrenes*, viz. *quicksilver* dissolved in double the quantity of *spirit of nitre*, or *aqua fortis*; a linen cloth dipped therein, and applied to the *gangrenous* part: this alone, he assures us, is sufficient. If the *gangrene* be occasioned by an intense frost, *snow-water*, or a linen-cloth dipp'd in cold water, and applied to the part affected, *Boerhaave* directs as the best cure. If the *gangrene* proceed to an entire *sphacelation*, and be seated in any of the limbs, or extreme parts, recourse must be had to amputation.

The *panaris*, *panaritium*, or *paronychia*, (from the *Greek* παρωνυχία, q. d. an abscess at the root of the nails) is a *tumour* or inflammation arising on the extremities of the fingers or toes, properly called *whitloe*.

An infallible remedy for the *panaris*, is to open it either with a point of a lancet, or with some unguent, and then to dip the finger in a *lixivium* made of pine ashes.

Chilblains are cured by washing and holding, for some time, the heel or other part affected in hot wine, where have been boiled *allum* and *salt*, of which a cataplasm is made, afterwards, by adding to it *rye-flower*, *honey*, and *sulphur*. The juice of radishes and also of turneps applied hot, with *unguent* of *roses*, is also a very good remedy.

The *burn* is cured by anointing the part with sweet oil, or with soft soap, or with white ointment, mixed with *unguent* of *roses*, and of *populeon*, the yolk of an *egg* and quick lime. If the *burn* be in the face, there must be particularly used the *mucilage* of *quince-seeds*, and of *psyllium*, of *sperm* of *frogs*, equal part of each, and to four ounces thereof must be added twenty grains of *sugar* of *saturn*. This remedy is spread on the face with a feather, and over it, is applied a piece of grey paper. This remedy is excellent.

If the *burn* has made a crust, 'tis taken off with fresh butter, spread on a cabbage-leaf, applied hot: or opened for the evacuation of the *pus*, which would cause a deep ulcer, if kept long under it, and there must be applied to it the *unguent* of *quick lime*, with *oil* of *roses*, and *yolks* of *eggs*.

The next sort of *tumours*, to be considered are the *erysipelas*, and its dependencies.

Erysipelas is an eruption of a fiery or acrid humour, from which no part of the body is exempted, though it chiefly attacks the face.

As to the material cause of an *erysipelas*, it seems to be of a caustic, acrid, and putrifying nature; perhaps corrupted bile, which, being conveyed into the mass of blood, indisposes the whole nervous and vascular systems, and excites a fever, till it is at last driven out to the surface of the body. Persons of a sanguine habit, young people, and pregnant women, are most subject to it; and all hot things, violent passions, and whatever occasions other inflammations, likewise give rise to this.

The patient is taken suddenly, whilst he is in the open air, with chilness, a shivering and other symptoms common in a fever: the part affected swells a little with great pain, and intense redness, and is beset with a vast number of small pustules, which, when the inflammation is increased, are converted into small blisters. The malady gradually creeps further and further, spreads itself from place to place, and is attended with a fever.

There is another sort, though it seldom happens, commonly arising from a surfeit, or a debauch of drinking spirituous liquors. A small fever, which precedes it, is followed presently by an eruption of pustules, almost all over the body, which look like the stings of nettles, and sometimes rise up into bladders: presently they go away again, with an itching

itching ſcarce tolerable; but as often as they are ſcratched they appear again.

This diſtemper has a great affinity with a peſtilential fever, as it is attended with moſt of the ſymptoms in that caſe: but this is to be underſtood of the worſt kind of *eryſipelas*. On the third and fourth day, the malignant matter is thrown out on the ſurface of the body, and then the ſymptoms a little abate. There is often a pain, redneſs, and *tumour* in the inguinal glands, from whence the matter, of a hot, fiery quality, deſcends to the feet. If the head is attacked, the parotid glands are affected; if the breaſt, the axillary. The mammary and axillary glands are not ſeldom ulcerated, and affect the joints with a virulent corruption; and likewiſe, as in the plague, there is nothing more dangerous than the expelled matter to return back from the ſurface of the body to the inward parts.

In ſome, eſpecially young perſons, the matter is not ſo violent, nor the fever ſo great: the glands remain unaffected, and the eruption happens on the ſecond day. This is not at all dangerous. In children, the umbilical region generally ſuffers, with a fatal event. If in a day or two the *tumour* ſubſides, the heat and pain ceaſe, the roſy colour turns yellow, the cuticle breaks, and falls off in ſcales, the danger is over. When the *eryſipelas* is large, deep, and falls upon a part of exquiſite ſenſe, the patient is not very ſafe; but if the red colour changes into black and blue, it will end in a mortification. If the inflammation cannot be diſcuſſed, it will ſuppurate, and bring on *fiſtulas* and a *gangrene:* when the patient is *cacochymical*, the leg will ſometimes ſwell three times as big as the natural ſize, and is cured with great difficulty. Thoſe who die of this diſeaſe, die of the fever, which is generally attended with difficulty of breathing, ſometimes a delirium, ſometimes with ſleepineſs; and this in ſeven days time.

Let the patient's diet be water-gruel or barley-broth, with roaſted apples. If he drinks any beer, let it be very ſmall, and let him keep out of bed ſome hours in a day.

The medicinal writers do not agree in their opinions, concerning purging in the cure of the *eryſipelas*; but what they deliver upon this ſubject, is full of doubtings and uncertainties, and that at a point of time when the diſtemper is moſt dangerous and threatning: however, it is the general opinion in this caſe, that it is a right practice, more eſpecially if the head is affected with an *eryſipelas*, and there comes upon it a *coma*, a *delirium*, or *convulſions*, wherein the brain is evidently attacked; then purging is the only indication that can afford any hopes of recovering the patient: nor in theſe difficulties ſhould the matter be delayed till the fever is abated, or the humour ſubſided. Therefore, the beſt practice appears to be that of taking away nine or ten ounces of blood, and the next morning giving the patient the common purging portion.

It will be ſafeſt to avoid external applications, unleſs a powder made of elder-flowers and liquorice ſprinkled on the part; or lime-water mixt with a fourth part of ſpirit of wine and camphire, dipping a linen cloth in it ſeveral times doubled, and applying it hot to the part.

An infuſion of ſcordium, elder-flowers, and fennel-ſeed, drank in the manner of tea, is uſeful to expel the morbific matter. If the diſeaſe does not yield to the firſt bleeding, let it be repeated. If that will not do, let it be reiterated twice more, one day being interpoſed between. On the days free from bleeding, preſcribe a clyſter of milk, and ſyrup of violets; alſo the cooling emulſion and julep.

Turner commends much a mixture of *ol. ſambucin.* and *aqua calcis*, with ſome ſpirit of wine camphorated. A cataplaſm of cow's dung is very good to eaſe the pain.

In a *ſymptomatic eryſipelas*, the following liniment is good: ℞ *Ol. ſambucin.* lixiv. *tenueor.* ana p. æ. m. let them be ſhaked in a phial till they unite in an ointment.

In a *ſcorbutic eryſipelas*, beſides externals, ſudorifics are to be given; as *rob. ſambucin. ſpi. ſamb ci bezoar. min. ſp. ſal. ammon. cochlear*, &c.

From the *eryſipelas* we'll paſs to the *Oedema*.

The OEDEMA, (from the *Greek* οἰδάω, *I ſwell*; whence οἴδημα, a *tumour*,) is a *tumour*, which appears whitiſh, ſoft, and lax, without any notable change of colour, heat, pain, or pulſation; and which yields to the preſſure of the finger, ſo as for ſome time to retain the dent or impreſſion thereof.

Its chief ſeat is in the legs: In a *leucophlegmatia* the whole body is *œdematous*.

Fomentations, cataplaſms, liniments, and plaiſters, are very good remedies for the *œdema*. The fomentations are made with *wall-wort*, tied in bundles, covered with hot wine, and put in an oven after the bread has been took out; they are alſo took out ſmoaking hot, the bundles are untied, and the part is wrapp'd up within them, covering them over with a hot cloth. This being often reiterated, the humour tranſpires by ſweat. The cataplaſm are compoſed of *camomile*, *melilot*, *St. John's wort*, *ſage*, *parietary*, the root of *briony*, *onions*; the whole boiled in *white wine*, with *honey*. Cataplaſms are alſo made with *horſe-dung* and *cummin ſeeds* boiled in ſtrong *vinegar*, mixing with it *barley-flour* to the conſiſtence of pap. The plaiſters are prepared with an ounce of *diachylum de gummis*, half an ounce of *martiatum*, a pound of *oil* of *lilies*, half an ounce of *cummin-ſeeds* in powder, half a drachm of *ſal-ammoniack*, and an ounce of *yellow wax*, to bring it to a confiſtence. If there was a hardneſs, the plaiſter made with the gum of *bdellium*, *ammoniac*, and *galbanum*, diſſolved in vinegar, muſt be uſed.

OEDEMATOUS *apoſthumes*, or *tumours*, which partake of the nature of the *Oedema*, are, the *phlyctains*, *empyſema*, *batracos*, or *ranuncle*, the *wyne*, the *talpa*, the *broncocel*, the *ganglion*, the *fungus*, the *king's-evil*, and all the ſpecies of *dropſies*, general and particular.

All the remedies preſcribed for the *œdema* are alſo employed variouſly in all theſe maladies, as are liniments, fomentations, cataplaſms, and plaiſters. Internal remedies, ſuch as diaphoreticks, ſudorificks, and purgatives, ſupported with an exact diet, are of great ſervice. The decoction, of *briony*, and *marſhmallow roots*, with *betony*, *liquorice*, and all other diureticks, which puſh by urine, give a great deal of eaſe.

The SCIRRHUS, (from the Greek σκιρῥος, a piece of marble) is a hard indolent *tumour*, formed gradually in the ſoft glandulous parts of the body; ſometimes internal and ſometimes external.

The *ſcirrhus* is cured by ſoftening and reſolving it, ſeldom by bringing it to *ſuppuration*. 'Tis ſoftened by the application of cataplaſms, made of the leaves of *violets*, *mallows*, *marſhmallows*, *leeks*, *alder*, *rue*, and *wormwood*; with *camomile flowers*, *horſe* and *cow's dung*, and roots of *white lilies*, all this is boiled together in wine, to which are to be added *honey* and *hog's-lard*, to make a cataplaſm, with crumbs of bread. 'Tis *reſolved* with plaiſters compoſed of *diachylum*, *melilot*, and *mucilages*, to which are added the *oil* of *worms* and the *flour* of *ſulphur*. And to render the remedy more efficacious, the *oil* of *tobacco* and *gum ammoniack* diſſolved in vinegar. Theſe topical or external remedies muſt be accompanied with internal, which ſerve to prepare the humours to be evacuated, as the decoction of *ſarſaparilla*, the uſe of good wine, and light aliments, of an eaſy digeſtion.

The POLYPUS, πολυπους or πολυπος, is a fleſhy tumour or excreſcence, on the inſide of the noſtrils, prejudicial to reſpiration, or ſpeech; call'd alſo, by way of diſtinction, *polypus narium*.

Polypus is alſo us'd for a morbid excreſcence in the heart; conſiſting of a tough concretion of grumous blood lodg'd therein.

The *polypus* of the noſtrils may be cured in its beginning, but when neglected, or ill managed, it degenerates into an incurable cancer. The general remedies are ſmall bleedings, and reiterated purgatives, with an exact diet; of the particular ones, are thoſe which dry up and conſume the excreſcence; as the decoction of *plantain*, *betony*, and *parietary*, in red wine, which muſt be drawn up the noſe, or introduced into it with ſmall tents, often renewed, adding to it ſome tincture of *myrrh*, and *honey*. If the diſtemper cannot be conquered by remedies, recourſe muſt be had to the extirpation thereof.

The NACTE, *longing*, is a *tumour* or excreſcence of the fleſh, which grows on the face, and every where elſe; occaſioned by the urgent deſires of the mother during geſtation, for things which ſhe has not enjoyed, as ſhe could wiſh.

The CANCER, is a roundiſh, hard, ragged immoveable *tumour*, of an aſh or livid colour; encompaſſed round with branched, turgid veins, full of black muddy blood; ſituate chiefly in the glandulous parts. There have been ſome found in the gums, belly, neck of the matrix, ureter, lips, noſe, cheeks, abdomen, thighs, and even the ſhoulders.

Stolterforth obſerves, that it has been often cured by mercury and ſalivation. It is uſually cured, while yet a ſmall *tumour* of the bigneſs of a nut, or at moſt of a ſmall egg, by *extirpation:* when it ſeizes the breaſt, or is burſt into an ulcer, *amputation* takes place.

Having thus treated of all the different ſpecies of *true tumours*, we ll paſs to the *enciſted* or *baſtard* ones.

ENCISTED *tumours*, are thoſe formed by a *depoſitum* of mixt and corrupted humours, whoſe matters are contained in *cyſtis*, or membraneous bags.

The ſpecies of thoſe *tumours* are the *ſteatoma*, *atheroma*, *meliceris*, &c. The *ſteatoma* is known by its matter, which reſembles tallow; the *atheroma* by its ſoftneſs reſembles pap; and that of *meliceris* reſembles honey.

Theſe ſorts of *tumours*, like the others heretofore mentioned, ſhould be reſolved; but however, the ſureſt way is to bring them to *ſuppuration*, and to extirpate the *cyſtis*, which is ſubject to be filled again, after the reſolution of the humour. All the remedies uſed for the *œdemas* and *ſcirrhus* are very good for theſe *tumours*. The ſpecifick ones are theſe: Take roſemary, ſage, wormwood, elder, camomile, melilot, St. John's wort, put them to boil in white wine, with mercurial honey, add to it the ſeeds of cummin pounded, and the oil of worms, to compoſe a cataplaſm, which muſt be renewed twice a day, after which, if the *tumour* cannot be diſſipated, you muſt apply the following plaiſter, which is excellent: take equal parts of *diachylum* and of *devigo*, four parts of mercurial plaiſter, melt them together, and mix with them ſaffron and oil of tobacco, to make a plaiſter, which you'll ſpread upon a piece of leather and apply on the *tumour*, without removing it but once in eight days to renew it.

As for the extirpation of the *cyſtis*, it is made by dividing the *tumour* into four parts, by procuring the

the fuppuration, and confuming the *cyftis* by degrees.

The SCURVY is a malady common among us. *Willis* fays, that the *fcurvy* is not a particular difeafe, but a legion of difeafes, by its attacking the feveral parts of the body at once.

The moft ufual fymptoms of the *fcurvy*, are, ftinking ulcers in the mouth, a copious falivation, head-ach, vertigo's, epilepfies, apoplexies, paralyfies; the face appears of a pale and dark red, fwelled, inflamed, and covered with puftules; the teeth fall, the gums fwell, itch, putrify, and ulcerate; they become cancerous, and the jaws are almoft immoveable; and the ulcers caufe fometimes fo much diforder, that the jaws are all eaten with it, and the teeth feen. There happens a relaxation of the parts, the patients grow ftupid and fleepy, they breathe but with difficulty, have a palpitation of the heart, cough, and faint away; they have frequent reachings, loofeneffes, gripes, have red and livid puftules on the belly and natural parts, the whole habit of the body grows dry, &c.

In the beginning of this malady it is eafily cured, but when it is rooted, has attacked the *vifcera*, or when it is a difeafe of the country, or the patients are old, the cure is next to impoffible. One of the beft remedies for this diftemper is exercife, and endeavouring to conquer drowzinefs, which is one of its moft dangerous fymptoms.

A very exact diet is held of more effect than the beft medicines; bleeding does not avail, ftrong purgatives are hurtful, fo is fugar, and all fweet things. *Mercurius dulcis* ufed internally, fo as not to falivate, but only raife a fweating, is found excellent. *Dolæus* undertakes to cure any *fcurvy* in twelve days time, by the ufe of this alone, only the patient muft drink nothing all that time but the decoction of fimple antifcorbuticks, fuch as that of horferadifh, forrel, butterbur, fcarzonera, fowthiftle, zedoary, polypody, elecampane, guaiacum, faffafras, muftard-feed, *nafturtium aquaticum*, *trifolium*, *paludofum*, &c. oranges, lemons, juniper-berries, &c. are alfo very good remedies.

Chefelden recommends a continued ufe of milk. *Etmuller* makes copious vomiting the bafis of the cure of the *fcurvy*. Strong cathartick, he obferves, are prejudicial; but gentle ones good; for the body is to be ftill kept open He forbids the ufe of vinegar, but allows the juices of fruits and vegetables to be wholfome. The ufe of lemon-juice is much recommended by Dr. *Lifter*. The decoction of muftard-feed, to wafh the mouth with, is, to the full, as excellent. Thefe remedies, taken internally, are very good for this difeafe, *viz.* the tincture of flint, from ten grains to thirty; diaphoretick antimony, from fix to thirty grains; *mercurius dulcis*, from fix to fixteen grains; diaphoretick *mars*, from ten grains to twenty; aperitive *crocus martis*, from ten grains to two fcruples; the volatile fpirit of *fal ammoniac*, from fix to twenty drops; the fpirit of *guaiacum*, from half a drachm to a drachm and a half; *tartarum vitriolatum*, from ten grains to thirty; tincture of antimony, from four drops to twenty; the volatile falt of tartar, urine, vipers, and hartfhorn, from fix to fifteen grains of each; fpirit of *gum ammoniac*, from eight drops to fixteen; and the mercurial *panacea*, from fix grains to two fcruples.

Emollient and deterfive clyfters muft be adminiftered to the patient when he goes to bed, keeping his body open with ptifans. He may take afterwards fudorificks, made of decoctions of fumitory, wild fuccory, dandelion, *fcolopendria*, fcabious, germander, borage; the roots of *fcarzonera*, polypody, parfley, and fennel; the flowers of green broom, alder, marygolds, &c.

The decoctions to wafh the mouth with, are made of fage, rofemary, hyffop, the leaves of oak, *cochelaria*, creffes, *nicotiana*, the roots of *ariftolochia*, tormentil, iris, and red rofes.

To ftrengthen the gums, gargarifms are made with fimple antifcorbuticks; as the fpirit of *cochlearia*, two drachms; a fcruple of fpirit of vitriol, a fcruple of common falt, four ounces of rofe and plantain-water, two of each. If the gums are rotten, they muft be rubbed with honey of rofes, and fome drops of fpirit of falt.

To appeafe the pains in the limbs, there muft be prefcribed baths and fomentations externally; and internally the decoction of faffafras, with fome drops of *laudanum*.

To appeafe the gripes, there muft be adminiftered clyfters made of whey, fugar, fyrup of poppies *cochlearia*, camomile, melilot, and oil of worms.

The ufe of milk hinders vomiting; the loofenefs is ftopped by the fpirit of maftick; the fever by the febrifuges and antifcorbuticks; the fpots are fomented with the decoctions of aromatick and antifcorbutick herbs, with nitre, and unguent of ftorax: for the ulcers of the legs, lint covered with a powder made of equal parts of fugar of *faturn*, *crocus martis*, myrrh, and *mercurius dulcis*, muft be applyed upon them. The following remedy is very good to fweeten the acidity of the humours: take half an ounce of fpirit of *cochlearia*, two drachms of tartarized fpirit of *ammoniac*, and one drachm of the tincture of worms; fifteen drops of which liquor are taken thrice a day, in a decoction of parietary.

Againft the *tubercles*, take two handfuls of the flowers of camomile and alder, two drachms of the roots of briony, and an handful of crumbs of bread; and have the whole boil'd in whey for cataplaſms. To appeaſe the head-ach, muſt be taken twenty five or thirty drops of the tincture of *ſuccinum*, in the antiſcorbutick ſpirits, or waters. To facilitate reſpiration, muſt be preſcrib'd two ſpoonfuls, ſeveral times in a day, of a medicine made with two drams of antiſcorbutick water, two drams of the eſſence of elecampane, and half a drams of ſpirit of gum *ammoniack*.

To hinder the putrefaction of the gums, they muſt be rubb'd often with a liquor made of a dram of the tincture of gum lack, three drachms of ſpirit of *cochlearia*, and fifteen or twenty drops of oil of tartar *per deliquium*. All the lotions made of waters and decoctions of antiſcorbutick ſimples, are very good for this uſe. They uſe at the *Hotel-dieu*, at *Paris*, the unguent of ſtorax, to take off the ſpots, and reſolve the hardneſs in the legs.

We'll paſs now to the *examen* of wounds and ulcers, and to the moſt eaſy manner how to cure them.

A Wound is a ſolution of the continuity of a fleſhy part, made by ſome penetrating body, while it yet remains freſh, bloody, and without putrefaction.

The two firſt things to be obſerv'd in the treatment of *wounds*, are their differences, and the inſtruments they are made by.

In *wounds* where any large artery is quite cut in two, the flux uſually proves mortal. A leſſer artery, cut tranſverſly, flies back againſt the ſolid parts, and will have its mouth ſtopp'd; if an artery be not quite cut off, there ariſes a perpetual flux; or if that be ſtopp'd, an *aneuryſma*. A nerve being cut off, flies back, produces a pain and obſtruction about the *wound*, and below it a numbneſs and waſting immobility; the caſe is much the ſame in *wounded* tendons, and membranes. *Wounds* of the temporal muſcle are rarely cur'd, but generally bring on horrible convulſions.

All *wounds* are reputed more dangerous and difficult of cure in winter than in ſummer; in autumn, than in ſpring.

The *cure* of *wounds* conſiſts in helping nature to make the reunion of the parts, which had been divided, after having took off and appeas'd all that could be an obſtacle to it; which are all foreign bodies, as bullets, burs, wood, ſtones, &c. or the accidents they are attended with; as, hæmorrhages, inflammation, mortification, excreſcence of fleſh, *hyperſarcoſa*, diſlocation, fracture of a bone, ſplinters, and ſometimes a bad air.

The moſt dangerous ſymptoms in a *wound*, are the hæmorrhages: therefore it may be ſtopp'd with the following remedy.

Take two ounces of vinegar, a drachm of colcothar, or red vitriol, two drachms of aſtringent *crocus martis*, and beat the whole together: in which the lint to be apply'd to the *wound* muſt be dipp'd.

There is alſo the *actual* and *potential cautery*, or the ligatures alone. The *actual cautery* is not always ſafe; a *potential cautery* has always the deſir'd ſucceſs; ſuch as this: take very near equal parts of *vitriol*, and the powder of what's vulgarly call'd *toad-ſtool*; and apply it with ſome lint on the place whence the blood flows, and the blood will be inſtantly ſtopp'd, taking care not to touch the nerve or tendon; becauſe vitriol is capable to excite convulſions.

If the *wound* be attended with an inflammation, cauſed by a *foreign body*, that foreign body muſt be immediately extracted with a proper inſtrument. If the inflammation is occaſioned by a quantity of *pus*, the *pus* muſt be evacuated. If it proceeds from exceſſive pains, thoſe pains muſt be appeaſed with anodyne cataplaſms and liniments; ſuch as thoſe which have been propoſed in the cure of the *phlegmon*; or the part muſt be bath'd with an equal quantity of ſpirit of wine and water. Sugar of *ſaturn* in lime-water has the ſame effect.

Againſt the mortification of the part, is uſed a decoction of *wormwood*, *St. John's-wort*, *roſemary*, and *aloes* made with wine; or the tincture of *aloes* and *myrrh*; or camphorated *ſpirit of wine* alone.

In great *wounds* it is very proper to cover the *apparatus* with ſuch a cataplaſm as this: take the leaves and flowers of camomile and melilot, ſummits of wormwood, mallows, marſhmallows, aniſeed and cummin-ſeed, in powder, which muſt be boil'd together in wine, adding to it barley-flour, to give it a due conſiſtence. If there was the leaſt appearance of a gangrene, there ſhould be mixed with it ſaffron, myrrh, aloes, and ſpirit of wine.

It is not neceſſary to thruſt tents into all ſorts of *wounds*; for in the ſmall ones it ſuffices to make the reunion with the balſams alone; becauſe they are not to be brought to ſuppuration.

Laſtly, The whole ſecret conſiſts in cleaning the *wounds*, whether with cloths, or with injections of tincture of myrrh and aloes, or with ſimple decoctions of wormwood, ſcordium, and bugle, in white wine; preſcribing internally the vulnerary decoctions of *alchymilla*, *veronica*, ground-ivy, St. John's wort, wormwood, centaury, bugle, chervil, and others.

The Sutures are often of very great help for the re-union of *wounds*, which cannot be reunited by the bandage; for *ſutures* are not to be made but while the *wounds* are recent and bleeding, when there is no contuſion, loſs of ſubſtance, nor great hæmorrhages; when they are not made by bite

of

of venomous beaſts; when there are no great inflammations, and the bones are not diſcover'd; becauſe they commonly are to be exfoliated. Neither are they made on the breaſt, becauſe of its motion.

Instruments to make *ſutures* with, are ſtrait and bow'd *needles*, wax'd *thread*, and the *fingers*.

The antients invented a great variety of Sutures; as, the incarnative *ſuture*, ſo called, becauſe by rejoining the edges of a wound, and keeping them together by means of a thread run a-croſs with a needle, they grow together, and incarnate as before.

The Restrictive *ſutures* ſerved to ſtop the flux of blood from large wounds, where any conſiderable veſſels were cut.

It is ſtill in uſe for wounds in the inteſtines, and called the *ſkinners ſuture*; becauſe they uſe the like in ſewing up the holes made by the butchers in fleaing off the ſkin.

The Intertwisted *ſuture* is when the needles are left ſticking in the wound, and the thread is wound round them, much after the ſame manner *taylors* do the threaded needles they keep in their ſleeves, &c. This *ſuture* is performed two ways; for either the needles are paſſed a-croſs the wound, or they are ſtuck on the ſide thereof.

All the *ſutures* hitherto mentioned, are made with needles and thread; beſides which, there is another kind called *dry ſutures*, which are performed with glue, ſize, or other proper viſcous matter.

The Dry *ſuture* is ordinarily made with ſmall pieces of leather, on linen cloth indented like a ſaw, ſo that the teeth may fall between each other, and the whole row may be cloſed. The cloth, before it is cut into this form, is ſpread with ſome proper plaiſter, in order to its firm adheſion. The plaiſters, thus prepared, being cut into this form, are applied on the firm fleſh, according to the length of the wound, reaching from it to the diſtance of ſome inches; and after they are dried, or well faſten'd to the part, the lips of the wound being approach'd, they may conveniently be held together by the *ſuture* in that poſture. This kind of *ſuture* is principally uſed for wounds in the face, to prevent unſightly ſcars. It is likewiſe convenient, when the fibres of the muſcles are cut a-croſs, and where it is difficult, or impoſſible to apply a bandage.

In the other kinds of *ſutures* the ſtitches ought always to be taken of a depth proportionable to that of the wound; care being had to avoid the nerves as much as poſſible. In long wounds they are beſt begun at the ends, but in ſhort ones at the middle. If the wound be angular, they muſt be begun at the angles. Before the knot be made, the lips of the wound muſt be as near, and as even as poſſible, approached near one another; the knots are begun by that of the middle. A ſimple one is made firſt on the ſide oppoſite to that where the matter is to be evacuated; a ſmall compreſs of waxed linen cloth may be put on that knot, on which compreſs muſt be made a running knot, to be untied eaſily, if ſome accident ſhould happen. If a plaiſter is to be placed on the wound after the *ſuture*, a ſmall compreſs is to be put on the knots, leſt they ſhould ſtick to the plaiſter. If there happens an inflammation in the wound, the knots muſt be relaxed; and when the accidents are paſt, tyed up again: but if the inflammation continues, the threads muſt be cut, by paſſing a probe under it. When the re-union of the wound is perfected, the thread muſt be alſo cut, by paſſing, likewiſe a probe under it. To extract the threads, a finger muſt be applyed on the knot, for fear of re-opening the wound.

Of Wounds in the Head two things are to be conſidered.

That *wound* is called *ſuperficial*, which goes no farther than the ſkin; and that *deep*, which penetrates as far as the *pericranium*, *cranium*, or the ſubſtance of the brain.

If the *wound* be only *ſuperficial*, it may be cured with *Hungary* water, or with balſam, putting over it a plaiſter of betony. If the wound, or the tearing of the ſkin be large, it muſt be ſewed up.

If the *wound* be *deep*, and in the *pericranium*, it muſt be kept open, waiting for the ſuppuration. If it penetrates as far as the *cranium*, there is either contuſion, or fracture; if contuſion, the *Chirurgeon* muſt wait for the ſuppuration, and the fall of the ſplinter, by keeping the wound open. If fracture, that fracture is either in the firſt or ſecond table, or in both. It is known to be in the ſecond table, only, when attended with no accidents; and in both tables, when the ſigns appear, and by the inciſion crucial of the fleſh, and the diſcovery of the *fiſſura*.

The ſigns of the fracture of both tables of the *cranium*, and of the extravaſation of blood, on the membranes of the brain, are the loſs of judgment or reaſon, at the very inſtant the wound is received, the hæmorrhage through the noſe, mouth, and ears, a drowzineſs and heavineſs of the head, and eſpecially bilious vomiting: whence it is concluded that the operation of the *trepan* is abſolutely neceſſary.

Wounds in the Face are to be treated with the greateſt care; to avoid, as much as poſſible, inciſions and ſuppuration; which would cauſe ſcars and deformities in the face.

Of the wounds of the Breast.

When

When the *Chirurgeon* is sure that the wound penetrates into the capacity of the breast, he must examine which part is wounded, by observing the situation of the wound, and its accidents. If the lungs are wounded, there is a frothy spitting of bright blood, with a difficulty of respiration, and a cough. If some of the large vessels be open, the patient feels a weight in the bottom of the breast, has cold sweats, breathes with difficulty, vomits blood, which likewise comes out of the wound. If the diaphragm is cut in its tendinous part, the patient has laughing convulsions. If the heart be wounded in its basis, or in its ventricles, the wounded faints away, and dies: but if the probe cannot penetrate, and none of the accidents abovementioned appear, it is certain that the wound is not of great consequence.

When the wound penetrates, and there is no part offended, but only an effusion of blood on the diaphragm, recourse must be had to the *empyema*; otherwise the extravasated blood would putrefy, cause inflammation, the gangrene, and consequently death. Which *empyema* is an operation, whereby the matters extravasated on the diaphragm, are evacuated by an aperture made on the *breast*.

From the *breast*, we will descend to the ABDOMEN. The qualities of a wound made in the *Abdomen* are known by probing it, observing its situation, and minding its accidents. By probing it is discovered whether the wound penetrates into the capacity, or not.

In the cure of the wounds of the *Abdomen*, care must be taken not to let the air enter into them; they must be dilated to sew the wounded intestine, and restore it to its place; the *epiploon* or *cawl*, if it comes out through the wound, must be tied and cut, lest growing putrid, it should infect the neighbouring parts, which must be washed with strong wine, in which have been boiled *camomile-flowers*, *roses*, and *wormwood*; they must be powdered with *aloes*, *myrrh*, and *olibanum*, and the wound sewed to be dressed outwardly; prescribing an exact diet to the patient; and abstaining, on these occasions, from clysters, especially if one of the great guts be wounded, using rather suppositories, and laxative ptisans, or diet-drink, to avoid dilatation.

Another kind of *wounds*, which deserve a particular attention and skill, are those made with FIRE-ARMS. Those wounds are always with laceration, loss of substance, fracassement, and breaking in the bones. They are red, black, livid, and with inflammation. They are seldom accompanied with *hæmorrhages*: they are commonly round narrower at the entrance than at the exit, unless they have been made with quartered bullets, &c.

If those wounds penetrate the substance of the brain, the *medulla spinalis*, the heart, the *pericardium*, the large vessels, and others of the noble parts, it is almost always present *death*: but all the superficial ones, those made in any other parts of the body, are curable.

To do it with judgment, and hope of success, the patient must be put, if possible, in the same situation he was when wounded, the easier to know the direction of the wound by the probe, with which the bullet must be searched, or some other extraneous bodies, as *wood*, *burr*, *linen*, *stuff*, and the like, which must be extracted, through the same aperture they have entered into it, avoiding lacerating the part in extracting them. If the operator has worked in vain for extraneous bodies, he will make a counter opening at the opposite part, on the place where any hardness is felt, without touching the vessels. The incision made, he must extract those bodies with his finger, or some instrument.

If the bullet be so far in the bone, that it cannot be extracted without splitting it, it is better to leave it there. If there is a great fracassement of bones in the legs or arms, they must be amputated. The pain and inflammation are to be appeased by bleeding, anodyne topicks, cooling clysters, and purgatives; if there had been a too great effusion of blood, bleeding is to be avoided.

The purgatives must be very gentle as are the *cassia*, *manna*, *tamarinds*, *syrup of violets*, and that of *damask roses*. Anodynes to appease the pain are cataplasms made with crumbs of *bread*, *milk*, *saffron*, and the *yolk of an egg*. *Oil of roses*, alone, made hot, is a very good remedy. To appease the great inflammations, there must be applied on the part *oil of roses*, the *white of an egg*, and *vinegar*, the whole beaten together.

Spirituous remedies are the first, which are to be applied on the wound; lint dipped in camphorated *spirit of wine*, and applied on the part, is excellent; but if the blood was to flow, there should be applied *styptick water*, or other astringent remedies, all which are to be applied hot. To hasten the suppuration of contused wounds, a digestive must be prepared of *oil of roses*, *yolks of eggs*, and *terebintine of Venice*. If the wound was on the nerves, tendons, or other nervous parts, none but spirituous remedies should be used, never unguents, which would only putrefy the parts.

The balsam of *Peru*, the distilled oils [illegible] *tine*, of *wax*, of *lavender*, of *bays*, and [illegible] of [illegible]*losophers*; the balsam of *St. John's* [illegible], [illegible] *wine*, and *gum elemy*, are excellent remedies for the nerves. Take four ounces of ung[illegible] *thea*, a drachm and a half of distilled [illegible], which being mixed together are applied; or, take an ounce of diſtilled *oil of terebintine*, a drachm of *ſpirit of wine*, half an ounce of camphire, mix it together, and let ſome of it be dropped in the wound; or, take a ſcruple of *euphorbium*, half an ounce of *terebintine*, and ſome *wax*; mix them together, to be applied hot to the nervous parts.

If the wounds are deep, injections are to be made with the following vulnerary water; it is very good for all ſorts of contuſions, for the *gangrene* and *ulcer*. Take ſmall *ſage*, *mugwort*, *comfrey*, of each four handfuls; *plantain*, *nicotiana*, *betony*, *St. John's wort*, *wormwood*, of each three handfuls; *fennel*, *centaury*, *bugle*, *ſcrophulary*, of each three handfuls; three ounces of round *ariſtoloch*, and two ounces of the long: let the whole be in digeſting, during thirty hours, in eight quarts of good white wine, and diſtilled afterwards in *balneo mariæ*, to the conſumption of a third part.

If the *gangrene* happens to the part, we will uſe the *ſpirit of matricaria*, made of two drachms of *maſtic*, *myrrh*, *olibanum*, *ſuccinum*, and a quart of wine rectified; the whole muſt be diſtilled. This is a very good fomentation: take equal parts of camphorated wine, and of water of *quick lime*, with two drachms of *camphire*. This fomentation muſt applied hot.

From *Wounds* we will paſs to *Ulcers*. Ulcer, *ulcus*, is a ſolution or diſcontinuity of texture, or loſs of ſubſtance in the fleſhy *parts* of the body, proceeding from an internal cauſe.

Old ulcers are rarely cured without the uſe of internal remedies, which are to be ſuch as deſtroy and abſorb the acidity; ſudorificks, eſpecially decoctions of the woods, antimonials, viperines, and volatiles; but above all things vomitories often repeated; in the moſt obſtinate *ulcers*, mercurial ſalivation is often required. *Old ulcers* are frequently incurable, without making an iſſue in the oppoſite part.

The cure of *ſimple*, *ſhallow ulcers* is commonly effected by applying a pledget armed with *liniment arcæi*, or *baſilick flower* to the part; a plaiſter of *diachyl. ſimpl.* or *de minio*, being laid over it, and repeating the dreſſing once a day, or ſeldomer. If only the *cuticula* be loſt, or eaten away, nothing more than a little *unguent. deſicativ. rub.* or *diapamphol*, &c. ſpread thin upon linen, need be applied.

If ſpungy fleſh ſhould grow up, in either caſe, it may be kept down with a little *Roman vitriol*, &c. Evacuations are indiſpenſibly neceſſary, in the cure of *ulcers* of the compound kind, where the conſtitution will admit thereof. If the *ulcer* be fiſtulous, ſinuous, cancerous, &c. and the matter fetid, thin, or ſanious, it is found proper to join calomel with the purgatives, or to give it in ſmall doſes, between the repetitions thereof, ſo as not to ſalivate.

Beſides the uſe of evacuating medicines, it will here alſo be proper to order a courſe of diet-drink, made with the ſudorifick woods, eſpecially where the *ulcer* is ſuſpected to be venereal. In the mean time, proper dreſſings are to be uſed.

When the *ulcer* obſtinately reſiſts this treatment, a ſalivation is generally propoſed, and ſeldom fails to promote the cure, though all other remedies ſhould have been tried in vain. If the patient be too weak to undergo the fatigue of a thorough ſalivation, it may be moderated, and kept up the longer, in proportion to his ſtrength.

External medicines, for *ulcers*, are digeſtives, cleanſers, ſarcoticks, and epuloticks. Mr. *Bullock* gives us a medicine of ſingular efficacy in the cure of *ulcers*; and it is no more than a decoction of walnut-tree leaves in water, with a little ſugar; in which a linen cloth being dipped, is to be laid on the *ulcer*, and this to be repeated every ſecond or third day. This ſimple and vulgar medicine, he finds, ſuppurates, deterges, incarnates, reſiſts putrefaction, &c. more than any other medicine known.

The *Venereal Diſeaſe* falls next under our conſideration, which we deſign to examine through its different ſtages, *viz.* the *clap*, *chordee*, *gonorrhœa*, *ſhankers*, *bubo's*, and the *grand pox*.

Venereal Disease, called the *French pox*, is a contagious malady, contracted by ſome impure humour, generally received in *coition*; and diſcovering itſelf in ulcers, and pains about the genital, and other parts.

The tradition is, that the *venereal diſeaſe* firſt broke out in the *French* army, when it lay encamped before *Naples*; and that it was owing to ſome unwholſome food: on which account the *French* call it, the *Neapolitan diſeaſe*, and the *Italians* and *Engliſh* the *French pox*: but others go much higher, and ſuppoſe it to be the *ulcer Job* complains of ſo grievouſly.

Phyſicians and *Chirurgeons* divide the *venereal diſeaſe* into ſeveral ſtages, of which the *clap* is the firſt.

Dr. *Cockburn*, and others after him, will have the *clap* to conſiſt in an ulceration of the mouths of the glands, of the *urethra* in men, and of the glandular *lacunæ* in women; and diſcovers itſelf by a painful tenſion in the *penis*, an excruciating pain in making water; by the *urine* appearing whitiſh, and full of ſmall threads.

If the perſon be affected with a running of a thin conſiſtence, a yellow or green colour, and in great quantity, and the teſticles ſwelled, it is uſually termed a *gonorrhœa virulenta*, and the *clap* ſuppoſed to be in its ſecond ſtage.

A *clap* is often attended with an inflammation and contraction of the *frænum*, and the under part of the *penis* called *chordee*, and which renders erection painful. If the *chordee* be violent, or does not decrease proportionably to the other symptoms in *gonorrhœa's*, an emetick of turbith mineral is usually given with success, it causing a revulsion from the part.

Clap is also often called a *virulent Gonorrhœa*, to distinguish it from a simple *Gonorrhœa*, which takes its rise from violent exercises and strainings; the immoderate use of hot foods, and particularly fermented liquors, as beer, wine, cyder, &c. This is cured by indulging rest, nourishing foods, broths, &c.

The cure is effected by emollient cataplasms, and fomentations upon the part, and a half bath. For the other species, more powerful means are to be used. The principal remedies are mercurial purges, an emulsion of green hempseed, cuttle-fish bone, turpentine, *saccharum saturni*, &c. we have, likewise, great commendations of green precipitate of mercury, and *mercurius dulcis*. *Balf. saturn. terebinthinatum*, prepared with a gentle fire, of *saccharum saturni*, and oil of turpentine, is much applauded where the heat is great about the reins and genitals; as also camphire. An infusion of cantharides in wine is the *nostrum* of a noted *Dutch* physician. Resin of the wood *guaiacum* is also recommended; and balsam of *cupaiba* is held a sort of specifick; to which must be added, *antimonium diaphoreticum*, *bezoardium minerale*, water wherein mercury has been boiled; injections of lime-water, *mercurius dulcis*, *saccharum saturni*, &c.

SHANKERS are the next thing in the *venereal disease* worthy attention. They are round ulcers, caved in the middle, which rise on the glans and the prepuce.

To cure *shankers*, they must be touched with the infernal stone, and brought to suppuration, with red precipitate mixed with the unguent of *André de la Croix*. Oil of Mercury, put upon lint is very good to open *shankers*, and to consume the flesh. The patient must be very well purged with calomel and scammony; after which, he must take the mercurial *panacea's*, which is a very good remedy for all but a confirm'd pox.

Next to *shankers* come BUBO's, which are large tumours, or abscesses happening in the groin. *Buboes* must not be left to come to a perfect maturity before they be opened. They must suppurate a long while, and care must be taken to purge the patient with calomel and scammony.

All these abovementioned are but the forerunners, of the *pox*, which sometimes begins by a virulent *gonorrhœa*.

When the *pox* is but just begun, it is easily cured; but if it be an old confirmed one, and the patient of a bad constitution, has his voice hoarse, and ulcers, *caries* and *exostoses*; the cure is very difficult.

The patient being prepared by proper purgatives must be brought to a salivation by *frictions*, made with unguent of *mercury*. This *unguent* is composed of *crude mercury*, mixed with *turpentine* in a mortar; the whole being mixed afterwards with *hog's-lard*; *i. e.* one part of *mercury* upon three of *hog's-lard*.

The *frictions* begin at the sole of the foot; from thence they are continued to the legs, and to the inside of the thighs, taking care not to touch the back bone. When the patient is of a tender constitution, sometimes a single friction suffices. He must be rubbed by the fire, after he has took some chicken broth. He must not be rubbed, each time, with more than one or two drachms of mercury without reckoning the grease. He is rubbed with the hand, so that no grease appear on his skin; after which, he must be put to bed. The *Chirurgeon* must often look in the mouth of the patient, to see if the mercury operates, which is easily known; because the tongue, gums, and *amigdalæ* swell, and grow thick; the patient has the head ach, his breath is strong, his face red, he has some difficulty to swallow his spittle, or begins to salivate.

During the frictions, the patient must be fed with chicken broth, eggs, &c. which he must take every two hours, at least. He must keep his bed in a warm room, and must not get up, but when the salivation is to be stopped, which commonly lasts 20 or 25 days, or rather till the salivation be fine, *i. e.* no longer stinking, nor coloured; but clear and fluid.

If a looseness happens during the salivation, it stops; but it must be procured again, by stopping the looseness, with clysters made with milk and yolks of eggs; and if it could not be procured that way, a slight friction must be made; if the salivation was too copious, it must be diminished with some gentle purgatives.

The patient salivates, ordinarily, three or four pounds every day, in a bason made on purpose; which he keeps in his bed near his mouth, into which the *saliva* runs. A small stick, tied round with some linen cloth, must be thrust, from time to time, between the teeth and the jaws, which otherwise would glue together.

If the salivation does not stop of itself, in a due time, to stop it, the patient must be purged. If there are ulcers left in his mouth, they must be dried with gargarisms made of barley-water, honey of roses, or warm'd wine. Warts are cured with being tied, if the ligature be possible; and if not, they must be consumed with causticks. Sometimes they are cut, and left bleeding, and washed afterwards with hot wine.

When the patient is up, he must be changed of linen, bed, and room, and purged after which, he will recover his strength by being fed with good aliments, and by drinking good wine. If he be too much weakened, he must drink cows milk with sugar of roses.

From the maladies of the flesh, we will proceed to those of the *bones*, which are five in number, *viz.* the *luxation*, *fracture*, *caries*, or *ulcers*, the *exostosis*, and the *nodus*.

Luxation, or *dislocation*, (from the *latin*, *luxare*, to loosen) is the slipping of the head of a *bone* from its proper receptacle into another place, whereby the natural motion of the joint is destroy'd.

The cure of a *simple luxation*, is by a speedy reduction of the dislocated member to its natural place. To this are necessary, 1. *Extension*, ἀντίταξις, that the head of the bone may more directly be introduced into its seat.

This extension is made either by the hands alone, or by ligatures or towels, or by instruments or great machines, when the *luxation* is difficult and inveterate. 2. After *extension* follows the intruding of the joint into its natural cavity: which likewise, may, either be effected by the hands only, or by the heel (as when the head of the *os humeri* is fallen into the arm pit) or by means of ladders, doors, pestles, or *Hippocrates*'s instrument, called *amb*.

Lastly, It is necessary, yet further, to apply compresses and bandages; by which means the articulation is preserved safe, 'till the ligaments may acquire their usual strength of elasticity and astriction.

The luxation of the thigh with the hip, is seldom or never reduced. That of the first *vertebra* is very difficult. That of the inferior jaw-bone, and of the sole of the foot is mortal.

If an inflammation should happen before the member is reduced, nothing ought to be attempted 'till that inflammation is appeased, but in order to prevent and appease it, the reduced member must be bathed with hot wine, in which have boiled the summits of *St. John's wort*, *camomile*, *rosmarin*, *stæchas*, and the like. The bands must be dipped in the same liquor.

If an *œdematous* tumour rises on the luxated member, after the articulation has been reduced, sudorificks must be administred to the patient, and the member anointed with oil of *St. John's worts*, or of *turpentine*, and covered with a plaister made of *yellow wax*, and *white resin*; the whole being melted, there must be added to it *white succin*, and *gummi elemi*; of each a sufficient quantity to make a mass, which must be incorporated with the *balsam* of *Peru*.

When the dislocated bone has not been reduced soon enough, there is formed in the cavity a *coagulum*, which hinders the reduction; this *coagulum* may be melted with the following oils before the reduction of the *bone*. Take one part of distilled oil of *human bones*, two parts of fetid oil of *tartar*; mix the whole together, and put *quick lime* over it to have it distilled through a retort; the part must be fomented with this oil.

If the *luxation* has happened through a too great relaxation of the ligaments, they must be strengthened by the part reduced being kept in its place by good bandages, prescribing all remedies, impregnated with an oily volatile salt, as those produced by the *sassafras*, *sarsaparilla*, *sal-ammoniack*, &c.

The most ordinary luxations are of the *wrist*, of the *leg*, of the *rotula*, of the *foot*, and of the *jaw-bones*.

The bone being reduced into its natural place, there are *bandages* used to keep it there, in the following cases. 1. In the *luxations* proceeding from internal causes; because the ligaments having been relaxed, a bandage must supply their want. 2. In the *luxation* of the jaw-bone, especially when it happens in gaping; because the ligaments having been weakened, and softened, by some humidity, want help to keep up the jaw bone, whose weight tends towards a new *luxation*; to which must be added, that the patient can scarce be at rest, and that the continual motions he is obliged to make, either to speak, or eat, could cause a second *luxation*. 3. In the *luxations* of the wrist and the foot; because, as we have observed already, they are ordinarily accompanied with startings of the *cubitus* and *radius*, and of the *tibia* and *peroneum*, a bandage must be made, from above downwards, to bring together gently the started bones, and keep them firm; which must be done without a compression on the afflicted part. 4. In the *luxations* of the clavicle, with the *sternum*, the arm must be kept up, by means of the scarf.

In all other *luxations*, there wants no bandage, unless there be an inflammation; and the bandage ought to be contentive only, to keep up what's put on the afflicted part. For the thigh, leg, &c. the

the patient must keep his bed for two or three days, to strengthen the part.

Let us proceed to FRACTURES

FRACTURE is a solution of continuity in a bone. when it is crushed or broken by some external cause.

In the cure of *fractures*, the *Chirurgeon* has two things to attend to; first, to restore the *fractured* bone to its natural situation; and to keep it tight with splinters, and bandages: in which case, nature takes on herself the office of healing and conglutinating it by forming a *callus* thereon

If the *fracture* be transversly, the reduction must be made by extension, and counter-extension; and if lengthwise, *coaptation* suffices. If the *fracture* be complicated with a wound, the cure must begin by the reduction, and the other remedies are administered afterwards, as in the simple *fracture*.

When there are splinters left in the *fracture* after the reduction made, they are not to be pulled out, but the *Chirurgeon* must wait patiently their coming out with the pus, or help their coming out with the use of injections made with the tincture of myrrh and aloes, and with proper plaisters, and also with pincers.

There is more or less time required in the cure of a *fracture*, as the *fractured* bones are different in bigness; thus the *callus* of the *fractured* jawbone is formed in 20 days; that of the clavicle, or shoulder, in 24; that of the *humerus* in 40; that of the *cubitus* in 30; that of the bones of the *carpus*, and of the fingers, in 20; that of the ribs in 20; that of the *femur*, or thigh, in 50; that of the *tibia*, or leg, in 40; and that of the bones of the *tarsus*, and of the toes, in 20.

To facilitate the formation of the *callus*, the *fractured* part must be rubbed with oil of worms, and hot spirit of wine, mixed together. The *Lapis Abteocolis* is a specifick on this occasion.

All the *fractures* of the CRANIUM do not oblige the *Chirurgeon* to have recourse to *trepanning*, but only the deep ones; as for the superficial, they are cured by exfoliation, or scaling of the bone.

The deep *fracture* of the *cranium*, which obliges to *trepanning*, is that made of both tables of that part, and which penetrates to the *meninges*, on which there is then an extravasated blood, which must be took off by the operation of the *trepan*

The accidents or signs of the *fracture* of the *cranium*, are, dimness of the eyes, and loss of judgment, both which happen at the very instant of the blow, or fall, with a bilious vomiting, which follows soon after. These signs are called *univocal*; there are others called *equivocal*, which are for a confirmation of the first: as the loss of blood thro' the nose, eyes, and ears; redness of the eyes, heaviness of the head, swelling of the face, and afterwards drowziness, shivering of the whole body, fever, convulsions, &c. but it is not necessary that all those signs should appear, to judge of the necessity of *trepanning*, since it suffices to have the *equivocal* ones to make the crucial incision in the place of the wound, and discover the bone to find the *fracture*. *See* the practice of *trepanning* hereafter.

The wounds with *fracture* must absolutely be *trepanned*; in which operation, oil of turpentine must be used to distil on the membrane of the brain; or spirit of wine mixed with oil of almonds; and the *Chirurgeon* must by all means bring it to a copious suppuration. The patient, besides, must be let blood before and after the operation, especially if there be a fever, or plenitude; taking care to facilitate the natural evacuations by means of clysters, at least every other day, prescribing an exact diet, free of all agitations of the body and mind, abstaining even from eating till the fourteenth day; and from coition, which is mortal at that time, for forty days from that of the operation; as it is, likewise, in all considerable wounds.

The method to be observed in the wounds of the head, and the *fractures* of the *cranium*, is as follows:

In the *simple wounds* of the *head*, none but balsams are to be used, applying a plaister of *diachylum* over it. When there is *contusion*, either in the *pericranium*, or *cranium*, the wound ought to be kept open till after the suppuration, or exfoliation. When there is only a *bump*, without wound, or accidents, it must be resolved with verjuice, vinegar, or spirit of wine mixed with oil of St. John's wort, in which compresses are dipped, and applied to the part.

The third *malady* of the BONES, is the *caries*; which is the putrefaction of the substance of the bone, or an ulcer, and the gangrene in that part.

The CARIES has either an internal or external cause

When the *caries* is known to proceed from an external cause, the best remedy is the powder of *Iris*, which suffices, when the *caries* is superficial; but the oil of *guaiacum* must be employed on lint, which is applied on the ulcer, when it is deep; or brandy, in which have been macerated iris-root, cinnamon, and cloves. Lastly, the *actual cautery* must be applied.

When the *caries* arises from an internal cause, the flesh must be opened, to give vent to the *sanies*, which runs from the ulcerated bone, the better to procure its exfoliation; and if the ulcer has not yet opened the bone outwardly, the *trepan* must be applied to it, treating the ulcer afterwards as above directed.

The

The Exostosis, (which is the *fourth malady* of the Bones) is a tumour, which riſes on the ſuperficies of the bone; occaſioned by the *depoſitum* of an unfiltrated humour in its own ſubſtance. This tumour is commonly accompanied with violent pains; becauſe in growing and riſing inſenſibly, it puſhes, raiſes, and lacerates the *perioſteum*.

There are ſeveral kinds of theſe tumours, and they are treated differently, *viz.* *Exoſtoſes* of thoſe afflicted with the pox, are cured by a good ſalivation; and when they come to rot, the hand and fire muſt be joined to remedies, to melt what is carious. *Abſceſſes* of the *articulations*, can't be conquered but by the *amputation* of the part; it is true, that ſome are cured without amputation, but it is with a great deal of care, and it takes a long time; but when the whole bone is *exoſtoſed*, it muſt be cut off. The *exoſtoſes*, or *nodus*, which riſe on the bones of the head, are more difficult to cure than others; as alſo the *caries* of that part.

There are other *maladies* of the Bones; as the ſoftneſs of the bones, their brittleneſs, bowing, or *rachitis*, vulgarly called *rickets*; and cracking.

The Softness *of the bones* proceeds from the nutritious juice of the bone being too little impregnated with ſaline and acrimonious particles, and their marrow too abundant; ſince that watery juice produces the ſame effect in the bones it does in trees, and in horn. One thing is to be obſerved, that there is never a *ſoftneſs in the bones* but where there has been left ſome leven of the *rachitis*. The beſt remedies for this malady, are ſudorificks, diureticks, and abſorbents.

The Rachitis, or *rickets*, is a diſorder affecting the bones of children, and cauſing a conſiderable protuberance, incurvation, or diſtortion thereof. It ariſes moſt commonly from the neglect of a dirty, lazy nurſe, who does not keep the child clean, nor give him proper exerciſe. Or it may be occaſioned by ſome fault in the digeſtion, occaſioning the aliment to be unequally applied to the body, by which ſome parts of the bones increaſe in bulk more than the reſt.

When the diſorder is taken early, it may be remedied by proper bolſters and bandages, ſuited to the parts affected; but when the bones are grown rigid and inflexible, other mechanical contrivances, as puddings, ſtrait boots, and ſeveral ſorts of machines or engines made of paſteboard, whalebone, tin, &c. are made uſe of, to reſtore the diſtorted bones to their natural ſtraitneſs.

Mercurius dulcis, ſyrup of chicory and of roſes, manna, and ſcammony, are accounted very good purgatives in the *rickets*; together with diuretick and diaphoretick ptiſans made of *china*, *ſarſaparilla*, &c. abſorbent powder, which corrects the acidity of humours, the infuſion of *millepedes*, or wood-lice, and dry frictions made over the whole body with a warm linen cloth before the fire, eſpecially on the parts affected, are found of ſervice. A liniment of rum and palm oil, or a plaiſter *de minio*, and *oxycroceum*, applied along the back, to cover the whole ſpine, are much eſteemed; alſo the oil of ſnails is very famous for the ſame intention; being what drains from them after bruiſing and ſuſpending them in a flannel bag; with this the limbs and ſpinal bones are anointed

Certain *bones* have been ſeen ſeveral times to *break eaſily*. A man coming out of the pox, and walking in his room broke at once both his thighs.

What cauſes the *fragility* of the bones is, that their parts being diſunited, and touching but ſlightly each other, they are ſeparated by the leaſt violence made to them.

The Cracking, or *cliquetis of the bones*, which is heard ſometimes in the motion of the members, depends on the acidity or drineſs of the articulations, occaſioned by the liquor they are moiſtened with being exhauſted; as it happens in certain perſons afflicted with the gout, who hear a noiſe in their knees while they walk. This noiſe may be cauſed by the extenſion of the ligaments and tendons, which ſurround the articulation, and ſtriking ſtrongly againſt the air, cauſe that noiſe.

Let us now proceed to *Chirurgical operations*. This is the niceſt point of the whole art. For this purpoſe it will be neceſſary to take a view of thoſe *inſtruments* uſed in the common operations; ſuch as are neceſſary to make a *cautery*, a *ſeton*, and for *bleeding*, *cupping*, and *bliſters*.

A Cautery, *Cauterium*, (from the *Greek* καυτηρ, or καυτηριον, formed from καιω, *I burn*) is a medicine to burn, eat through, or corrode ſome ſolid part of the body. *Cauteries* are of two kinds, *actual* and *potential*.

Actual Cauteries, are thoſe which produce an inſtantaneous effect; as fire, or a red-hot iron, which are applied in the *fiſtula lachrymalis*, after extirpation of cancers, amputations of legs or arms, &c. in order to ſtop the hæmorrhages, and produce a laudable ſuppuration. They are alſo ſometimes applied to carious bones, abſceſſes, and malignant ulcers, in order to open a paſſage for the diſcharge of the peccant humours. The irons us'd on theſe occaſions, are ſometimes crooked at the extremity, and that variouſly, according to the various occaſions; whence ſome are called *cultel-*

lary, others *punctual*, others *olivary*, &c.

The *actual cautery* of hot iron is frequently applied for the making of issues in parts where cutting is difficult, or inconvenient: It makes a little round hole, which is to be filled up with a pea, or ivy-berry, to keep it open for the humour to pass through.

Potential CAUTERIES, are compositions of caustick medicines, usually of quick-lime, black sope, and chimney-soot.

In the operation the *actual cauteries* are the surest; but in hæmorrhages *potential cauteries* are the surest.

Cauteries, otherwise called ISSUES, are applied wherever there is to be attraction, to correct the *intemperies*, or stop the course of humours, by making a scar to the part; however, the places they are commonly affixed to, are the *fontanella* on the head, the back, between the first and second *vertebra*, at the exterior part of the arm, in a small hollow which is between the muscle *deltoides*, and the *biceps*; between the muscle *psoas*, and *vastus internus* in the inside of the knee, above the *flexores* of the leg; observing, that the *issue* be placed every where near the great vessels, that it may draw, and purge more abundantly.

There is an easy way of making an *issue*, which succeeds best in children; it is done after this manner: having applied a small piece of blistering plaister, about the bigness of a small pea, to the part where you would have an *issue*, and letting it lie on for a few hours, it will cause a blister; the skin being raised, apply a pea as usual, and compress it tight with a bandage, till by degrees it sinks in, and forms an issue.

The SETON, *Setaceum*, is a wound made in the skin of the hind-part of the neck, or elsewhere, which is kept suppurating by means of a little skein of silk or cotton passed through it, and which has very near the same effect, as a cautery. The skein of silk ought to be dipped in oil of roses, and one of its ends should be longer than the other, to procure the evacuation of the humours. It often happens, that a *Chirurgeon* is obliged to use it in wounds made with a small sword, or with a musket, which run thro' and thro', then the skein is soaked in proper medicaments, and every time the *apparatus* is rais'd, that part drenched with pus must be cut off, which is then drawn from the ulcer.

CUPPING, is an operation for the discharge of blood and other humours, by the skin. It is performed by collecting the humours into a tumour under the *cutis*, and letting them out thence by scarification.

Cupping is performed either *dry* or *wet*. *Dry cupping* is when it is done without opening the skin; and the *humid*, or *wet*, when made with scarifications. The operation is performed thus: The vessel is heated with candles, tow, a torch, lamp, or the like; but in my opinion tow is best, and less troublesome. A ball of it is made slightly between both hands, and thrust into the *cucurbitulæ*, which is afterwards held over a candle; the flame of the candle catches the tow, which immediately appears all in flames: in which state the vessel must quickly be applied close to the part, which is no sooner done but the flame is extinguished, and the tumour begins to rise; for the air in the cavity of the vessel being, by this means, rarefied, and brought near to the condition of a *vacuum*; that part of the body covered by its becoming less pressed by the air than the rest, its juices are forced up with the *cutis*, and raise a bunch in the cavity of the vessel; to which the scarificator being applied, and ten or twelve incisions made at the same time, a plentiful evacuation is effected.

BLEEDING, more properly called PHLEBOTOMY, (from the *Greek* φλεψ, vein, and τεμειν, to cut) is a species of evacuation of the utmost importance in medicine, performed by the *Chirurgeon* by the artificial incision of a vein or artery.

The vessels opened in *phlebotomy*, are the *preparate vein*, in the forehead; the *ranulæ*, under the tongue; the *jugulary veins* and *arteries* in the neck; the *temporal arteries* in the temples; the *basilica*, *cephalica*, and *mediana*, in the arms; the *salvatella* between the *annularis* and little finger; the *saphena* on the internal *malleous*, or ankle; and the *ischiatica* on the external.

The conditions requisite to *bleed* well, are, to chuse well the vessel, to not prick at a venture, to not *bleed* without necessity, or the advice of a physician, who must know the proper times for it, as that of the intermission in intermitting fevers, the cool of the morning in summer, and towards noon in winter; and how to make different orifices; for in summer they ought to be smaller, and greater in winter.

To avoid pricking the *artery* in *bleeding*, you must know that the *artery* is placed in the arm under the *basilica*, and that you must feel it before you make the ligature, and observe well if it be profound, or superficial; for if it be superficial, it may be easily avoided, by pricking the vein higher or lower; but however, when an *artery* has been opened, if it be well opened, the blood must be let to flow, till the person falls into a *syncope*, or faints away, and through that means it is easier to stop the blood afterwards; which will be done by making a good bandage with several compresses,

preſſes, putting in the firſt a piece of chewed paper with graduated compreſſes over it.

That in the *bleeding* of the foot, there are very few or no accidents to be feared, becauſe the veins of the muſcles are accompanied with no arteries, nor tendons. Therefore it is ſaid that the arm muſt be given to a maſter *Chirurgeon*, and the foot can be given to a prentice.

The firſt operation made on the head, and the moſt conſiderable one, is, that of Trepanning, to relieve cuts, contuſions, caries's, and fractures in the ſkull, by means of an inſtrument called the *trepanum*, or *trepan*

Before we begin this operation, it will be neceſſary to obſerve, 1. That there is no *trepanning* on the ſupercilious *ſinus's*, becauſe of their cavity, nor on the ſutures, becauſe of the veſſels which paſs there; nor on the temporal bones, without an urging neceſſity, eſpecially on that part which joins with the parietal, becauſe the extremity of that bone would part, being only applied on the parietal; nor on the middle of the coronal, and occipital, becauſe of an interior eminence to which the *dura mater* adheres; nor on the lateral *ſinus's* which are ſituated on the ſide of the occipital. 2. That if the fracture be very narrow, the *trepan* may be applied upon it; but it is better to *trepan* on the ſide of the fracture, on the inferior part; that the *trepan* is never applied on hollowneſſes; and that if the bones part, there ought to be no other *trepanning* than to raiſe them with the *elevatory*.

Notwithſtanding theſe cautions, if a violent fracture ſhould happen in or near theſe parts, you ſhould *trepan* as near them as poſſible; and if the fracture has paſſed acroſs the *ſutures*, you muſt *trepan* within a finger's breadth of the *ſuture* on each ſide. Sometimes it is impoſſible to diſcover the particular part of the *cranium* which is injured, the patient in the mean time being affected with the moſt dangerous and urgent ſymptoms. In theſe caſes it will be neceſſary to trepan firſt on the right ſide, then on the left, afterwards upon the forehead, and laſtly upon the occiput, and ſo round till you meet with the ſeat of the diſorder.

After having pitched upon the part to be *trepanned*, your next buſineſs is to ſhave the *ſcalp*, and make an inciſion through the integuments to lay bare the *cranium*, except it be done already by the wound. The inciſion of the integuments may be made in the form of a croſs, or of the letters X, V, or T, large enough to admit the crown of the *trepan* upon the bone. The wound may be enlarged, and the hæmorrhage ſtopped, after the integuments and *perioſteum* are ſeparated and elevated from the *cranium*, by inſerting a large quantity of ſcraped lint. Next a compreſs dipped in warm camphorated ſpirit of wine muſt be applied and retained by the kerchief bandage. Then the patient is to be left, if the diſorder will permit, for a few hours, that the blood may be ſtopped before the *trepan* is applied.

Among the apparatus, or inſtruments and dreſſings, which muſt be provided, before the operation is entered upon, the firſt and principal is the *trepan* with its crown, (*ſee* the plate, *fig.* 1.) made in the ſhape of a common gimblet, with a handle turning round. The crown of this inſtrument, marked A, is joined to the lower part of the handle, B, by a ſcrew, ſo that it may be taken off and put on at pleaſure, or elſe that a crown of another ſize may be ſcrewed in its place.

The *trepan* is diſtinguiſhed into male and female; in the firſt of which the crown is furniſhed with a ſharp point E, but when the ſaid point, or pyramid, *fig.* 2. is taken out by the winch, *fig.* 3. the *trepan* is then termed female.

You muſt alſo be provided with a *ſcalpel* of a particular make, with a round and flat head, as repreſented in *fig.* 4. which is denominated the *lenticular ſcalpel*; to which is added another inſtrument for gradually depreſſing the *dura mater*, of the ſhape repreſented in *fig.* 5. There muſt be alſo a perforating inſtrument provided, *fig.* 6. which muſt be ſcrewed into the cavity B of the handle, *fig.* 1. alſo a hair-bruſh and an elevatory. *

* Elevatory, *elevatorium*, is an inſtrument for raiſing depreſſed or fractured parts of the ſcull, to be applied after the integuments and *perioſteum* are removed. If there is any hole, the inſtrument muſt be faſtened to it; but if there is none, the *ſcrew-end* of the inſtrument muſt be applied. *See* plate, No. 1.

But as theſe elevatories are ſo contrived, that, where the neighbouring bones are fractured or depreſſed, they cannot be applied without greatly increaſing the pain, *Surgeons* have invented another kind which might be applied with more ſafety, called *tripes*, from the number of its feet. It is near twice as big as the figure we have given of it; (*ibid. Fig.* 2.) and the feet A A A ſtand nearer or farther from each other, as there is occaſion. The manner of applying it is this: the feet are to be applied to the ſound parts of the head, and the ſcrew B C, by frequently turning its handle DD, will preſently lay hold of the depreſſed part of the *cranium*, eſpecially if a ſmall hole has been made in it with the point of a ſharp awl. Then upon turning the ſcrew, E E, the *trepan* is raiſed by degrees, and with it the depreſſed part of the *cranium*. But if any opening ſhall appear between the fractured parts, it will be proper to take off the pointed end of the inſtrument B, and in its room fix the elevatory G, by the ſcrew H, about the part F of the figure No. 2. by the aſſiſtance of which it will be eaſy to raiſe the depreſſed part. *See* the manner of applying this inſtrument repreſented *ibid.* No. 3.

The

The apparatus of dreſſing and bandage, to be applied after the operation, conſiſts of a doſſil of lint, of an orbicular figure, which muſt be tied round the middle with a piece of thread about a ſpan long; there muſt be pledgits of lint for covering the other dreſſings, and filling up the cavity of the *cranium*, &c.

The apparatus being thus provided, in order to perform the operation with greater readineſs and exactneſs, the patient muſt be diſpoſed in ſuch a convenient poſture that the *Chirurgeon* and aſſiſtants may have free acceſs to perform each their part.

The dreſſings being removed the wound is to be cleanſed; after which, the head being placed in a convenient manner upon a pillow, the *Chirurgeon* takes the perforating *trepan*, *Fig.* 6. and adapting it to the handle B, *Fig.* 1. inſtead of the crown A, ſo that by turning round the handle D, he makes a full entrance, or aperture, with his inſtrument, and then applies the male *trepan*, with a crown A, *Fig.* 1. Upon the top of the handle CC the *Chirurgeon* fixes his left hand, upon which he places his chin or forehead, while with his right he ſlowly and carefully turns round the handle till the crown of the *trepan* with its ſpindle have made a circular entrance deep enough in the *cranium*, and then he removes the ſpindle, and continues his work with the crown of the *trepan* only as long as he ſees convenient; all the ſaw duſt being firſt bruſhed off from the *cranium*, and the teeth of his inſtrument, with the bruſhes. He now continues to uſe the *trepan* till the ſaw-duſt becomes bloody, which denotes that he has penetrated the *diploë*: however, he may not always meet with this ſign, becauſe in ſome ſkulls the *diploë* may be wanting in the part trepanned; but when the ſaw-duſt becomes bloody, the inſtrument is to be laid aſide: and after waſhing away the blood with a ſponge dipt in ſpirit of wine, he then ſcrews the *elevatory*, by two or three turns into the ſmall aperture in the middle of the *trepanned* piece of the bone, and takes it out again, making two or three more turns with the crown of his *trepan*: then he examines with a probe, whether the plates of the *cranium* are ſufficiently ſawed through, which cannot be better known than by attending to the colour of the circular groove; for when that appears blue or grey, it is a ſign that you have penetrated thro' the lower plate of the bone, ſo far as to render the *dura mater* almoſt conſpicuous thro' it; but if the bony plate appears livid in one part of the circular groove, and white in another, it is a ſign that the *trepan* has not cut equally through, and therefore it muſt be inclined and preſſed a little harder upon the whiteſt parts, moving round the handle till the ſaw-teeth of the crown have cut deep enough to make the round piece of the bone looſe or moveable. In that caſe it will not be convenient to cut totally through the bone with the ſaw-teeth of the *trepan*.

Having thus extracted the round piece of the *cranium* the blood uſually follows it: which being wiped off, the *Chirurgeon* is to examine whether there be any fragments remaining to be extracted and looſened; for then you muſt ſmooth the rough parts about the lower margin of the aperture, by applying the *ſcalpel*, Fig. 4. to prevent the *dura mater* from being pricked and injured by any of the ſharp ſplinters.

This done, the blood will more readily diſcharge itſelf, but to promote its exit you may gently incline the patient's head to one ſide, and another tenderly preſſing the *dura mater* itſelf, either by the hand of the *ſcalpel* or the *depreſſor*, Fig. 5, by which means the patient is no ſooner relieved from the preſſure of the extravaſated blood on his brain, but he inſtantly begins to recover his ſenſes: the *Chirurgeon* ſhould then direct him to fetch a deep breath, or hold it with a ſtrain, like one that has a hard ſtool.

The dreſſings and deligation are to be made with a round pledgit of dry lint laid next the *dura mater*, with a thread faſtened to it, and hanging out of the aperture, that it may be placed under, and drawn out from beneath, the *cranium*; upon which pledgit is afterwards poured ſome honey of roſes diluted with a little ſpirit of wine: you then impoſe a like pledgit of lint, furniſhed with a ſtring with other doſſils, till the cavity is replete: and in the next place, the *cranium* and wound itſelf, is to be dreſſed with lint, ſpread with ſome digeſtive ointment, upon which add a ſquare compreſs dipt in warm ſpirit of wine, and then ſecure the whole, without a plaiſter by the head bandage. In the ſubſequent dreſſings, which muſt be repeated once or twice every day, you muſt avoid fat and oily applications.

The wound being conſtantly attended, you will have an exfoliation of a thin plate from the *trepanned* margin of the bones, uſually within forty or fifty days, which ought not to be pulled away by force. The exfoliation being obtained, there will appear new fleſh and *callus* ſhooting up from the clean bone and *dura mater*, ſo as at length to fill up the whole cavity.

That inſtrument called the *exfoliating-trepan*, is ſometimes uſed to pare away a carious part in a bone. It is repreſented in *Fig.* 7. and when uſed is to be ſcrewed into the handle B of *Fig.* 1, in order to be turned round: A is its point: B B the wings, which ſcrape the bone while the inſtrument is turning about.

From the *cranium* we'll descend to the *eyes*, and make the operation of the *fistula lachrymalis*, and the *ablation of the cataract*.

The operation of the *fistula lachrymalis* is made when there is a fistulous ulcer at the great angle of the eye, at the place of the *glandula lachrymalis*.

For the operation of the *fistula lachrymalis*, the patient is put in a commodious situation, his sound eye is covered, to hinder him from seeing the instruments; the bad eye must be kept steady with a spoon; an incision, in form of a half moon, is made on the tumour with a *lancet*, avoiding cutting the eye-lid, or the small cartilage which serves as a pully to the great *obliquus*; and if the bone was carious, a small *actual cautery* should be thrust into it; for this, a small funnel is made use of, through which is introduced the *cautery* on the bone.

The *apparatus* and bandage of this operation, is made by filling up the wound with small dry tents of lint covered likewise with lint, a plaister over it, and a compress over the plaister. The *bandage* is made with a handkerchief folded triangular, whose ends are tied behind the head. If the flesh grows too much, it must be consumed with the *infernal stone*; and if it be necessary to dilate the wound to facilitate the exfoliation, small pieces of spunge, prepared with wax, must be thrust into it; afterwards the callosities must be consumed with *causticks* mixed with oily remedies, to weaken the action, taking care that they should not incommode the eye. If the bone was carious, *euphorbium* must be applied to it, or small tents of lint dipped in tincture of myrrh and aloes. The ulcer must be treated afterwards as all other ulcers.

The CATARACT is a suffusion of sight arising from a little film, or pellicle, which swimming in the aqueous humour of the eye, and getting before the pupil, intercepts the rays of light. The operation is made to blue, green, pearl-colour, &c. *cataracts*. To know if the *cataract* be in a condition to be couched, the patient is ordered to rub his eye; if the *cataract* remains immoveable, it must be couched; but if it changes place, the operation must be deferred till it has grown solid. The spring and autumn are the most proper seasons for this operation, which must be effected in the following manner:

The patient is made to sit down, the eyes turned towards the light; after the sound eye shall have been covered, the *Chirurgeon* must sit on a seat higher than that of the patient, a servant must hold the patient's head, who must be ordered to turn the eye towards the nose; the globe of the eye must be kept steady, with the *speculum oculi*, which is a small machine in form of a spoon, pierced in the middle; through which the eye is made to pass. The *Chirurgeon* takes a round, or flat steel needle, which he judges best; with which he pierces the *adnata*, by the edge of the *cornea*, on the side of the little *canthus*, or small angle of the eye, pushing boldly his needle till he comes to the middle of the *cataract*. He pushes the *cataract* upwards, to loosen it, and then downwards, keeping it sometimes, with the point of his needle beneath the pupil; if it re-ascends after he has quitted his hold, it must be brought down again. The operation is ended, when the *cataract* remains where he has lodged it, in the bottom of the eye. In pulling out the needle, he must close the eye lids, and press them a little upon the eye.

The *apparatus* and *bandage* of this operation is to close both the eyes of the patient, and put a band over them. He must keep his bed for seven or eight days, and some defensive is put upon the eye, to hinder the inflammation.

There are other operations made on the eyes. 1. There is, sometimes, *pus* under the *cornea*; to extract which the eye is kept steady by means of the *speculum oculi*; a small incision is made with a fine lancet, and the eye a little pressed, to procure the evacuation of the *pus*. If it was too thick it must be extracted, by sucking it softly through a small pipe, in the middle thereof there must be a small phial, into which the *pus* falls, while sucked. 2. A small tumour grows often in the eye. That tumour must be tied by the root with a running knot, to tie the tumour faster, from time to time, to make the tumour fall. If the tumour was on the hole of the pupil, this operation must not be attempted, because it would hinder the passage of the light 3. Sometimes there is a pretty hard membrane, called *unguis*, formed at the great *canthus*, or angle of the eye. If that tumour was not adherent to the great angle, it should be cut at its root, by tying it; this is performed with a blunt needle, with a thread which must be run under the membrane, and then tied. 4. If the eye-lids were glued together, the operator must take a bowed needle, blunted and threaded, which he must run under the eye-lids, drawing afterwards the ends of the thread to raise the eye-lids; and then they are to be separated with a lancet. 5. If the *cils* or hairs prick the eye, they must be pulled out one by one, with a pair of pinchers. 6. If there were small, hard, and transparent tumours on the eye-lids, they must be opened, for to evacuate the *pus*.

The operation of the POLYPUS is made when there are excrescences of flesh in the nostrils. If the *polypus*, or excrescences of the flesh were livid, stinking, hard, painful, and very adherent, they ought

ought not to be touched, they are cancers, and not *polypus*; but if they are whitish, red, hanging, and without pain, the extirpation must be made with pinchers. The *polypus* is seized as near its root as possible; the *forceps* is moved from one side to the other, to loosen the *polypus*. If the *polypus* descends into the throat, it must be extracted through the mouth with bowed pinchers If after the operation there happens an hæmorrhage, it is stopped by introducing, into the nostrils, tents dipped in some styptick liquor; or the liquor shall be syringed into the part.

From the nose we'll descend to the mouth, and make the operation of the *Hare-lip*. This operation is made when the *lip is split*.

To make this operation; if the lip was adherent to the gum, it must be loosen'd with a *bistoury*, without touching the gum. The edges of the lip must be a little pared with the scissars, to help the reunion; which to perform with the more ease, the edges of the lip should be laid hold of with pincers. The servant who supports the head of the patient, must press his cheeks forward, to approach the edges of the lip; then a needle threaded with a waxed thread must be run through both the edges of the wound, from outwards, inwards, at one line distance from the edges; the operator must take care that the two edges of the lip should be very well adjusted together, and very equal; the thread is turned round the needle, by crossing over.

For the *apparatus* and *bandage*, the lips of the wound must be washed with hot wine; the points of the needles are cut, and small compresses applied to their ends. Lint with some good balsam is applied on the wound, and a piece of linen cloth dipped in some desiccative liquor placed between the lips and the gum, to hinder them from gluing together, if they must have been separated. Over all is put an agglutinative plaister, which must be sustained with an uniting bandage, which is a small band pierced in the middle. 'Tis passed behind the head, and brought before; one of its ends is passed through the hole, which is applied on the wound, and both ends of the band passed where it is tied. A number of needles must be put in proportion to the length of the wound, which wound must be dressed three days afterwards. For the first time no other thread but that of the middle needle, if there be three, is to be put round it; to effect which, a servant must push the cheeks forward. The eighth day the middle needle, if it be a young child, must be taken off, though the needles are not to be taken off till the edges of the wound appear to be joined; neither are they to be left too long, because the holes they have made could not be closed without some difficulty.

Our next operation is in the THROAT and called the *bronchotomy*.

This operation is to cut into the wind-pipe to prevent suffocation in a squinancy. It is performed thus; the body of the patient being prepared, an incision is made between the third and fourth *annu i*, or in the *trachæa*. In separating the muscles *sternohioides*, care must be taken not to cut the recurrent nerves, because the patient would lose his voice; nor the glands *tyroid s*. The skin and integuments divided, and the muscles removed, a silver tube is applied, short and flat, a little bow'd, and not thrust too far, for fear it should cause a cough. This tube must have two small rings, to fix two ribbands on them, which must be tied round the neck. 'Tis left in the wound till the accidents are over, after which it is took out, and the lips of the wound approached near one another with the uniting bandage above described, and the wound dressed.

Leaving the *throat*, we'll lean on the BREAST, to make the operation of the *cancer*.

It must be done in the following manner.

The patient being laid on a bed, the arm on the side of the *cancer* must be raised upwards, and backwards, to give a greater relief to the tumour.

Take a *forceps*, turned at both ends, in form of a half moon; so that both ends of the two half-moons pass over one another, when the *forceps* are shut: and the breast is taken and drawn with the *forceps*, and cut, at one blow, with a flat and very sharp knife. The operator begins to cut at the inferior part, that the mammary vessels should be cut last; for fear of being incommoded by the hæmorrhage.

If the tumour was not yet ulcerated, a crucial incision is made to the skin, without penetrating into the glandulous body; the fore-pieces of skin are separated from the glands, the cancrous tumour is embraced with the pincers, and cut. If there are swelled vessels, they must be tied before the extirpation of the tumour. If the tumour was adherent to the ribs, it ought not to be touched.

From the out-side of the *breast* we'll penetrate into its in-side, to make the operation of the *Empyema*.

The EMPYEMA, from the *Greek* ἐν, in, and πύον, pus, is a collection of pus, or purulent matter, in the cavity of the breast; discharged thither upon the bursting of some abscess, or ulcer, in the lungs, or membranes that inclose the breast.

The cure is difficult, from the difficulty of absorbing, or evacuating such extravasated matter: if nature shews any endeavour to throw it off by vomiting, urine, or the like, she must be seconded and assisted therein. Thus if the urine be purulent,

 administer

administer diureticks; if the stools, laxatives; if the spitting, expectorants; but never emeticks. Otherwise recourse must be had to the operation, which must be performed as follows:

If the tumour appears outwardly, the abscess must be opened between the ribs; but if there are no exterior signs, the operator must chuse the most commodious place to make his aperture. The patient set up in his bed, supported by somebody, the aperture is made between the fourth and fifth, or the fifth and sixth ribs, reckoning from the lowest, at four fingers breadth distance from the *spina*. To make it, the skin is pinched transversly, to cut it lengthwise, the operator holds it on one side, and a servant on the other: the incision is made with a strait *bistoury*, and must have three or four fingers breadth in length; the fibres of the great *dorsalis* are cut transversly, that they may not stop the aperture; the index of the left hand is thrust into the incision, to put aside the fibres; the *intercostales* muscles are to be cut, and the point of the *bistoury* guided with the finger, to pierce the *pleura*, for fear of wounding the lungs, which are often adherent to it. The aperture being made, if the pus runs out well, it must be left running; if not, the index must be put into the wound, to break the adherences whereby the lungs are tied to the *pleura*; which is done by turning the finger round between the *pleura* and the lungs.

To facilitate the evacuation of the pus, the patient is made to lean, shut his mouth, stop his nose, and to push, as if he would blow; if blood is contained in the part, more of it must be evacuated than if it was pus; because the evacuation of pus weakens more than that of blood.

In making the incision, the *intercostales* muscles must be cut transversly, not to discover the edges of the ribs; thus the wound will not become so soon fistulous.

If it be judged that there is pus on both sides the breast, both sides must be opened; because the breast is divided into two by the *mediastinum*; in that case both apertures must not be left open, for fear of suffocating the patient.

The Apparatus, and *bandage*, is made with a tent covered with balsam; it must be soft, and blunted at the end, and must enter no further than between the ribs, for fear it should wound the lungs. If the tent was made of lint, it would be a great deal better than one made of linen; a thread must be tied to it, otherwise it would chance to fall into the breast. *Pledgets*, or lint, must be put upon the wound, a plaister, and a good compress, over all. This *apparatus* is supported with a napkin pinned round the breast, which napkin is also supported with a scapulary, which is a band six fingers broad, pierced in the middle to pass the head through, one of the ends falling behind, and the other before, both to be pinned to the napkin. This done, the patient is put into his bed half sitting, if the lungs were to hinder the evacuation of the pus, the operator must have recourse to a *canula*.

We must continue our progress, and fall from the breast to the *abdomen*, for the operation of the *paracentesis*.

Paracentesis, from the *Greek* παρα, with, and κεντειν, to prick, is an operation, which consists in the opening a little hole in the lower venter, or belly, to let out waters collected in the cavity thereof, or between the teguments, in an *ascites*, or water dropsy.

This operation is made with a kind of stillet, or bodkin. The patient is supported in his bed, that the waters may descend the easier. A servant must press the belly with both hands, to make it form a tumour. The operation is usually performed two or three fingers breadth on one side the navel, sometimes a little lower, but always so as to avoid the *linea alba*. Before the puncture, it would be very proper to raise the skin a little; the bodkin is accompanied with its *cannula*, which remains in the belly after the *puncture*; the bodkin is took out, to let the water flow as long as the patient's strength will allow; the best operators draw all the water at once. When a new *puncture* is wanted, it must be made under the first.

The Apparatus and *bandage* are made with a large compress four times double, supported with a napkin folded into three or four, and this napkin supported with the scapulary.

There are several operations made in the *abdomen*, as the *gastroraphy*, that of the *exomphalus*, of the *bubonocele*, and *compleat hernia*, of the *castration*, of the *stone*, of the *puncture* of the *pireneum*, and of the *fistula in ano*.

The operation of the Gastroraphy is made, when there is a wound in the belly big enough to let the intestines or guts come out. If there be a wound in the intestine or gut, it must be sewed up with the skinner's *suture*. If the *epiploon* or *caul* was mortified, what's mortified must be cut off; for this, a needle threaded with waxed thread, is run through the sound part of the *epiploon*, without pricking the vessels; the *epiploon* is tied on both sides with each of those threads, which have been run double through it, and cut off an inch beneath the ligature. The threads must come out at the wound, to be took off after the suppuration. Then the guts must be thrust again, alternately, with the ends of the fingers, into the belly. If they cannot be reduced with ease, they must be

fomented

fomented with spirituous fomentations, made of a handful of flowers of *camomile* and *melilot*, an ounce of *anniseed*, with as much *fennel* and *cummin-seed*, half an ounce of *cloves* and *nutmegs*; the whole must be boiled in milk, adding to it an ounce of camphorated *spirit of wine*, two drams of *saccharum of saturn*, with two scruples of *oil of anniseed*, which fomentation must be used hot.

Before the operator makes the *sutures* of the intestines, or guts, he must have them fomented with camphorated spirit of wine; but if the intestines were mortified, they must not be sewed up, but only fomented with spirituous liquors. Clysters are not to be administred to the patient, lest they should swell up the intestines, but suppositories, or laxative ptisans must be used, if natural evacuations be necessary. The patient ought to be very sober while the cure lasts, and take no other aliments but good broth and gellies.

If the *intestines* cannot be reduced, the wound must be dilated, as far as possible from the *linea alba*, rather towards the inferior part of the belly than towards the superior, if the wound be in the superior. To dilate it, the intestines are placed on one side of the wound, and a compress dipped in hot wine, is put over them, which must be held by somebody; a proper probe is introduced into the belly, taking care not to engage the gut between the probe and the *peritonæum*; to avoid which, the gut must be a little drawn up: the probe is held with the left hand, to run a bowed *bistoury* into its *canelure*, and the teguments are equally cut, outwards and inwards, and the intestines thrust alternately into the wound with the index fingers.

The *suture* must be interwisted; it is made with two bowed or crooked needles, threaded at each end with the same thread; the index of the left hand is introduced into the belly to keep up the *peritonæum*, the muscles, and the skin, on the edge of the wound; the needle is ran with the other hand into the belly, conducting the point of the needle with the index, and piercing pretty deep. The other needle is ran into the other lip of the wound, inside of the belly, observing the same thing as in the first, if several stitches were to be made, the process is the same. A servant must approach the edges of the wound, and make the knots. The wound is to be dressed, and the *apparatus* supported with the napkin, and scapulary. The patient must lye on his belly, for the first days, to cicatrise the wound of the belly, or of the guts.

If the intestine was entirely cut, it should be sewed all around the wound so as to remain always open: if the patient should live, he would render his excrements that way.

The operation of the EXOMPHALUS, is made when the intestines have formed a *hernia* in the umbilick. The patient is laid on his back, and an incision made on the tumour as far as the fat, in pinching the skin, if possible; otherwise it must be made on the tumour as far as the fat, without pinching it. Afterwards the membranes are tore with nails, to discover the *peritonæum*, for fear of cutting the intestine. When the operator perceives the *peritonæum*, he draws it upwards with his nails, to make a small aperture to it: he introduces the index of the left hand into the belly, to guide the point of the scissars, with which the incision is to be dilated. He thrusts again the gut into the belly, and if the *epiploon* was adherent to the tumour, he would loosen it from it; but if the intestines were adherent to the *epiploon*, they must be separated by cutting part of the *epiploon*, rather than touch the intestine. The intestine being reduced, a servant must press the belly on the edges of the wound. If there was a mass of flesh at the *epiploon*, formed by the adherence of the *epiploon* with the muscles, and the *peritonæum*, that must be loosened, and then a ligature made to carry it off with the *epiploon*, as we have done in the *gastroraphy*, dressing the wound afterwards. The same precautions mentioned in the *gastroraphy*, must be used in this; and the *apparatus* supported with the napkin and scapulary.

The operation of the BUBONOCELE is made when the intestinal parts are fallen into the *groins*, or the *scrotum*. For this the patient is laid on his back the buttocks a little risen. the skin is pinched transversly on the tumour; the operator holds the skin by one side, and the servant by the other, and makes an incision in following the plit of the *groin*; when he has discovered the fat, he must tear with an instrument, or with his nails, every thing he meets with 'till he comes to the intestine, which he must take out, a little, if it does not adhere to the *annuli* of the muscles, and handle it softly, to dissolve the excrements. This done, the intestinal parts are reduced alternately with the indices into the belly, if possible; if not, the wound must be dilated upwards, by introducing a probe into the belly, to run the scissars through its *canelure*. If the probe cannot enter, the intestine must be drawn out a little, in putting the finger upon it near the *annulus*, and a small scarification shall be made to the *annulus* with a strait *bistoury*, which must be conducted with the finger to introduce the probe, upon which shall be run a bowed or crooked *bistoury* to cut the *annulus*, or ring, *i. e.* to dilate the wound within side. The operator must not go too far, for fear he should cut a branch of arteries; afterwards the parts are reduced into the belly. If the

the *epiploon* had cauſed the *hernia*, it muſt be tied, and what's alterated cut. The *annulus* muſt be ſcarified within, in order to make a good *citatrice* or ſeam.

The APPARATUS and *bandage* muſt be made with a very ſoft and blunted tent, big and long enough to hinder that the impulſion of the inteſtines ſhould make them re-enter between the *annuli*; and that tent muſt be tied to a thread, to be extracted at pleaſure. The wound muſt be filled with lint, covered with a good digeſtive, made with turpentine, and the yolk of eggs; a plaiſter, and a compreſs of a triangular figure, and bandage *Spica*.

The operation of the *compleat* HERNIA is made when the inteſtinal parts fall into the *ſcrotum* in men, and in women to the bottom of the lips of the *matrix*. For this operation the patient is laid on his back, as in the *bubonocele*, and the inciſion is made in the ſame manner; this is made as far as into the *ſcrotum*, and the membranes are lacerated as far as the inteſtine. The operator examines if the parts be adherent to the teſticle; if it be the *epiploon*, it muſt be looſened, and a piece of it left to the teſticle; but if it was the inteſtine, and it could not be ſeparated without offending the one or the other, it is better to offend the teſticle than the inteſtine. If the *epiploon* was alterated, it muſt be cut as far as into its ſound part; the wound is filled with lint; and for bandage, the *ſpica*, as in the *bubonocele*.

The operation of the CASTRATION is occaſioned by the mortification or *ſarocele* of the teſticles. In this operation the patient is made to lie on his back, his backſide higher than his head, to open his legs, which are held by ſervants; then the operator pinches the ſkin of the *ſcrotum*, giving one end to hold to a ſervant, while he holds the other, to which he makes a longitudinal inciſion from top to bottom. The carnoſity of the *dartos*, which wraps in the teſticle, is ſeparated. The veſſels are tied between the *annuli* and the tumour, and cut a finger's breadth under the ligature. The ſpermatick veſſels are not to be ty'd too hard, for fear of a convulſion; one end of the thread muſt be left to come out of the wound. If the excreſcence of the fleſh was adherent to the teſticle, and is felt moveable, it muſt be ſeparated dextrouſly, leaving a ſmall piece of that fleſh to the teſticle. If ſome conſiderable veſſels were to appear on the tumour, they ſhould be tied, before it is cut.

The APPARATUS and *bandage* are made by filling the *ſcrotum* with lint. The *bandage* muſt be the ſuſpenſor of the *ſcrotum*, called *pauche*; it is a *bandage* with four chiefs, the ſuperior ſerving for a girt, and the inferior paſs between the thighs, and are tied behind to the girt. There is another *bandage* of the *ſcrotum* with four chiefs, the ſuperior ſerve for a girt; it is ſplit at the bottom, is without ſeam; the inferior chiefs croſs over one another, to paſs between the thighs, and be tied to the girt; both are pierced through for the paſſage of the *penis*.

The next operation, which falls under our conſideration, is a very great one, called the *operation of the* STONE.

Mr. *Sharp* lays down the following method of ſearching for the ſtone. The patient being laid on a horizontal table with his thighs elevated, and a little extended, paſs the ſound, or catheter, with the concave part towards you, till it meets with ſome reſiſtance in the *perinæum*, a little above the *anus*; then turning it without much force, puſh it gently on into the bladder, and if it meets with an obſtruction at the neck, raiſe its extremity upwards, by inclining the handle of it towards you; and if it does not then ſlip in, withdraw it a quarter of an inch, and introducing your fore-finger into the *rectum*, lift it up, and it will ſeldom fail to enter.

Though, upon ſearching, the *Chirurgeon* may be aſſured of a ſtone in the bladder, yet he is not without farther enquiry to operate immediately; ſince there are ſome obſtacles that forbid the operation, either abſolutely, or only for a certain time. Among theſe, that of the greateſt conſequence is the gravel or ſtone in the kidneys, which is known by the pain in the loins, vomiting, retraction of the teſticles, numbneſs of the thighs, and often by matter, which the inflammation produces in the kidneys. Difference of age make an extreme difference in danger; infants and young people almoſt always recovering; but ſtill the operation is adviſeable in thoſe advanced in years, though it is not attended with near the ſame ſucceſs.

Before the operation is performed, it is proper to prepare the patient with a gentle purge the preceding day, and a clyſter early in the morning, which will be of great ſervice in cooling the body and making the operation leſs dangerous, where the *rectum* is liable to be wounded, when full.

The moſt convenient time for the operation of *lithotomy* is ſpring or autumn, though when the patient is in exquiſite torment, or his life in danger, the preſent opportunity ſhould be embraced.

Lithotomy is of two kinds: that made into the bladder is termed *cyſtotomy*; but when the ſtone is in the kidneys, which very rarely happens, the operation is termed *nephrotomy*.

With reſpect to the ſeveral methods of performing *lithotomy* for the ſtone in the bladder, they, according to *Heiſter*, are four: the firſt, and moſt antient, is the *apparatus minor*, called likewiſe the

ceſſian

ceſſian or *guidonian* method: the ſecond, the *apparatus magnus*, or *Marianus's method*; the latter being termed the new, and the former the old method: the third is the *apparatus altus*, or *hypograſtic* ſection; wherein the inciſion is made at the lower part of the *abdomen* in the *anterior* ſide of the bladder, immediately above the *os pubis*; whereas in the reſt it is made in the *perinæum*, between the *anus* and the *ſcrotum*: the fourth, and moſt modern method, was invented towards the end of the laſt century, and is termed the lateral operation.

The firſt method is now entirely laid aſide; though *Heiſter* thinks it practicable on boys under fourteen: the wound of the bladder in this operation, ſays *Sharp*, is made in the ſame place as is now practiſed in the lateral method; but its being impracticable on ſome ſubjects, and uncertain in all others, has made it to be univerſally exploded.

In performing *lithotomy* by the *apparatus major*, Mr. *Sharp*'s directions for the ſituation of the patient are thus. Having laid the patient on a ſquare horizontal table, three feet four inches high, with a pillow under his head, let his legs and thighs be bent, and his heels made to approach his buttocks by tying his hands to the ſoles of his feet with a couple of ſtrong ligatures; and to ſecure him more effectually from ſtruggling, paſs a double ligature under one of his hams, and carry the four ſtrings round his neck to the other ham: then paſſing the loop underneath, make a knot by threading one of the ſingle ends through the loop; and thus the thighs are to be widened from each other, and firmly ſupported by proper perſons.

The patient thus ſituated, *Heiſter*, directs the operation as follows: the operator, dipping the beak of a ſizeable and grooved ſteel catheter A, (ſee the plate fig. I,) in oil, he conveys it through the *urethra* into the bladder, and being aſſured there is a ſtone, turns the crooked part of the *catheter* in the bladder and *urethra* towards the left ſide of the *perinæum*, but the handle and *penis*, which contains it, towards the right *inguen*, then delivers it to the aſſiſtant, who holds up the *ſcrotum* in the other hand; for the crooked convex part of the *catheter*, thus elevated in the *perinæum*, renders that part of the *urethra*, which is to be divided, ſufficiently perceptible both to the ſight and touch. He next lays hold of the integuments of the *perinæum* with the fingers of his left hand, holding in his right the inciſion-knife, B, wrapped in linen, as he would do a pen for writing: with this he makes a longitudinal inciſion downwards, about the middle of the left ſide of the *perinæum* near the *future*, through the fat, then he again feels for the *catheter*, and afterwards divides the *urethra* in a direct line downwards, ſo that the end of the knife may paſs into the groove of the *catheter*.

After a proper inciſion, the ſurgeon parts with his knife, inſerting in the groove of the *catheter*, it an aſſiſtant holds it, the nail of his finger or thumb: then he takes a male *conductor*, C. dips it in warm oil, and having paſſed it through the groove of the *catheter* and neck of the bladder into the bladder itſelf, extracts the *catheter*. The male *conductor* being thus paſſed, a female *conductor*, D, is introduced upon it, in ſuch a manner as the latter receives the prominent back of the former in its groove, and conveys it ſafely into the bladder through its neck.

After this the two *conductors* are gently ſeparated by their handles, and then a ſtraight *forceps*, E, dipt in oil and ſhut very cloſe, is carefully conveyed into the bladder between the *conductors*. The *forceps*, after it is introduced, and the *conductors* withdrawn, muſt be opened ſeveral times to dilate the wound, and then ſhut to ſearch for the ſtone: when the ſtone is found, they muſt be opened with both hands, in ſuch a manner that one jaw, if poſſible, may lay hold under the ſtone, and the other above it. When the ſtone is thus intercepted, the *forceps*, by a gentle motion from ſide to ſide, muſt be brought towards the *rectum*, and the ſtone extracted downwards; becauſe the parts dilate and yield more eaſily that way, while upwards they meet with a reſiſtance from the *os pubis*: but if it lies concealed in any part of the bladder, and cannot be laid hold of by the *forceps*, the operator muſt paſs the two firſt fingers of his left hand into the *anus*, elevate the ſtone, and force it into them. If it is ſituated in the upper part of the bladder, behind the *oſſa pubis*, the *inferior* part of the *abdomen* muſt be preſſed downwards by the hand, that it may commodiouſly be taken hold of, and drawn out by the ſtraight or a crooked *forceps*; and if it is lodged on either ſide, the crooked inſtrument F is moſt convenient.

When the ſtone is too large to be extracted whole, it muſt be broken by a *forceps*, G, with teeth, and the fragments to be drawn out one after another. Laſtly, if the ſtone is too large and too hard to be either extracted or broken, a prudent ſurgeon will deſiſt, and heal the wound, or leave a fiſtula for the diſcharge of the urine.

The ſtone being thus extracted, and the bladder cleared, the wound is cleanſed with a ſponge, the ligatures untied, the patient put to bed, and the wound now dreſſed with doſſils of ſcraped lint: if the hæmorrhage be too profuſe, it may be ſtopped by pledgits of lint dipt in a proper ſtyptic, and the arteries compreſſed with the fingers till it ſtops. Theſe muſt be covered with a linen-bolſter, and a large ſquare compreſs without a plaiſter, ſecuring the

the whole with the T bandage, or that with four heads; and if they are ineffectual, the artery must be tied up with a crooked needle and thread.

After dressing, the patient must be supplied with plenty of ptisan, barley-water, or a strengthening and composing emulsion; his diet should be the same as for people in fevers, or after great wounds.

The *apparatus altus*, or *high operation*, is performed as follows. The patient being duly prepared, and laid in a proper situation, a hollow silver *catheter*, with a flexible leathern tube H. (*ibid*) at the end of it, is to be introduced into the bladder: to the tube must be fitted a large syringe, for the injecting of such warm water, barley-water, or milk, as the patient can bear. When this is done, the *catheter* is extracted: then while an assistant introduces his two fore-fingers into the *anus* to elevate the stone and bladder, the operator makes an incision in a right line through the skin, fat, and abdominal muscles, immediately above the *ossa pubis*. The external wound should be three fingers-breadth long in children, and four in adults; then introducing the left *index*, the *Surgeon* feels for the liquor that distends the bladder, and then makes an incision into the bladder immediately above the juncture of the *ossa pubis*: after which he passes a small knife into the body of the bladder, so as to make a small wound with the point only; through this aperture he passes a crooked or straight knife, armed with a button, whereby he enlarges the wound upwards the breadth of one or two fingers. He then introduces his left *index* to draw the upper part of the bladder towards the navel, and then enlarges the wound downwards. Immediately after, he introduces the fore-finger of the other hand, and examines the size and situation of the stone, and accordingly he enlarges the wound either upwards or downwards, in order to extract it. And when the stone is extracted, and nothing left, the wound is dressed, and the patient treated much in the same manner, as in the former case.

The fourth method, which is called the *lateral operation*, is performed thus: every thing being properly prepared, introduce a *catheter*, and afterwards make an incision of a proper length, beginning where they end in the *apparatus major*, and continuing it downwards between the *accelerator urinæ*, and *erector penis*, on the left side of the *intestinum rectum*; and directing the knife to the posterior part of the *catheter*, through the inferior and lateral part of the bladder, behind the prostate gland, and above the seminal vesicles, then continue it forwards through the sphincter of the bladder, and left side of the prostate glands into the membranous part of the *urethra* even to its bulb, which preserves the *rectum* better than the lateral method.

Among *Cheselden*'s emendations, Doctor *John Douglas* enumerates these. 1. If he finds the patient's pulse low after the operation, he applies blisters to the arms, which effectually raise his spirits. 2. If the wound grows callous, he lays on a piece of blister-plaister to erode it, by which new flesh pullulates, and the wound unites. 3. If the wound be putrid, he mixes a little verdigrease with some digestive ointment.

Women are less subject to the stone in the bladder than men, and their urinary passages are more short and lax, so that in general the stone being but small, discharges itself with the urine, and when it happens to increase in the bladder, we have instances of its coming away spontaneously. Doctor *Douglas* proposes to extract a small stone in a woman, by dilating the *urethra* with a tent of gentian-root, or prepared sponge; but when the stone is large, he approves of the *high operation*, distending the bladder with warm water, and compressing the *urethra* by an assistant's finger in the *vagina*, and then making an incision into the bladder immediately above the *os pubis*. This, *Heister* says, is a very proper method, when the stone is very large, and the patient young and healthy; but *Morand*, when the stone is small, prefers the *apparatus major*.

Upon the whole, *lithotomy* appears to be a dangerous and precarious operation, nor can one method alone be depended on; but the *Chirurgeon* must be determined in the choice, by the particular circumstances of the case.

Nephrotomy, the *second species* of *lithotomy*, is by most writers on the subject thought impracticable, who therefore absolutely reject it; though we have many instances of persons, who have been cured of wounds of the back penetrating to the kidneys. *Heister* mentions one cure of this kind performed by himself. Wounds, therefore of the kidneys, especially those inflicted on the back, without penetrating into the cavity of the *abdomen*, he says, are often curable. And though *Hippocrates* prohibits his pupils from practising *lithotomy*, yet in treating of disorders in the kidneys, in his work *de Intern. Affect.* he directs to make an incision near the kidney, when it is tumefied and elevated, and after extracting the *pus*, to discharge the gravel by diuretics; for this opening may preserve the patient, who must otherwise die: and again, he says, when the kidney, being suppurated, tumefies near the spine, a deep incision should be made upon the tumour near the kidney, or into the kidney itself. *Rouset*, *Riolanus*, and others, think

nephrotomy,

nephrotomy may be practised with success, if the opening is made where the stone is perceptible, and neither the emulgent artery, vein, nor ureter wounded, nor the cavity of the *abdomen* penetrated. But beyond all dispute it must be reasonable, when nature points out the place by a tumour or abscess in the loins, proceeding from a stone in the kidneys.

The inferior parts are subject to another dangerous disorder or malady, which requires a most severe operation. It is the FISTULA in ANO.

This is a deep winding, callous, cavernous ulcer, yielding a virulent matter in the *anus* or fundament.

The ancients reckoned four kinds of *Fistulas in ano*; but the best writers of late reduce them to two. The *first* are those arising from a *phyma*; these are very painful, and difficult to cure, as entering deep among the interstices of the muscles, and forming various *cuniculi*, or *sinus's*; which the more remote they are from the *Anus*, the worse they are, by reason they do not allow of being cut. The *second* owe their origin to an internal hæmorrhage, or extravasation between the coats of the *rectum*; and have a small perforation near the circumference of the *anus*, whence they yield a thin *sanies*, or ichor, without pain; they in time bring on itchings and excoriations, and the orifices at length become callous, and are sometimes closed, and sometimes open again.

The fresh, simple *fistula*, may be cured without danger, by *cutting*, where that may be done without damage to the muscle of the *anus*, in the following manner:

If the *fistula* be open outwards, the patient must lie on his belly at the edge of the bed, his legs asunder; the operator must make a small incision with a bistoury, at the orifice of the *fistula*, to run into it a small, thin, and bowed or crooked bistoury; at the end thereof there must be put a small pointed stillet, with a small silver tongue to it, to recover it, that it may enter without causing any pain; this bistoury must be introduced into the *fistula*, having the index of the left hand in the *anus*, and its tongue must be drawn out; the handle of the bistoury must be held with one hand, and the stillet, which pierces the *anus*, with the other. The instrument is drawn out to cut the *fistula* all at once.

If the *fistula* opens in the intestine, an incision must be made outwards, at the bottom of the *fistula*, to open it in the place where ordinarily appears a small tumour, or inflammation; or where the patient feels some pain when the part is touched. If the tumour was far from the *anus*, it might be opened with the potential cautery to avoid causing pain. When the bottom of the sack is opened, the bistoury, with its stillet and tongue, is introduced into it. The end of the stillet is extracted through the *anus*, and the flesh cut all at once. If the *fistula* was too far in the *anus*, the sphincter of the *anus* should not be entirely cut, for afterwards the patient could not be able to retain his excrements.

After the *fistula* has been opened, all the sinuosities found in it must be cut, likewise, with scissars; the wound is filled with tents made of lint, dipped in some anodyne *pledgets*, a plaister, a triangular compress, and the whole supported with the bandage called T.

From the *trunk* of the *body*, we'll descend to the extremities, and make the *amputation* of the LEG.

For the *amputation of the leg*, the patient is made to sit on the edge of his bed, or in a chair; he must be supported by two servants, one to hold the leg at the bottom, and the other to draw the skin upwards above the knee, that the flesh may cover the bone after the operation. A pretty thick compress is placed within-side the knee on which are made two ligatures; the first above the knee, to stop the blood, to be straitened with the *gripe*; the second under the knee, to straiten the flesh for the knife. Before the first ligature be straitened, a piece of card must be put under it, for fear of pinching the skin. The leg being made very steady, the operator plac'd to the inside of the limb, makes the incision with a bow'd knife, turning circularly to the bone, keeping one of his hands on the back of the knife, and endeavouring to separate the flesh from the bone with a stroke or two; then divides also, the *periosteum* from the bone with the back of the knife, or a bistoury, and cutting the flesh and vessels which are between the two bones. The flesh being cut, a splitted band must be put upon it, whose chief must be crossed, to draw the flesh upwards, that the bones may be cut further, and covered by it after the amputation, and also to facilitate the passage of the saw. The *Chirurgeon* must then take the leg with his left hand, and the saw with the right, which he must apply on the two bones, to cut them both at the same time, beginning by the *peronæum*, and ending by the *tibia*. He must incline the saw, and go softly, at first, to make the way; after which, he must go swifter, and with as few strokes as possible.

The ligature of the vessels is done by laying hold of their mouths with a forceps with springs, which forceps is given to a servant to hold: a needle, threaded with a wax thread, is run thro' the flesh under the vessel, and run again, and then algature is made with the two ends of the thread to the veſſel. The gripe, is taken off with the band, the patient is ordered to bow a little, the ſtump and the fleſh is brought down to cover the bone.

The APPARATUS and *bandage* are made by putting ſmall compreſſes on the veſſels, and dry pledgets on the tow bones, and ſeveral other pledgets covered with aſtringent powders; over it another great pledget of cotton or tow covered with aſtringent powders, the whole being wrapped up with a plaiſter, and a compreſs in form of a croſs of *Malta*, with three or four longitudinal compreſſes, and a circular one. The croſs of *Malta*, and the compreſs, are placed within-ſide of the knee, whoſe chiefs, or ends, are croſſed over the ſtump; they muſt be held by the ſervant who ſupports the part; the other chiefs are croſſed, likewiſe; the two longitudinal compreſſes croſſing one another; are placed at the center of the ſtump, and a third longitudinal is made to run round the ſtump, to ſtop the two firſt; they muſt be three fingers in breadth, and long enough to paſs on the ſtump.

This done, the bandage is made with a band four ells long, and three fingers broad, rolled to a globe, with which are made three circularies on the edge of the part cut, riſing upwards by *doloirs*, and paſſing obliquely the band under the knee, and deſcending again over the firſt turns; continuing thus to deſcend and riſe till the whole ſtump be covered; the band muſt be ſtopped above the knee. In three or four days the dreſſing may be removed, and proper digeſtives, mixed with aſtringents, applied; having an actual cautery, or ſome powerful ſtyptick, in readineſs, in caſe of a violent hæmorrhage at the firſt opening. M. *Sabourin*, *Chirurgeon* of *Geneva*, is recorded in the hiſtory of the *Royal Academy of Sciences*, *Anno* 1702, for an improvement in the method of *amputation*, propoſed to the academy. The whole ſecret conſiſts in ſaving a piece of fleſh, and ſkin, a little lower than the place where the ſection is to be made; wherewith the ſtump is to be afterwards covered. The advantages whereof are, that in leſs than two days time this fleſh unites with the extremes of the divided veſſels, and ſo ſaves the neceſſity either of binding the ends of thoſe veſſels with thread, or of applying cauſticks, or aſtringents; which are methods very dangerous, or at leaſt very incommodious. Beſides the bone, thus covered up, does not exfoliate.

From theſe examples (compared with our treatiſe on ANATOMY) the curious enquirer into SURGERY may form a judgment, not only of the uſe of this art; but alſo of the manner of executing many cures and operations, not particularly mentioned in this treatiſe.

As for the practice of MIDWIFERY, which is acknowledged amongſt *chirurgical operations*; the ſubject is of that conſequence, that it deſerves a treatiſe by itſelf; and therefore ſhall refer the reader to the the letter M, in the courſe of this work.

Of CHRONOLOGY.

CHRONOLOGY is the regulation of times, in regard to *civil* and *eccleſiaſtical* hiſtory; ſhewing by remarkable ſigns and tokens, notes and characters, the exact time when every memorable action has happened ſince the Creation: whence it has it name from χρόνος, *time*, and λογος a *diſcourſe*.

Its buſineſs is to aſcertain and adjuſt the various epochas and other periods mentioned in hiſtory, ſo that the eſtabliſhment and revolutions of empires and kingdoms, and other remakable events may be truly ſtated.

Mr. *Locke* writes, that hiſtory owes its uſe and beauty to *Chronology*; and that, without its aid, hiſtory would be a jumble of facts confuſedly heaped together, not capable of giving either pleaſure or inſtruction,

This ſcience begins with ſome preliminary definitions. For before chronological facts can be aſcertained, it is neceſſary to agree upon the definition and diviſion of TIME.

Firſt, TIME is the meaſure of *motion*, which motion has always been calculated, or computed by the motion of the *ſun* and *moon*; as the moſt regular and conſtant.

Secondly, Upon this doctrine, *time* has been uſually divided into *ſolar* and *lunar* revolutions, called *years* and *months*.

The *ſolar year* is the ſpace of *time* the *ſun* takes to paſs through the twelve ſigns of the *zodiack*, conſiſting of 365 days, 5 hours, and 49 minutes. This is known by the name of the *natural* or *aſtronomical* year. But there are other *annual* diviſions of *time* deviſed by the church and ſtate, called *artificial* or *civil*, and *eccleſiaſtical years*.

Hence aroſe the variety of computations, which ſo much perplex our hiſtories.

The *civil year* is that form of year, which each nation has contrived to compute *time* by; or it is the *tropical year* conſidered as only conſiſting of a certain number of whole days, *viz.* 365 days, without

without any regard to the surplus of hours and minutes; which every fourth year being added together make one whole day, and then the civil year contains 366 days, which is called *bissextile* or *leap-year*; the invention of *Julius Cæsar*, to make the *civil year* keep pace, with the *tropical* or *astronomical*. Of which more particularly hereafter.

In the year 1582, it being observed that the vernal equinox, was by this calculation brought back from the 20th to the 10th of *March*, Pope *Gregory* XIII. cast out ten days at once in the computation, by ordering the *first* of *October* to be held for the *eleventh*, &c. And to prevent the like excess for the time to come, in the *Italian* computation, he ordained, that at the end of every century, the *bissextile* or *intercalary* day should be omitted, except the fourth century, when it is to be retained; because the *eleven* minutes, that the *Italian* exceeds the *natural* year, do not amount to a day in less than 131 years.—This is what was called the NEW-STILE in contra-distinction to the *Italian* computation, which was continued by several nations for a long time, where the Pope's power was not acknowledged. But in 1752, the parliament of *Great Britain* enacted, that the 3d of *September* in that year should be held for the *fourteenth*; and that for the future this nation should compute *time* by the *New-stile*, and to begin the year on the *first* day of *January*, which before did not commence till the 25th of *March*.

The *lunar year* corresponds with the moon's revolution only. For, as the moon takes up 29 days, 12 hours, 44 minutes and 3 seconds in passing through the 12 signs; twelve of these monthly revolutions make one *lunar* year, consisting of 354 days, 8 hours, 48 minutes and 38 seconds. So that the difference between the common *lunar* year and the *astronomical solar* year is 11 days, 5 hours and 49 minutes.

The first division of *time* by *years* appears to have been made by *Romulus*: but it was very far from being exact: for it consisted only of 304 days divided into ten unequal months of 30 and 31 days alternately. The inconvenience that arose from this calculation was somewhat removed by the addition of as many days yearly, as he found would make the state of the heavens correspond to the first month, which additional days remained without any distinct appellation till the reign of *Numa Pompilius*, who divided them into two months by the name of *January* and *February*: yet the *astronomical* observations of his successors finding that the entire revolution of the sun could not be accomplished in this number of days, *Julius Cæsar* added 11 days and 6 hours more; which brought it to that exactness, which has been ever since the basis of our computations, though Pope *Gregory*, as mentioned above, has established it upon a more nice calculation.

Julius Cæsar observing that time had lost 67 days by the fault of the *pontifices*, who had the charge of regulating its motion at *Rome*, since the days of *Numa*, invited *Sosigenes*, the eminent mathematician from *Egypt*, to assist him in the formation of a more regular annual computation; who, resolving to fix the beginning of the year to the *winter solstice*, was obliged to make that year consist of 445 days, divided into 15 months, which is there called *annus confusionis*, the *year of confusion*,

The *Egyptians* computed *time* by a year of 365 days, divided into 12 months of 30 days each; besides 5 intercalary days added to the last month. This is called *Nabonasser's year*; and, as it looses one whole day of the *Julian year* in every four years; so its beginning in the course of 460 runs through every part of the *Julian* year till they meet again. However, as this year is used by *Ptolemy*; it is useful in comparing the ancient *astronomical* observations with the modern.

Nabonasser's year after the battle of *Actium*, was obliged in some measure, with the *Egyptian* liberty, to give way to the regulations of the *Roman* conquerors: and this year thus reformed is stiled, *annus Actiacus*. The *Egyptian* year was the same, only differing as to the names of the months.

The *Greeks* originally computed *time* by a *lunar year*, consisting of 12 months, each of 30 days; but were changed into months of 30 and 29 days alternately computed from the first appearance of the *new moon*, with the addition of an intercalary month of 30 days, every 3d, 5th, 8th, 11th, 14th, 16th and 19th year of a cycle of 19 years, in order to keep the *new* and *full moons* to the same term of seasons: alway commencing at the *full moon* next after the *summer solstice*.

The *Macedonian* year differed from the *Attic* originally, only in the names, and order of the months. But the modern *Macedonian* year is *solar*, and perfectly agrees with the *Julian* year.

The ancient *Jewish* year was also *lunar*, consisting of 11 months, which alternately contained 29 and 30 days: and was made to agree with the *solar year* by 11 and sometimes by 12 days at the end of the year, or by an intercalary month. The *modern Jews* compute also by a *lunar year*, but they reckon 12 months in common, and in a cycle of 19 years, they add an intercalary month to the 3d, 6th, 8th, 11th, 14th, 17th, and 19th year.

The *Syrian* is a *solar year*, and begins with *October* in the *Julian* account of *time*.

Bbb 2 The

The *Perfian year* is alfo *folar*, confifting of 365 days, divided into 12 months, with 5 days added to the laft. This was called the *Yezdegerdick year*, to diftinguifh it from the *Gelalean* or fixed *folar year*, introduced in *Perfia* in the year of 1079, which was formed by an intercalation made fix or feven times in four years, and then once every fifth year: the former was *Nabonaffer*'s year; the latter is accounted the beft and jufteft for keeping the folftices and equinoxes, and for anfwering accurately to the *folar* motions.

The *Arabs* and *Turks* differ from the *Syrian year*, only in placing the intercalary mouth, which they add every 2d, 5th, 7th, 10th, 13th, 15th, 18th, 21ft. 24th, 26th and 29th year in a cycle of 29 years.

The *Jews*, and moft other nations in the eaft had a *civil year*, which arbitrarily began with the *new moon* in *September*: and an *ecclefiaftical year*, which commenced from the *new moon* in *March*.

The *civil*, or *legal year* has varied much in divers nations. In *France*, during the reigns of the *Merovingians*, it began on the firft day of *March*. Under the *Carlovingians*, on *Chriftmas-day*. Under the *Capetians*, the prefent race, on *Eafter-day*; which is ftill the commencement of the *ecclefiaftical year* in the *Gallic* church: but *Charles* IX. in 1564, ordained that the *civil year* fhould thence forward commence on the firft day of *January*.

In *England* the legal commencement of the *year*, till the *year* 1753, was upon the 25th of *March*; according to which beginning of the *year*, our forefathers were obliged to date all their civil affairs. But we now by act of parliament begin our *year* the firft day of *January*: the church of *England*, however, as to her liturgical forms begins the *ecclefiaftical year* on the *firft funday* in *Advent*.

The *Mahometans* begin their *year* the minute the *fun* enters *Aries*: the *Perfians* in the month that anfwers our *June*: the *Chinefe* and moft of the *Indian* nations begin the year with the firft moon in *March*: the *Brachmans* do not begin their year till the new moon in *April*. The *Mexicans* begin the year on the 23d of *February*; being directed by the firft appearances of the fpring, or the leaves of trees putting forth about that time: and they divide their year into 18 months of 20 days each, making in all 360 days, at the end of which they fpend 5 days entirely in mirth. The *Abyffines*, who begin their year on the 26th of *Auguft*, divide their time in the like manner, and finifh the year with five days mirth, which they called *pagomen*. The *Greeks* begin their year from the firft day of *September*.

In courfe of time the *annual calculations* by *aftronomical obfervations* were formed into *cycles*, *olympiads*, *luftrums*, *indictions*, *centuries*, *ages*, *periods*, *epochas*, or *æras*.

A Cycle is a certain period or feries of years, which regularly proceed from the firft to the laft, and then return again to the firft, and circulate perpetually.

The moft confiderable *cycles* are thofe of the *fun*, of the *moon*, and of the *Roman indiction*.

The cycle of the fun confifts of twenty eight years, which contain all the poffible combinations of the *dominical* letters, in refpect to their fucceffive order, as pointing out the common years and leap-years; fo that, after the expiration of the *cycle*, the days of the month return in the fame order to the fame days of the week, throughout the next *cycle*; except that upon every *centefimal* year, which is not a leap year, the letters muft always be removed one place forward, to make them anfwer to the years of the *cycle*; for inftance, if the year 1800 were a *leap-year*, as every *centefimal* year is in the *Julian* account, the *dominical letter* would be E D, and C would be the *dominical letter* of the next year: but as it is a common year in the *Gregorian* account, D is the *dominical letter* of 1801, which anfwers to the eighteenth of the *cycle*, C to the nineteenth, &c. until the next *centefimal* year.

To find the year of this *cycle* for any year of the *chriftian* æra, add 9 to the current year of Christ, becaufe the *cycle* commenced nine years before the *chriftian* æra, and divide the fum by 28, the quotient will fhew the number of *cycles* which revolved fince the beginning of that in which the *chriftian* æra commenced: and the remainder, if any, fhews the current year of the *cycle*: but if there be no remainder, it fhews that it is the laft, or twenty-eighth year of the *cycle*.

The *dominical letter* of each year in this *cycle*, until the year 1800, appears by the following table.

1	DC	5	FE	9	AG	13	CA	17	ED	21	GF	25	BA
2	B	6	D	10	F	14	B	18	C	22	E	26	G
3	A	7	C	11	E	15	G	19	B	23	D	27	F
4	G	8	B	12	D	16	F	20	A	24	C	28	E

Cycle

Cycle of the moon, or *lunar cycle*, called also the *golden number*, is a period of *nineteen years*, after which the *new* and *full moons* return on the same days of the months, only one hour twenty-eight minutes sooner: so that, on whatever days the *new* and *full moon* fall this year, they will happen nineteen years hence, on the same days of the months, except when a *centesimal common year* falls within the *cycle*, which will move the *new* and *full moons* a day later in the calendar than otherwise they would have fallen, insomuch that a *new moon* which fell *before* the *centesimal year*, suppose on *March* 10, will fall nineteen years afterwards, on *March* 11. The number of years elapsed in this *cycle* is called the *prime*, from its use in pointing out the day of the *new moon*, *primum lunæ*, and the *golden number*, as deserving to be writ in letters of gold.

The *golden numbers* are those placed in the *first* column of the calendar, betwixt *March* 21 and *April* 18, both inclusive, to denote the days upon which those *full moons* fall, which happen upon, or next, after *March* 21, in those years, of which they are respectively the *golden numbers*.

For finding the *golden number*, add one to the current year of our LORD, because one year of this *cycle* was elapsed before the *Christian* æra began, and divide by 19, the remainder is the current year of this *cycle*, or *golden number*; but if nothing remains, it shews that it is the last year of the *cycle*, and consequently the *golden number* is 19.

Cycle of the Roman indiction, is a period of *fifteen years*, in use among the *Romans*, commencing from the *third* year *before* CHRIST. This *cycle* has no connection with the *celestial* motions; but was instituted, according to *Baronius*, by *Constantine*; who having reduced the time which the *Romans* were obliged to serve; to *fifteen years*, he was consequently obliged, every *fifteen years*, to *impose*, or *indicere*, according to the *Latin* expression, an extraordinary tax for the payment of those, who were discharged; and hence arose this *cycle*.

To find the *cycle* of *indiction* for any given year, add 3 to the given year, and divide the sum by 15, the remainder is the current year of the *cycle* of *indiction*; if there be no remainder, it is the fifteenth or last year of the *indiction*.

These three *cycles* multiplied into one another, that is, $28 \times 19 \times 15$, amount to 7980, which is called the *Julian period*, after which the three foregoing *cycles* will begin again together. This *period* had its imaginary beginning 710 years before the creation, according to the common opinion among *chronologers* concerning the age of the world, and is not yet complete. It is much used in chronological tables.

The OLYMPIAD is a space of *four years* invented by the *Greeks*, and named by them from *Olympia* in *Peloponnesus*, where they worshipped *Jupiter* with great ceremony and games. This institution in in *Chronology* is dated in the 776th year before CHRIST, or 24 years before the building of *Rome*. Some have been led to compute the *Olympiad* a term of *five* years, because it is written that the *Olympic games* used to be celebrated every *fifth* year. But the late archbishop *Potter* in his *Grecian* antiquities discovers a fallacy in that expression, and shews that the *games were celebrated every fiftieth lunar month*: that this being the *second month* after the expiration of *four lunar years*, might be called the *fifth year*: but that if the intercalation be duly considered, an *Olympiad* will answer pretty exactly to four solar years and no more.

The LUSTRUM was the space of *five years*. It was an institution by the *Romans*, and particularly regarded the time of paying their taxes and subsidies.

The INDICATION is also of *Roman* extraction, and related only to affairs of state. It consists of three *lustra* or *fifteen years*.

Other states have made use of the like mensuration of time. The *papacy* ever since the days of *Charlemain*, has used this term in the date of *bulls*, beginning from the 1st of *January*. We also find an *indiction* at *Constantinople*, which commenceth on the first of *September*, and another in the empire, called the *imperial* or *Cæsarian* indiction, which takes its date from the 14th of *September*.

A CENTURY is the space of *one hundred solar years*, by which *Chronologers* generally divide the age or duration of the world.

AGE is a computation, which divides time into three parts; *viz.* The *age of nature*; which comprehends the whole time from *Adam* to the publication of the law by *Moses*. The *age of the Jewish law*; which takes in all the time from *Moses* to JESUS CHRIST: and the *age of grace*, which are the years elapsed from the incarnation of the *Son of* GOD.

By another computation used in antient authors, the duration of the world is also divided into *ages* thus: The *first*, from the *creation* to the *deluge* in *Greece* in the reign of *Ogyges*, called the *obscure*, or *uncertain age*. The *second*, follows to the commencement of the *Olympiads*: and there, the *third*, or the *historical age* commenceth.

The *poets* divide the duration of the world into *four ages*, viz. the *golden age*; the *silver*; the *brazen*; and the *iron age*.

The definitions of *period*, *epocha*, and *æra* are so nearly alike, that they are generally used as synonymous terms to signify the first point, or certain

time

time remarkable for ſome event, from which the ancients number the years that followed.

The *creation* of the *world* is the grand *period*, or *epocha* for the beginning of the account of time; in all nations But there is great variety amongſt *Chronologiſts* in regard to the number of years, the world has exiſted.

However, it will be neceſſary to produce the *principles* upon which *Chronology* in its preſent ſtate depends. Which is, *Firſt*, the *teſtimony* of *writers* or *authors*: *Secondly*, *Aſtronomical* obſervations, eſpecially *eclipſes* of the *Sun* and *moon*: and *Thirdly*, ſuch *epochas*, as are allowed to be certain in hiſtory.

Of all writers or authors the *teſtimony* of the Bible deſerves the greateſt credit. The hiſtorical tables of the *Chaldæans* or *Babylonians*, pretended to be grounded on aſtronomical obſervations, carry the foundation of their empire back to ſo many myriads of years, and relate ſuch obvious falſities, that *Ariſtotle* could not refrain numbering them amongſt the incredible and falſe writers.

The *Egyptian* account of 342?1 years, which they aſſign to the government of their nation by the *gods* and *demi-gods*, before ever a man ruled their empire, brought upon the hiſtorians of that nation this diſadvantageous reflexion by *Plato*, That *they were miſerably ignorant of antiquity*; and ſhould diſcredit every particular aſſerted upon ſo bad a computation.

The *Chineſe* are not more to be regarded. They date their hiſtories many ages before the creation, and they are ſtuffed with ſuch unaccountable ſtories, and contradictions, that there can be no expectation of arriving at an exact computation of time by their books.

I don't deny that ſome objections lie againſt the *Chronology* of the *Bible* alſo: but thoſe objections are quite of a different ſort. They are not ſupported by proofs of falſities and ſelf-contradiction; but ariſe from a *variation* in the accounts of ages of men and periods of events, delivered in the *Hebrew* and *Greek* copies of that ſacred book. They both agree in the *facts*, but differ in the *duration* of time, and that at the moſt but 1500 years, which the *Septuagint* carries the world higher than the vulgar account: whereas the *Chaldeans* pretend that the world is *forty-thouſand years* older. *See* the ſcripture account defended in *Hearne's Ductor hiſtoricus*, vol. I. p. 18, *&c.* and *Card. Pezron's Antiquitè de Tems.*

If we look into the hiſtories of all nations, their origin is attended with great obſcurity. No people, but the *Jews*, were bleſſed with an inſpired writer of their firſt tranſactions. And I might add that no other nation can produce the firſt writer of its ſettlement. So that there are now extant no materials for compiling a Chronology of the firſt ages, but the *Holy Scriptures*.

Another difficulty in Chronology ariſes from the different *Æras* and years in divers nations. The *Grecians* computed from the beginning of the *Olympiads*: the *Romans* from the *building* of their city: the commencement of the *Aſſyrian* monarchy, being doubtful, makes that *Æra* doubtful alſo: the ſame is remarked of the *Nabonaſſarean Epocha* uſed by the *Egyptians*. Some nations have uſed no *epocha* at all: and the *Chriſtians* did not begin to compute from the *birth of* Christ till 532 years after he was born.

The beginning of the year both in ſeveral nations, and in the different *epochas* is ſo various, that it alſo creates much perplexity in the account of time. Before the law was given by *Moſes* the *creation* is dated from the *autumnal equinox*: but at the inſtitution of the paſſover God commanded *Niſan* at the *vernal equinox* to be the firſt month. The *Grecians* began the year with the olympiad at the full moon after the ſummer ſolſtice. Some reckoned the beginning of the *Roman* year from the 21ſt of *April*; others dated it from the 1ſt of *January*. And thus of others, as above obſerved, in the account of the years.

It ought alſo to be remarked, that the *poets*, who have taken the liberty to forge people and tenets that never exiſted, or brought ſtories from different ages ſo near together, as to deſtroy their credibility, have greatly contributed to perplex *Chronology*; and they ought to be carefully avoided.

Hence it appears that the *teſtimony* of *authors* (the *ſcripture* only excepted) is very precarious.

By *ſcripture* we may gather a certain ſucceſſion of time for 3500 years, after which *Herodotus* and other credible authors, who write the hiſtories of their own times, will enable us to proceed.

In the mean time let us examine the *ſecond principle* in *Chronology*; this is the *book of nature*, wherein the *motions* and *aſpects* of the *ſun* and *moon*, and other *planets*, give us a certain guide in this ſtudy.

An Eclipse of the *ſun*, or of the *moon* is ſuch an identical mark of a year, that it is eaſy to diſtinguiſh it, at any diſtance of time from an infinite number of other years. Nothing therefore can ſo well aſcertain the year of a battle, the foundation of a city, the death of a Prince, *&c.* as an *eclipſe* that happens on or near the ſame day: becauſe by *aſtronomical tables* it is diſcovered, that an *eclipſe* ſeen upon ſuch and ſuch a day, ought *neceſſarily* to have happened in ſuch and ſuch a year. Thus by an *eclipſe* of the *ſun* mentioned by *Juſtin* to have

happened

happened at the time the tyrant *Agathocles* crossed the seas from *Sicily* to invade the *Carthagenians*, it is found by *astronomical* calculation to have been done in the year of the world 3634, and 316 years before the vulgar *Æra* of CHRIST, on the 15th of *August*.

Again, as it is observed that the great conjunction of *Saturn* and *Jupiter* happens at the end of every 800 years in the same degree of the *Zodiack*; this phænomenon might also be adapted to distinguish and characterize the times. There have been eight of these great conjunctions since the creation: one of which, according to Archbishop *Usher*, was in 3998, two years *before* the *birth* of CHRIST, and the last of them happened in *December* 1603.

The same use might be made of the aspects of all those planets, which happen but seldom. *See* this *principle* largely treated of in CALVISIUS, and in the Reverend Mr. BEDFORD's *scripture Chronology*.

The most general *principle* observed by historians in the account of time, is to observe certain constant *epochas* agreed upon by all writers.

These EPOCHAS are divided into *sacred* and *civil*.

The most eminent *sacred epochas* are reduced to *thirteen*, viz.

1. The Creation.
2. The Flood, A. M. 1656.
3. The calling of *Abraham*; before C. 1921.
4. The deliverance and departure of the *Jews* from *Egypt*, before C. 1491.
5. The building of *Solomon*'s temple, before C. 1012.
6. The restoration of the *Jews* by *Cyrus*, and foundation of the *second* temple, before C. 536.
7. The finishing of the second temple in the 6th of *Darius Hystaspes*, whom the scripture names *Ahasuerus*. before C. 515.
8. The birth of our SAVIOUR, JESUS CHRIST.
9. The martyrdom of St. *Peter* and St. *Paul*, after C. 67.
10. The *destruction* of the temple and dispersion of the *Jews*, after C. 70.
11. The Æra of DIOCLESIAN, or the *martyrs*, 302.
12. Peace given to the church by CONSTANTINE the *Great*, 312.
13. The first general council at *Nice*, 324.

The *civil epochas* of most note are,

1. The taking of *Troy*, A. M. 2766.
2. The first *olympiad*, A. M. 3174.
3. The building of *Rome* A.M. 3197 or 8.
4. The *Æra* of *Seleucides*, A.M. 3637.
5. The first *Julian* year in which *Cæsar* reformed the calendar. Before C. 45.
6. The building of *Constantinople*, A. D. 330.
7. The *Hegeira* or flight of *Mahomet* from *Mecca*; *July* 16, A.D. 622, instituted by *Sultan* OMAR III.
8. CHARLEMAIN, or CHARLES *the Great*, establishes the new empire. A. D. 800.
9. *Constantinople* taken by *Mahomet* II. A. D. 1453.

Besides these *universals*, each nation have their peculiar *epochas* of memorable events, as in ENGLAND. 1. The invasion of BRITAIN by CÆSAR. 2. The establishment of the *Saxon heptarchy*. 3. The expulsion of the *Saxons* by the *Danes*. 4. *Norman conquest*. 5. The union of the houses of *York* and *Lancaster*. 6. The reformation in *religion* and expulsion of *popery*. 7. The accession of the house of *Stuart* to the throne. 8. The beheading of King *Charles* I. 9. The usurpation of the throne by *Oliver Cromwell*. 10. The restoration of King *Charles* II. 11. The *Revolution*. 12. The union with *Scotland*. 13. The accession of the house of HANOVER to the crown of GREAT BRITAIN.

Therefore we will run through the most material parts of the *Chronology* of every nation that is come to our knowledge; beginning with

The CHRONOLOGY of the *ancient* PATRIARCHS.

This part begins with ADAM, recounting his children and their descendants as far as the death of the patriarch ISAAC.

JACOB is the first amongst the names in the *Chronology* of the *Hebrew judges*: which epocha ends with *Samuel*, who gave his nation a King.

Within this space of time the *Assyrian* empire was established, A. M. 1774 by *Nimrod*, whom prophane history names *Belus* the first King in the world. This monarchy continued upwards of 1300 years, when it was destroyed by the *Medes*.

In the mean time SAUL was anointed King over the *Hebrews*, divided into the kingdoms of *Israel* and *Judah*: and notwithstanding the powerful opposition this little state met with frequently from the neighbouring nations, and the destruction brought upon their liberty by the powerful enemies of their God and religion; the *Jews* kept up the succession of their Kings, till the death of *Agrippa*, the son of *Herod Agrippa*, about 70 years after CHRIST.

The *Medes* began to reign at *Nineveh* under *Arbazes*, at the expulsion of *Sardanapalus* the *Assyrian* monarch; and they maintained their conquest of of the *Aſſyrian* empire about 325 years, when the *Aſſyrian* line was reſtored in the perſon of Phul, who was lineally ſucceeded by *Tiglath-pileſer*, *Salmaneſſar*, *Sennacherib*, and *Aſſarhaddon*, in whom the *aſſyrian* monarchy expired for ever. For after him there is no mention made of kings of *Aſſyria*, but of *Babylon* only: the firſt of whom was *Merodach Baladan*, and the laſt the prophane *Belſhazzar* or *Baltaſſar*, who was killed, in the midſt of his debaucheries by *Cyrus*, who, on the entire ruin of the *Babyloniſh* empire or kingdom, the conqueror founded the *Perſian* monarchy.

With *Cyrus* we begin the *Chronology* of the *Perſian* empire: which with his other conqueſts, was divided at the death of *Alexander the Great*, about 260 years after, amongſt his captains.

Upon the death of *Alexander the Great*, his conqueſts and dominions were erected into four monarchies; viz. *Macedon*, *Egypt*, *Syria*, and *Aſia*

Macedon was poſſeſſed by *Philip Aridæus*, and continued till the death of *Perſes*, when after a ſucceſſion of 145 years this kingdom became extinct.

Egypt fell to the lot of *Ptolomy*, natural brother to *Alexander*, and his memory was ſo revered by his male ſucceſſors on the throne of this kingdom, that they all took the name of *Ptolomy*, at their acceſſion This kingdom, at the death of Queen *Cleopatra*, became a *Roman* province; 288 years from its firſt foundation by the *Ptolomies*.

Syria was ſeized by the mighty warrior Seleucus Nicanor, i.e. *victorious*. This is he, who extended his dominion over *Syria*, *Perſia*, *Media*, and *Babylon*; and who gives name to the *æra* of the *Seleucides*, by which the *Maccabees* begin to reckon the kingdom of the *Greeks* and *Seleucides*. Here we find a ſucceſſion of nineteen kings, beſides the founder, within the compaſs of 263 years, when it was reduced by the *Romans* and became a province to them.

The *Romans*, whoſe power at this time overawed the whole world, were firſt eſtabliſhed in the form of a monarchy by Romulus; but authors differ very much about the date of *Rome*'s foundation: *Torniel* fixes this *epocha* in A. M. 3300, *Capel* in 3247, *Genebrard* in 3403, *Clavius* in 3198, *Salian* in 3302, *Varro* in 3197, *Cato* in 3198.

In this ſtate it was governed by *ſix kings* for the ſpace of 220 years according to *Livy*, and *Halicarnaſſus*.

At the expulſion of Tarquin *the proud*, it degenerated into a *republic* under the government of a *ſenate* and *conſuls*, who were two, choſen annually, for the term of 462 years; when Julius Cæsar uſurped the ſovereign power, and laid the foundation of the *Roman* empire in his own perſon.

During the *republic*, the *Roman* hiſtory records ſeveral alterations in the form of government, for though the conſuls maintained their dignity, their power was ſomewhat controuled by introducing a new magiſtrate by the name and ſtile of *tribune of the people*, choſen out of the commonalty to protect them from the oppreſſion of the great, and to defend the liberties of the people againſt the incroachments of the ſenate and conſuls. This magiſtrate was firſt erected in the 2 1ſt, year U. C.

In the year 303 U. C. the conſuls for the time being gave ſuch a general diſguſt by their iniquitous practices, that the government was lodged in the hands of a new magiſtracy of *ten men*, called *decemviri*, with power to draw up and make laws for the people. But this ſovereign power ſo intoxicated the heads of the new magiſtrates, that in leſs than three years they found it neceſſary to put an end to it, and the *conſular power* was again reſtored.

In 311 U. C. the ſenate and people agreed to chuſe ſix *military tribunes*; three by the general of the army, and three by the people in the *comitia*, who were inveſted with conſular honours and authority; in order to prevent any exceſs of power in the adminiſtrators of the republic.

Beſides theſe officers, we alſo meet with a ſupreme temporary magiſtrate, created by the name of *dictator* by the ſenate or the people on ſome extraordinary occaſion, to command with ſovereign authority in all affairs, whether military or civil. The firſt officer of this kind was *T. Largus* created in 253 U. C.

The military hiſtory of this nation contains ſeveral remarkable *epochas*: as the taking of *Rome* by the *Gauls* in the year 365 U. C. The *Roman* war with K. *Pyrrhus* in 473 U. C. The firſt *Punic* war, and the firſt appearance of the *Romans* upon the ſea, in 489 U. C. The ſecond *Punic* war, in 537 U. C. The *Macedonian* war begun with K. *Philip* in 554 U. C. The end of the *Aſiatic* war, in 564 U. C. The beginning of the third *Punic* war in 602 U. C. The *Numantian* war, in 620 U. C. The *Jugurthine* war in 643 U. C.

The conqueſts made by the *Romans* were not able to defend their liberty againſt the ambition of thoſe entruſted with their armies.

Julius Cæsar turned their own ſtrength againſt the conſtitution of his country, and changed the republic into a monarchy. From his uſurpation the *Roman* empire takes it *epocha*, about 48 years *before* the birth of Christ.

This monarchy, continued down to the year 454 after Christ, when *Valentinian* the third was murdered by the intrigues of his general *Maximus*

Maximus supported his tyranny only 77 days, and his successors down to MANILIUS or AUGUSTULUS, so little deserve the name and dignity of emperors, being raised to the government by factions and murders, that though ODOACER did not put an end to the *Roman* empire till the year 475, yet we can scarce admit any of the successors of *Valentinian* III. to have a place amongst the emperors.

The *Roman* empire, as established by JULIUS CÆSAR, was intended by him to be *hereditary*: and accordingly we find that it passed either by heirship, adoption, or by the will of the emperors in succession, till the cruelties of NERO provoked the army to place GALBA upon the throne at his death, by their own election. And, though many examples shew that the children and nephews frequently succeeded afterwards to their relatives, it is certain that the army never gave up this power, and exercised it sometimes so licentiously, that different parts of the army would set up divers emperors at a time.

The senate also claimed a right to name an emperor; as may be seen in the exaltation of PAPIENUS, BALBINUS, and GORDIAN the *first* and *second*, whom they successively placed in the imperial seat in opposition to *Maximinus*, that monster of cruelty and intemperance, who is recorded to eat 64 pounds of meat, and drink 24 quarts of wine in one day. But the military faction having the power in their own hands soon convinced the senate, by putting their emperors to death, that they had lost their authority and liberty, by permitting the army to swell above the capacity of the civil power.

From the time of CONSTANTINE *the Great*, the first *Christian* emperor, and founder of the city of *Constantinople* (which he honoured with a senate, and the citizens with the rights and privileges of the city of *Rome)* the succession was regulated in a much better manner, and the empire for some generations descended in a right line, till the weakness and vices of *Valentinian* III. favoured the ambition of *Maximus*, who, after killing his sovereign, usurped his throne, and married his widow EUDOXIA by compulsion.

Here we must date the foundation of the republic of *Venice* A. D. 452, by the same VALENTINIAN, who flying before the arms of ATTILA king of the *Huns*, who had invaded *Italy*, retired in the 27th year of his reign into those islands of the *Adriatic* sea, where *Venice* now stands.

Here also we fix the *Epocha* of the eruption of the VANDALS with the *Roman* empire; who invited by the disgusted EUDOXIA, to take vengeance on MAXIMUS, landed in *Italy* under the command of *Genserick* their general, unexpected, and entered *Rome* without opposition. The *Vandals* plundered the city, and having burnt such parts thereof as they thought proper, they retired with their booty back to the coast of *Africa*.

After *Maximus*, the army in *Gaul* set up one AVITUS, who abdicated the throne after ten months, and made way for a new election by the senate and army together, who raised *Majorian* to the purple. He was murdered by the perfidy of his *generalissimo* RACIMER: who first placed SEVERUS LIBIUS in his seat, and afterwards caused him to be poisoned, to make way for ANTHEMIUS. But this creature of the *generalissimo* falling also under his displeasure, was killed by his procurement, to enable him to give the imperial dignity to one OLIBRIUS.

Thus the *Roman* empire was obliged to receive four emperors, and their lives sported away at the will and pleasure of a man, who had been raised to the chief command of their armies from the condition of a common centinel.

RACIMER died soon after the advancement of OLIBRIUS: and the distracted state of the empire encouraged the GOTHS, to attempt its reduction. They accordingly invade *Rome*, kill OLIBRIUS, and place GLYCERIUS upon the throne, who was deposed by JULIUS NEPOS; as he himself was, after fifteen months by ORESTES general of his army, to make way for his own son MANILIUS, nicknamed AUGUSTULUS, who was obliged to submit to ODOACER king of the *Erules* or *Heruli*, a people from the *Euxine sea* who assumed the name of king of *Italy*, on 23d *August*, 476.

Thus ended the *Roman* empire in the *West*. But, as *Constantine the Great* had laid the foundation of another empire, or succession of emperors at *Constantinople* in the *East*, it must be remarked, that this establishment did not follow the fate of *Rome*.

The *Eastern empire*, which began in the year of CHRIST 306, flourished till the death of ALEXIS V. in the year 1204 (except we should allow it to continue in the succession of LASCARIS at *Nice*, as below).

Upon his death the *Eastern* throne was filled by THEODORE LASCARIS. But the factions and destructions of its state were so great, that the *French* were encouraged to dispossess him: and they accordingly drove him from CONSTANTINOPLE: and their general BAUDOUIN, earl of *Flanders*, was saluted emperor by his army. In which state *Constantinople* continued from 16th of *May*, in the year 1204, for 58 years.

LASCARIS on his expulsion from the imperial seat of *Constantinople* in 1204, retired to *Nice* in *Asia*,

Aſia, where he reſumed the title of emperor, and collected and protected the ſcattered parts of his empire. By this means the *Eaſtern empire* may be ſaid to deſcend ſo low as the conqueſt of *Conſtantinople* by *Mahomet* II. in the year 1453. By which computation the empire founded in the Eaſt by Constantine *the Great*, laſted 1147 years.

After the extirpation of the *Weſtern* branch of the *Roman* empire, founded by *Julius Cæſar*, we find another erected under the ſame name by Charlemain, who was crowned emperor of the *Weſt* or of *Germany*, on the 25th of *December* 800, in whoſe houſe the ſucceſſion continued for the ſpace of 112 years, whoſe defeat by the *Hungarians* and death made way for Conrade I. duke of *Franconia* and *Heſſe*.

Conrade was the firſt *German* that governed that empire. He began his reign in the year of Christ 912. He was ſucceeded by *Henry* I. ſon of *Otho* duke of *Saxony*, whether by election or otherwiſe does not appear. But it is certain, that the imperial dignity continued in his family for five generations. To the fourth of whom, *Otho* III. authors generally attribute the inſtitution of the *electoral* college.

From this family the electors transferred their choice to Conrade II. a ſon of Hermandus, duke of *Wormes* and *Franconia*. In which the purple was worn for four generations.

By this elective power we find alſo that the families of *Suabia*, *Hubsbourg*, *Naſſau*, *Luxembourg*, *Bavaria* and *Auſtria* have enjoyed the ſovereignty of the empire of *Germany*: and in particular that the *Auſtrian* faction in the electoral college has prevailed, and always given it to one of that family ever ſince the 30th of *May*, 1438, when Albert, II. archduke of *Auſtria*, was elected emperor of *Germany*: except Charles Albert duke and elector of *Bavaria*, who was introduced by the intrigues of *France* in the year 1741.

Upon the ruins of the ancient *Roman* empire, we are to view the erection of ſeveral powerful kingdoms, beſides the partitions already mentioned. As,

The kingdom of the Visigoths erected in the year of Christ 409, or, according to others, in 412, by *Atolf*, who tore *Spain* from the dominion of the *Romans*.

This kingdom flouriſhed, and its kings not only drove the *Romans* entirely out of *Spain*, where they had kept a footing almoſt 700 years, *viz.* to the year of Christ 485, but greatly extended their dominion. But at laſt, in 713, the *Viſigoths* were themſelves overpowered, and an end was put to their kingdom by the *Moors*, called in by a diſcontented nobleman to revenge the diſhonour done by king *Roderic*, who had deflowered his daughter.

The kingdom of the *Franks* or *French*, erected by Pharamond in the year 420 or 421, was another remnant of the *Roman* empire.

Pharamond was ſucceeded by his ſon Clodion; whoſe ſucceſs againſt the *Romans* and their allies in *Gaul*, enabled him to remove the place of his reſidence from the caſtle of *Inſpruck*, ſituate between the towns of *Weſel* and *Duſſeldorp*, (the very ſpot lately occupied by the allied army under prince Ferdinand of *Brunſwick*) to the city of *Cambray*.

The acquiſitions obtained by his arms put his family upon a moſt reſpectable footing.

He was ſucceeded in his power and dignity by Merovee, a younger ſon of *Clodion*, elected by the *French* at *Amiens* for his good qualities, in preference to his brethren: and from this ſtock the *French* derive the *genealogy* of their kings, by the name of the *Merovingian* race.

Merovee therefore is accounted the founder of the *French* monarchy: whoſe reign began in 448. He changed the name of *Gaul* into that of *France*, and placed the ſeat of his reſidence near *Strasbourg*.

This race of kings became extinct in Childeric III. who was dethroned for his *ſtupidity* in the year 751, by *Pepin*, one of his great officers, who, favoured by the clergy, was crowned king in his ſtead, in the ſame year; and his race held the *French* ſceptre till Louis *the idle* reſigned his breath and his kingdom in 987, to *Hugh Capet* the moſt powerful amongſt the nobility, and the father of the Capetian, or third race of *French* kings, which in his preſent majeſty amount to the number thirty one.

In Britain, the kingdom of *Scotland* was eſtabliſhed by Eugene in the year 427, which continued under its own ſovereigns alone till the year 1603, when *James* VI. of *Scotland* aſcended the *Engliſh* throne. From that time *Scotland* fell under the dominion of the Kings of *England*; and by the *Union* in 1706, *Scotland* is united there to *England* by the name of Great Britain.

The Chronology of the kings of *England* begins properly at the *Epocha*, when Egbert the firſt monarch united the *Heptarchy* under one dominion and name of *England*. He defeated the *Danes*, who had invaded three times, ſucceſſively, his dominions, in the year 830. He died, in the year 836, after he had reigned 37 years.

Ethelwulf ſucceeded his father *Egbert*, in the year 836; he was very wiſe, and very brave. He died in the year 857, after he had reigned 21 years.

Ethelbald, his ſon, ſucceeded him, in the year 857; he had once already endeavoured to have himſelf acknowledged king, during his father's abſence,

absence, who was gone to *Rome*; but he was frustrated in his attempt. He died, after he had reigned two years.

ETHELBERT succeeded him, in the year 860; he was gentle, prudent, and brave. He died in the year 866, after he had reigned five years.

ETHELRED succeeded him, in the year 866; he was brave and just. Under his reign the *Danes* ravaged *England*, against whom he fought nine battles in one year. In one, fought near *Reading*, he gained a compleat victory over them: but in another, near *Basing*, he received a mortal wound, of which he died in 871, after he had reigned six years.

ALFRED, an accomplished prince succeeded him, in the year 871; he obliged the *Danes* either to quit his dominions, or to be baptised. He founded the university of *Oxford*, the second, for antiquity, in all *Europe*, and died in 900, after he had reigned 20 years.

EDWARD I. succeeded him; he rendered himself famous for his prudence, piety, and the good laws he made; he signalized, likewise, his valour, against the *Danes* and the *Britons*. He died in the year 925; after he had reigned 24 years.

ADELSTAN succeeded him, in the year 925; he had a vast deal of wit and courage, was a great admirer of learning, and of the learned, gained several great victories, was pious, and liberal to churches. He died, after 16 or 17 years reign.

EDMUND I. succeeded him in the year 941; he was just, pious, and brave. He gained several victories over the *Danes*, and died in the year 946, after he had reigned 6 years.

EDRED was crowned king at the demise of *Edmund*, his brother, in the year 946; he protected the good, and chastised with severity the profligate. He maintained his authority against the revolt of those of *Northumberland*, and defeated them in a battle. He took special care to promote religion and piety, and died, with the reputation of a saint, in the year 955.

EDWIN, his nephew succeeded him in the year 955; he was impious, incestuous, and cruel; and hated of his subjects, who revolted against him. He died in the year 959, after he had reigned 4 years.

EDGAR succeeded him in the year 959; he was religious, just, prudent, and pacifick; and though of a low stature, very great in courage and valour. He ordered *Ludwal*, prince of *Wales*, to deliver every year 300 wolves, instead of a tribute which king *Adelstan* had imposed upon him, to free his dominions from those wild and voracious creatures. He died in the year 975, after he had reigned 16 years.

EDWARD II. succeeded him, in the year 975; he was meek, pious, just, prudent, and brave. He was killed by the perfidy of his mother-in-law *Elfrida*, who wanted to place her son *Ethelred* on the throne, in the year 979, after he had reigned three years.

ETHELRED II. came thus to the throne, by the crime of his mother, in the year 979, and that crime brought upon *England* an infinite number of calamities: for the *Danes* invaded the kingdom, where they committed great ravages. *Ethelred* was a negligent, proud, and avaricious prince. The day of his coronation there was seen, all over *England*, a cloud, one half like blood, and the other half like fire. He gave secret orders, throughout all his dominions, that on the 30th of *November*, all the *Danes* found among them should be massacred; which orders were executed in the year 1002. He died in the year 1016, after he had reigned 27 years.

EDMUND II. began to reign in 1016; he was good, just, prudent, brave, and gained great victories. He divided his kingdom with *Canute*, and died some time afterwards, in 1017.

CANUTE I. who succeeded him in 1017, is celebrated for his piety, courage, prudence, and conquests. He died in the year 1036, after he had reigned 20 years.

HAROLD succeeded him in the year 1036; he was a vicious prince, abandoned to all sorts of crimes. He died in the year 1039, after he had reigned four years.

HARDICANUTE succeeded him, in the year 1039; he was cruel and avaricious. He had the body of his brother dug up, and thrown into the *Thames*, He died at table at *Lambeth*, of the fumes of a debauch, in the year 1041, after he had reigned two years.

ST. EDWARD III. called the *confessor*, succeeded him in the year 1041; he was prudent, brave, good, just, grateful, and very religious. He died in the year 1065, after he had reigned 23 years.

Under *Edward the confessor's* reign there fell so great a quantity of snow, that a vast number of animals died of hunger. The year following happened a violent earthquake, accompanied with lightning, which burnt the corn in the fields, and caused a great famine.

WILLIAM THE CONQUEROR, Duke of *Normandy*, came into *England* in the year 1066, and having defeated *Harold*, elected king by the *English*, ascended the throne. The defeat of *Harold's* army was so great, that 60000 of his men were slain in the field of battle. *William* abolished the

the *Engliſh* laws, and eſtabliſhed thoſe of *Normandy*; after which, he returned into *France*, took and plundered *Mantes*, and died at *Rouen*, in 1087, after he had reigned 21 years; during which happened a frightful earthquake, contagious maladies, inundations, and incredible conflagrations.

WILIAM II. called *Rufus*, ſucceeded his father, in the year 1087; he was brave, liberal, inconſtant, in his enterpriſes had but little judgment, and perſecuted the biſhops. While he was hunting in *New Foreſt*, *Tirel*, one of his ſervants, wounded him unawares with an arrow, of which wound he died in 1100.

Under *Rufus*'s reign happened an earthquake, in which the ſea overflowed its limits, and in that inundation the eſtate of the earl of *Godwin* in *Kent*, was entirely ſwallowed up; the ſame which we call at preſent the *Goodwin-ſands*; and near *Abingdon* a ſource ſprung up, which run fifteen days, and cauſed the plague and the famine.

HENRY I. ſeized on the treaſures of his father, by which means he was preferred to *Robert*, his eldeſt brother, then abſent in the *Holy land*, where he helped to take the city of *Jeruſal m*. *Robert*, at his return into *E gland*, was maletreated by *Henry*, who cauſed his eyes to be put out: *Henry* died in 1135, after he had reigned 35 years.

Under *Henry* I. a lady, called *Juga*, left a ham, a year, for every huſband and wife, who ſhould have paſſed a year and a day in the conjugal ſtate, without having repented and violated the laws of marriage, of which they were to take an oath at *Dunmow* in *Eſſex*.

STEPHEN OF BLOIS ſucceeded him in the year 1135; his reign was accompanied with continual troubles, and he had ſeveral very great differences with the empreſs *Matilda*, who had been declared heireſs of *Henry* I. her father: He died in the year 1154, after he had reigned 19 years.

HENRY II. ſon of *Matilda*, ſucceeded him in the year 1154; he was a prince adorned with ſeveral very great and excellent qualities; he conquered *Ireland*, and had very great differences with *Thomas Becket*, archbiſhop of *Canterbury*. *Henry* had the diſpleaſure to ſee his own children revolt againſt him: He died in the year 1189, and reigned 34 years.

Under *Henry* II's reign there fell in the *Iſle of Wight*, a rain of blood, which laſted two hours. Fiſhermen took up in their nets, on the coaſt of *Suffolk*, a monſter, covered all over with hairs, who had a human form, and who eſcaped from them, and re-plunged into the ſea.

RICHARD I. ſucceeded him in the year 1189; he was brave, and ſignalized his zeal for the faith, by carrying his arms into the *Holy Land*, where he waged war againſt the enemies of the chriſtian name. He died in the year 1199, after he had reigned 10 years.

JOHN I. ſucceeded him in the year 1199: he was an unfortunate prince, and loſt *Normandy*, which was re-united to the crown of *France*: he was hated by his ſubjects, who revolted againſt him; the extreme ſorrow he conceived for it cauſed his death, which happened the 19th of *October*, in the year 1216, after he had reigned 15 years.

HENRY III. ſucceeded him in the year 1216; he died the 16th, or 20th of *November* 1272, and reigned 65 years.

EDWARD I. ſucceed him in the year 1272; he was vigilant, brave, juſt, and very fortunate in his enterpriſes: he defeated at *Berwick* the *Scotch*, in a pitched battle, where 70,000 of them were killed in the field: he died in 1307, after 34 years, 7 months, and 21 days reign.

EDWARD II. ſucceeded him, in the year 1307; he proved unfortunate in his war againſt the *Scotch*, who, with 30,000 men, defeated 100,000 *Engliſh* in a pitched battle near *Bannokſboreugh*: he was inhumanly treated by his own ſon, and died of a violent death, the 29th of *Jannary* 1327, after 20 years of a reign continually diſturbed by domeſtick diviſions.

EDWARD III. ſucceeded him in the year 1327; he gained the famous battle of *Creſſy*. where the *French* loſt 30,000 men, and 1500 perſons of note. The next day the *Engliſh* cut again 7000 *French* to pieces. In that battle fought in the year 1346, there was no quarter given. *David*, king of *Scotland*, having entered *England* at the head of an army of 60,000 men, was beaten, and himſelf taken priſoner. In 1356 prince *Edward*, ſon of *Edward* III. gained the famous battle of *Poitiers*, where *John*, king of *France*, was taken priſoner. *Edward* III. died the 21ſt of *June* 1377, after he had reigned 51 years.

RICHARD II. ſucceeded him in the year 1377; he was brave and loved glory: he died in the year 1399, after he had reigned 22 years.

HENRY IV. aſcended the throne by a regicide, having cauſed his own king to be killed, in the year 1399; his reign was a texture of perpetual revolutions, which filled *England* with blood and miſeries: he died the 20th of *March*, 1413, after he had reigned 13 years and an half.

HENRY V. ſucceeded him in the year 1415; he gained over the *French*, in 1415, the glorious victory of *Agincourt* in *Picardy*: he died in 1422, after he had reigned 9 years.

HENRY VI. aſcended the throne in the year 1422; his reign proved unfortunate, and was diſturbed

disturbed with civil wars: he died the 21st of *May*, 1461, after he had reigned 39 years.

EDWARD IV. succeeded in the year 1461; he was a very fine prince, brave, and liberal: he defeated in a battle *Henry* VI. who retreated into *Scotland*, and was afterwards killed in the *Tower* of *London* by *Edward's* order, after a life mixed with prosperity and adversity. *Edward* died the 9th of *April* of the year 1483, after he had reigned 22 years.

RICHARD III. duke of *Gloucester*, having killed the young *Edward*, son of *Edward* IV. and published that *Edward* IV. was a bastard, usurped the throne in 1483: he was a hypocrite, impious, cruel, and plunged in all sorts of vices: he was vanquished and killed by *Henry* earl of *Richmond* in the year 1485

HENRY VII. gained the throne by the defeat of *Richard* III. in the year 1485; he was very pious, loved learning, and the learned. He died the 21st of *April*, 1509, after he had reigned 24 years.

HENRY VIII. his son, succeeded him, in the year 1509; he had a vast deal of wit and capacity, but was turbulent and inconstant. He made a divorce with the church of *Rome*; declaring himself head of the church of *England*. He dyed the 28th of *January* 1547, after he had reigned 39 years, and 9 months.

EDWARD VI. his son, succeeded him in the year 1547. Under his reign the mass was abolished. He died in the year 1553, after he had reigned six years.

MARY succeeded him, in the year 1553. She married *Philip* II. king of *Spain*, and restored the exercise of the *Popish* religion. She died of the dropsy, in the year 1558, after she had reigned five years.

ELIZABETH, her sister, succeeded her, according to their father *Henry* VIII's testament, in the year 1558. She had a vast knowledge, spoke five or six languages, was a great politician, and had several other excellent qualities; but she caused *Mary Stuart*, queen of *Scotland*, whom she had detained prisoner for several years, to be beheaded. *Elizabeth* died the 4th of *April* 1603, after she had reigned 40 years, and in the 70th year of her age.

JAMES I. succeeded her, in the year 1603; he was prudent, learned, and a lover of the learned. He died in the year 1625, after he had reigned 22 years.

CHARLES I. succeeded him, in the year 1625; he was an extraordinary good prince, very much inclined to clemency, and brave; but he wanted one of the most essential qualities of a great prince, which is firmness; and his weakness made him sacrifice his first minister, the earl of *Strafford*, to the fury and rage of the declared enemies of monarchy; which unpolitical step gave so violent a shake to his crown, that it made it fall with his head. This his unhappy catastrophe happened the 30th of *January*, 1648-9, after he had reigned 24 years.

Oliver Cromwell, about four years after took the reigns of the government, under the title of *Lord Protector of the Commonwealth of* England; and, in some measure, obliged the greatest powers of *Europe* to acknowledge him as such; though, in fact, they could not consider him otherwise than as an usurper, who had dyed his sacrilegious hands in the innocent blood of his legitimate sovereign. *Cromwell* had certainly all the qualities capable to adorn a throne, had he been born for it; for he was brave, prudent, grateful, wise, a great politician, and liberal without prodigality: but his extravagant ambition, hypocrisy and cruelty, which made him sacrifice to his security the lives of so many of his fellow-subjects, on which he had not the least right, and which was the same thing as murdering them in cool blood, eclipsed all his virtues, and must render his memory infamous throughout all ages. He died the 3d of *September* 1658.

CHARLES II. succeeded his father the 30th of *January* 1648-9, but was kept from his dominions by his revolted subjects till 1660; when he was restored to his throne by the prudent conduct of *Monk*, general of the army of the mock-commonwealth in *Scotland*. *Charles* II. died the 16th of *February* 1685, after he had reigned 36 years, and 7 days.

JAMES II. his brother, succeeded him the 16th of *February* 1685; he was a brave and learned prince, but so attached to *Popery*, as made him unfortunate. He abdicated the throne and his family was excluded by act of parliament. He retired into *France*, where he died at *Germain en Laye*, the 13th of *February* 1701.

WILLIAM and MARY, after king *James*'s retreat into *France*, were proclaimed king and queen of *England* in 1689. *William* III. was certainly one of the greatest heroes of his time, but often beaten by the *French*. His wisdom was as great as his magnanimity, and both contributed much to the keeping him on the throne, notwithstanding all the efforts of his enemies, and, perhaps, of some of his former friends, who can never like long the same face, let it be ever so beautiful. Queen *Mary* died in 1695, and king *William* died the 8th of *March*, 1702.

ANNE, queen of *Great Britain*, succeeded him, the 8th of *March* 1702. She has been one of the

greatest

greateſt ornaments of the *Britiſh* throne. She entered into that grand alliance formed by all the other powers of *Europe* againſt *Franc* alone, and her forces had a very great ſhare in thoſe ſeveral victories gained by the grand allies. Queen *Anne* united *England* to *Scotland*, a project which ſome of her predeceſſors had formed, but had found very difficult in the execution. She died the 1ſt of *Auguſt* of the year 1714, after ſhe had reigned 12 years, 4 months, and 23 days.

George I. of the moſt illuſtrious houſe of *Hanover*, ſucceeded her, the 1ſt of *Auguſt* 1714. He was one of the moſt excellent princes of his time; for he was extreamly good, very much inclined to clemency; very brave, wiſe, judicious, prudent, and a great politician. He died on his journey to *Hanover*, the 11th of *June* 1727, after he had reigned 12 years, 10 months, and 10 days.

George II. his ſon, ſucceeded him, the 11th of *June* 1727: he g verns his ſubjects with mo deration and prudence.

The kingdom of Denmark is of a later date: for *Harold* I. is the reputed founder thereof, about the year of Christ 930. The kingdom of *Norway* was united to it by the marriage of *Aquinus* king of that country with *Margaret*, who ſucceed her father *Valdemare* III. on the throne of *Denmark*, in year 1376, though it does not appear to have been *hereditary* in any family till the ſtates complimented Frederick *the third* with power to leave the crown to his family. This *epocha* happened in the year 1669.

Though *Norway* was united to *Denmark* till the year 1376, yet the firſt notice, that we have of this kingdom inform us, that it was ſubject to *Suenon* or *Suein*, king of *Norway* in 998. This kingdom had kings of its own from that *epocha* down to its union with *Denmark*, as above related. But ſome will bring its independency ſo low as to the year 1439, when Christopher *the third* confirmed their union, which has always continued ever ſince.

The kingdom of Sweden is of a later date. Comut the firſt king began to reign in the year of Christ 1182. It has been ſometimes hereditary, and at other times elective. No king could rule more arbitrarily than Charles XII. and yet the preſent king is ſo circumſcribed in his power and authority by the ſenate, that he is obliged to look and ſee his ſubjects oppreſſed, and even to ſign what his conſcience, and the publick intereſt tells him is ruinous to his country.

The empire of Muscovy or Russia, which, in theſe days, makes ſuch a figure on the theatre of *Europe*, was known as early as the year 988, by the name of a dukedom: when duke *Wolodimine* embraced the *Chriſtian* faith, and took the name of *Bazil* in his baptiſm. As for its hiſtory previous to this *epocha*, there is no dependence upon it

Their wars with the *Tartars* after this kept them always employed; and ſometimes in ſubjection. In the year 1477, *John Biſilides* or *the Great* aſcending the throne, he ſhook off their yoke, and put his country in a more reſpectable condition. But the preſent flouriſhing ſtate of this country and people, is entirely to be aſcribed to the prudence, wiſdom and courage of Peter I. who aſſumed the title of Czar, or Cæsar, i. e. *emperor* of all the *Ruſſias*, and died in the year 1725.

The kingdom of Poland was erected by Poleslas I. who, in the year 999, obtained the title of king from the emperor Otho. This kingdom has a particular form of government. It is under a king, as ſupreme governor; but in itſelf it is a republic. The nobles elect the king, and his majeſty can do no act but what his electors authorize him to do.

Beſides theſe temporal empires and kingdoms, there is a ſpiritual or eccleſiaſtical ſtate in *Europe*, called the *patrimony* of St. Peter, and governed by a prince named Papa or Pope, that at preſent, and for the moſt part has kept his reſidence in the city of *Rome*; originally nominated by the *weſtern* emperor; but for ſeveral centuries elected by a ſet of *eccleſiaſtical creatures* named *Cardinals*, promoted to that dignity by the pope himſelf.

The chronology of the *Popedom* is very unſettled. The advocates for the *papal ſupremacy and infallibility* ſeek for its *epocha* in the perſon of St. Peter, who they affirm was the firſt Pope of *Rome*. Others with greater plauſibility diſtinguiſh between the *eccleſiaſtical* and *political* ſtate of the *Popedom*; and allowing the ſucceſſion of biſhops in the church to riſe from St. Peter, deny the exiſtence of the Pope's *power*, as a temporal prince before the pontificate of Silvester I. whom Constantine *the Great* favoured with ſome temporal exemptions, immunities and power for the better regulation of the *chriſtian* church. And they who have entirely thrown off all communion with the *Pope*, not only laugh at the ſucceſſion from St. Peter; but with ſtrong vouchers undertake to ſhew that the riſe and progreſs of the *papal* power has been a work of time, obtained firſt from the weakneſs, inadvertency, and bounty of princes and emperors, or procured by frauds, violence and rebellion, which in the pontificate of *Gregory* VII. who was choſen *Pope* on the 22d of *April* 1073, moſt daringly uſurped a right to abſolve ſubjects from their natural allegiance, and depoſe kings and emperors; and claimed a ſupreme right over the conſcience of all men, and to impoſe what interpretation they

pleaſed

pleased upon the sacred text of the New and Old Testaments.

I shall subjoin the empire of the TURKS. This is a collective power, composed of several branches lopped off from the limbs of the old *Roman* empire, by *Osman*, or *Ottoman* I. in the year of CHRIST 1300. He made himself master of several provinces in lower *Asia*; which conquests were extended by his son ORCHAN, who succeeded him in 1326.

SOLIMAN I. who succeeded him in 1358, carried his arms towards *Europe*, and made himself master of *Adrianople*. In which undertaking he was seconded by his brother AMURATH I. He pushed his conquest towards *Europe* by the help of the *Genoese*; and ravaged the coasts of *Macedonia*, crossed the streights of *Gallipoli*, and defeated the prince of the *Bulgarians*.

BAJAZET, who succeeded him in 1392, ravaged *Macedonia*, over-ran *Albania*, plundered *Thessaly*, and bid fair for universal monarchy, had not *Tamerlane* emperor of the *Moguls*, stopt his career, and taken him prisoner.

MAHOMET I. who ascended the throne in 1413' subdued *Pontus* and *Cappadocia*: and MAHOMET II. totally destroyed the empire of the *East* by the conquest of *Constantinople* in 1453, and bringing twelve more kingdoms under his subjection; and was preparing to enter *Italy* with a victorious army, when death cut him off near *Nicomedia*.

BAJAZET II. added *Lepante* and *Modon* in the *Morea* to the *Ottoman* empire. And *Selim* I. who began to reign in 1512, reduced many places in *Persia*; took *Grand Cairo* in *Egypt*, and put an end to the empire of the *Mamelus*.

SOLOMAN *the magnificent*, in 1521, took *Belgrade*; *Rhodes* in 1522, entered *Ruda* in 1526, and penetrated to the walls of *Vienna*. And SELIM II. reduced *Cyprus* in 1570.

Such was the rapid increase of the *Ottoman* empire; which now seems resolved to remain content with its present extent; and sufficiently employed to keep its different and distant countries in due obedience.

Of CHYMISTRY.

CHYMISTRY (*Greek* χυμος, juice, and χυω, to melt) is the art of separating the several substances, whereof *mixed* bodies are composed, by the means of fire, or other such powerful agent; and of composing new bodies in the same way, by the mixture of several substances, or ingredients.

By *mixed bodies*, we understand those things that naturally grow and increase, as *minerals*, *vegetables*, and *animals*. Under the name of *minerals* are included the several metals, minerals, stones and earth: under *vegetables*, all manner of plants, gums, rosins, fruits, fungus's, seeds, juices, flowers, mosses, and all their productions: and under *animals*, all sorts of animals, their parts, excrements, and what ever belongs to them.

CHYMISTRY, like other arts has its particular object: and therefore, it will be necessary to consider those natural bodies called *mixts*, which are its proper objects, by some called the *principles* of *chymistry*.

These *principles* are three *active*, viz. *spirit*, *oil* and *salt*: and two *passive*, viz. *water* and *earth*. Because the three first by their great motion cause all manner of *action*; and the two last serve to stop the quick motion of the actives.

The *spirit*, which is called *mercury*, is the first of the *active principles* that appears to us, when we make the anatomy of a mixt body. It is a subtile, piercing, light substance, that is more in motion, than any of the others. It is this which causes all bodies to grow in more or less time, according as it abounds in them more or less. But it happens that the bodies wherein it abounds are more liable to corruption, by reason of its too great motion, and this is observed in animals and vegetables. On the contrary, the greatest part of minerals, as containing but a very small quantity of it, do seem to be incorruptible. It cannot be drawn pure. But either it is involved in a little *oil*, that it carries along with it, and then may be called a *volatile spirit*, such as the spirit of wine, of roses, of rosemary, of juniper; or else is detained by some *salts*, which check its volatility, and then may be called a *fixt spirit*, as the acid spirit of vitriol, alum, salt, &c.

The *oil*, which is called *sulphur*, by reason of its inflammability, is a sweet, subtile, unctuous substance that rises after the *spirit*. This is said to cause the diversity of colours and smells, according to its disposition in bodies: this gives them their beauty and deformity, uniting together the other *principles*: this also sweetens the acrimony of *salts*, and by shutting up the pores of a mixt, hinders it from corrupting, either through too much moisture or cold. Wherefore many trees and plants that have

have a great deal of *oil*, are wont to laſt green much longer than others, and can reſiſt the extremity of ill weathers. It is always drawn impure, for either it is mixt with ſpirits, as the *oils* of roſemary, of lavender, which ſwim above the water; or elſe it is filled with ſalts, that it draws along with it in the diſtillation, as the *oil* of box, *guaiacum*, cloves, which do precipitate to the bottom of the water by reaſon of their weight.

Salt is the laſt of the *active principles*, which remains diſguiſed in the earth, after the other *principles* are extracted. It is a fixt, incombuſtible ſubſtance, that gives bodies their conſiſtence, and preſerves them from corruption. This cauſes the diverſity of taſtes, according as it is diverſly mixed.

There are three different *ſalts*, as the *fixt*, *volatile*, and *eſſential*. The *fixt ſalt* is that which remains after calcination: which is drawn thus, The calcined matter is ſet to boil in much water for diſſolving the *ſalt*, then the diſſolution is filtrated: and when all the moiſture is evaporated, the *ſalt* is found dry at the bottom of the veſſel. The *ſalt* of plants drawn after this manner, is called *lixivious ſalt*: The *volatile* is that which eaſily riſeth, as the *ſalt* of animals: and *eſſential ſalt* is that which is obtained from the juice of plants by cryſtallization. This laſt is betwixt the *fixt* and *volatile*.

Water, which is called *phlegm*, is the firſt of the *paſſive principles*: it comes in diſtillation before the *ſpirits* when they are *fixt*, or after them when they are *volatile*. It is never drawn pure, but always receives ſome impreſſion from the *active principles*. And this cauſes it to have a more deterſive virtue in it than common *water*. It ſerves to ſeparate the *active principles*, and to bridle their motion.

The *earth*, which is called *caput mortuum*, is the laſt of the *paſſive principles*, and can no more be ſeparated pure than the reſt, but will ſtill retain ſome *ſpirits* in it; and if after you have deprived it of them as much as you are able, you leave it a good while expoſed to the air, it will recover new ſpirits again.

Yet, the word *principle* in *Chymiſtry* muſt not be underſtood in too nice a ſenſe: for the ſubſtances which are ſo called, are only *principles* in reſpect of us, and as we can advance no farther, in the diviſion of bodies; but we well know that they may be ſtill divided into abundance of other parts, which may more juſtly claim, in propriety of ſpeech, the name of *principles*: wherefore ſuch ſubſtances are to be underſtood by *chymical principles* as are ſeparated and divided, ſo far as we are capable of doing it by our weak imperfect powers. And becauſe *Chymiſtry* is an art that *demonſtrates* what it does, it receives for fundamental only ſuch things as are palpable and demonſtrable.

Obſerve alſo, that under the general idea of *ſpirit* are comprehended liquors of quite oppoſite natures; ſome being acid, and others alkaline; which laſt are ſuch enemies to the former, that as ſoon as they are put together they raiſe a violent effervеſcence, and grow hot: and to theſe may be added a third ſort, called vinous or inflammable ſpirits; which though very ſubtile and penetrating, are not manifeſtly either acid or alkaline.

All theſe ſorts of ſpirits Mr. *Boyle* ſhews to be producible: and, 1. The *vinous*, which nature ſcarce ever produces of herſelf, are the creatures of vinous fermentation, or are actually produced, though not ſeparated, in that operation.

2. The *alkaline* or *volatile ſpirits*, called alſo the *urinous*, by reaſon of their affinity in many qualities with ſpirit of urine, are manifeſtly not ſimple but compound bodies; conſiſting of the *volatile ſalt* of the reſpective concretes diſſolved in the phlegm, and for the moſt part accompanied with a little oil: ſo that theſe may be referred to the claſs of volatile ſalts.

3. *Acid ſpirits* appear to be producible; becauſe thoſe drawn from common ſalt and nitre are very different in reſpect of taſte, &c. from the bodies they are procured from, which are not properly acid: ſo that it does not appear that theſe ſpirits pre-exiſted in that ſtate of thoſe bodies.

What farther confirms this doctrine of ſpirits is, that the ſame body, merely by different ways of ordering it, may be brought to afford either *acid*, *vinous*, or *urinous* ſpirits; add, that whereas ſalt is accounted the principle of all taſte, it follows that ſpirits, being ſapid, muſt contain ſalt; ſince it is taſte that characterizes and diſtinguiſhes it from phlegm, and denominates it *acid*, *vinous*, or *urinous* ſpirit.

Spirits diſtilled from fermented liquors, conſiſt of very different ingredients, *viz.* a pure ſpirit or alcohol, phlegm, a certain acetous fermented acid, and a ſmall quantity of ill-ſcented oil; ſo that it becomes neceſſary, in order to obtain the ſpirit perfectly pure, to re-diſtil it ſeveral times. By reducing ſpirit therefore, to the utmoſt degree of purity, an *alcohol* is obtained; which, as Doctor *Shaw* expreſſes it, is a liquor *ſui generis*, and poſſeſſed of many peculiar qualities; as, 1. When abſolutely purified, it is an uniform and *homogene* liquor, capable of no farther ſeparation, without loſs or deſtruction of ſome of its *homogeneous* parts. 2. It is totally inflammable, leaving no ſoot, nor any moiſture behind. 3. It has no peculiar taſte or flavour, any more than pure water, except what is is owing to its nature as alcohol, or perfectly pure spirit. 4. It is an unctuous and crispy fluid, running veiny in the distillation, and its drops rolling on the surface of any other fluid, like peas upon a table, before they unite. 5. It appears to be the essential oil of the body it is obtained from, broken very fine, and intimately and strongly mixed with an aqueous fluid, which is assimilated, or changed in its nature, in the operation. 6. And lastly, it seems to be a kind of universal fluid, producible with the same properties from every vegetable subject; but to produce it thus, requires some care in the operation.

On these principles is founded the opinion, that all spirits may be reduced to a perfect similarity or sameness, from whatever subject they are produced, and on this depends their convertibility into one another; for when once they are brought to this standard of simplicity, there needs nothing more than to add the oil of such of the finer spirits as is required to convert the spirit into that particular kind. By this means the same tasteless spirit, whether obtained from *malt*, *sugar*, or *grapes*, may be made into either *malt spirit*, *brandy*, or *rum*, by adding the essential oil of the *grape*, *sugar*. or *malt*; and thus what was once malt spirit, shall become brandy, or whatever else the operator pleases.

Many methods have been attempted to obtain the first point, that is, the reducing the spirit to perfect and pure *alcohol:* the most practicable means seem to be long digestion, and the repeated distillation from water into water, where the essential oil will at once be left upon two surfaces, and the acid imbibed: the shorter ways, are those by rectifying from neutral absorbent salts and earths; such are *sugar*, *chalk*, and the like; and, lastly, the use of fixed alkalies may be tried, for these very forcibly keep down both the phlegm and oil; insomuch that this last method promises to be the shortest of all, if the art were known of utterly abolishing the alkaline flavour, which the *alcohol* is apt to acquire.

For, as *vinous spirits* arise with a less degree of heat than watery liquors, if due regard be had to this circumstance, very weak spirits may, by one or two wary distillations, in a degree of heat less than that in which water boils, be tolerably well freed of their aqueous phlegm: and in order to free it from its foul oil, add to every gallon of it a pound or two of pure, dry, and fixed alkaline salt, which being digested together for some time, the alkali, from its own property of attracting water and oils, will imbibe the remaining phlegm, and such part of the disagreeable unctuous matter as may be still left in the spirit, and sink with them to the bottom of the vessel. If the spirit be now again gently drawn over, it will arise entirely free from its phlegm and nauseous flavour; but as some particles of the alkaline salt are apt to be carried up with it, and give it an urinous relish, a small proportion of any fixed acid liquor, or rather of an acid salt, as vitriol or alum, should be added to it.

The spirit obtained by this process is called *alcohol*, and is extremely pure, limpid, perfectly flavourless, and fit for the finest purposes: it may be reduced to the strength commonly understood by proof-spirit, by mixing twenty ounces of it (by weight) with seventeen ounces of water. The distilled cordials made with these spirits, are much more elegant and agreeable than when the common rectified or proof spirits of the shops are made use of.

There are many occasions in which *Chymists*, and other artificers, stand in need of the true and purest *alcohol*, the least remainder of water rendering the operation unsuccessful: hence it is absolutely necessary we should have some marks, by which to distinguish whether our *alcohol* be pure or not. The principal of these are, 1. If the supposed *alcohol* contains any oil dissolved in it, and so equably distributed through it, that it is no ways perceptible, then upon pouring of water into it, the mixture will grow white, and the oil separate from the *alcohol*. 2. If any thing of an acid lies concealed in the *alcohol*, a little of it mixed with the alcaline spirit of *sal ammoniac* will discover the acid by an effervescence excited by the effusion of the acid; for otherwise there would be only a simple coagulation. 3. If there be any thing of an alkali intermixed, it will appear by the effervescence excited by the effusion of an acid. 4. But it is a matter of great difficulty to discover whether there be any water intermixed with it.

The best method of doing this is the following: take a *chymical* vessel with a long narrow neck, the bulb of which will hold four or six ounces of *alcohol*. Fill this two thirds full with the *alcohol* you intend to examine, into which throw a dram of the purest and driest salt of tartar, coming very hot out of the fire; then mix them by shaking them together, and set them over the fire till the *alcohol* is just ready to boil. Being thus shaken, and heated, if the salt of tartar remains perfectly dry, without the least sign of moisture, we are sure that there is no water in the *alcohol*. The learned *Boerhaave* tells us, that by this method he discovered water in *alcohol* which had been looked upon as pure, having undergone every other method of trial.

Animal oils are their *fats*, which are originally vegetable oils: all animal substances yield them, together with their volatile salts, in *distillation*.

Vegetable oils are obtained by *expreſſion*, *infuſion*, and *diſtillation*.

The *oils* by *expreſſion* are obtained from the ſeed, leaves, fruit, and bark of plants: thus, the ſeed of muſtard, and of the ſun-flower, almonds, nuts, beech-maſt, &c. afford a copious oil by expreſſion; and the leaves of roſemary, mint, rue, wormwood, thyme, ſage, &c. the berries of juniper, olives, Indian cloves, nutmeg, mace, &c. the barks of cinnamon, ſaſſafras, and clove, yield a conſiderable proportion of eſſential oil by diſtillation.

The method of procuring *oils* by *expreſſion* is very ſimple: thus, if either ſweet or bitter almonds, that are freſh, be pounded in a mortar, the oil may be forced out with a preſs, not heated; and in the ſame manner ſhould the oil be preſſed from linſeed and muſtard. The avoiding the uſe of heat in preparing theſe oils, intended for internal medicinal uſe, is of great importance, as heat gives them a very prejudicial rancidneſs.

This method holds of all thoſe vegetable matters that contain a copious oil in a looſe manner, or in certain cavities or receptacles; the ſides whereof being broken, or ſqueezed, makes them let go the oil they contain: and thus the zeſt or oil of lemon-peel, orange-peel, citron-peel, &c. may be readily obtained by preſſure, without the uſe of fire. But how far this method of obtaining oils may be applied to advantage, ſeems not hitherto conſidered. It has been commonly applied to olives, almonds, linſeed, rape ſeed, beech-maſts, ben-nuts, walnuts, bay-berries, mace, nutmeg, &c. but not that we know of to juniper-berries, caſhew-nuts, Indian cloves, pine-apples, and many other ſubſtances that might be enumerated, both of foreign and domeſtic growth. It has, however, been of late ſucceſsfully applied to muſtard-ſeed, ſo as to extract a curious gold coloured oil, leaving a cake behind, fit for making the common table muſtard.

Certain dry matters, as well as moiſt ones, may be made to afford *oils* by expreſſion, by grinding them into a meal, which being ſuſpended to receive the vapour of boiling water, will thus be moiſtened ſo as to afford an oil, in the ſame manner as almonds; and thus an oil may be procured from linſeed, hemp-ſeed, lettuce-ſeed, white poppy-ſeed, &c.

As to the treatment of oils, obtained by expreſſion, they ſhould be ſuffered to depurate themſelves by ſtanding in a moderately cool place, to ſeparate from their water, and depoſite their fæces; from both which they ought to be carefully freed. And if they are not thus rendered ſufficiently pure, they may be waſhed well with freſh water, then thoroughly ſeparated from it again, by the ſeparating-glaſs, whereby they will be rendered bright and clear.

The next claſs of *oils* are thoſe made by *infuſion* or *decoction*, wherein the virtues of ſome herb or flower are drawn out in the oil; as the oils of [illegible], camomile, hypericum, elder, &c. However, theſe require to be differently treated: thus, for the ſcented flowers, particularly roſes, inſolation does beſt; becauſe much boiling would exhale their more fragrant parts: but oils impregnated with green herbs, as thoſe of camomile and elder, require long boiling, before they receive the green colour deſired. And, in general, no oils will bear to be boiled any longer than there remains ſome aqueous humidity, without turning black.

There are many compound oils prepared in the ſame manner, *viz.* by boiling and inſolation, and then ſtraining off the oil for uſe.

The ſame contrivance has likewiſe its uſe in making eſſences for the ſervice of the *perfumer*; not only where eſſential oils cannot be well obtained in ſufficient quantities, but alſo where they are too dear. The eſſential oil of jeſſamine-flowers, honey-ſuckles, ſweet-briar, damaſk-roſes, lilies of the valley, &c. are either extremely dear, or ſcarce obtainable by diſtillation; and in ſome of them, the odorous matter is ſo ſubtile, as almoſt to be loſt in the operation. But if theſe flowers be barely infuſed in fine oil of nuts, or oil of ben, drawn without heat, and kept in a cool place, their ſubtile odorous matter will thus paſs into the oil, and richly impregnate it with their flavour. And theſe eſſences may be rendered ſtill more perfect by ſtraining off the oil at firſt put on, and letting it ſtand again, without heat, upon freſh flowers; repeating the operation twice or thrice.

Oils, or fats, may likewiſe be obtained, by boiling and expreſſion, from certain animal ſubſtances; for the membranes which contain the fat, being chopped ſmall, and ſet in a pan over the fire, become fit for the canvas-bag, and, by preſſure, afford a large quantity of fat; as we ſee in the art of *Chandlery*, which thus extracting the oily matter, leaves a cake behind, commonly called *graves*.

As to the eſſential oils of vegetables, they are obtained by diſtillation, with an alembic and a large refrigeratory. Water muſt be added to the materials, in ſufficient quantity, to prevent their burning; and they ſhould be macerated or digeſted in that water, a little time before diſtillation. The oil comes over with the water, and either ſwims on the top, or ſinks to the bottom, according as it is ſpecifically heavier or lighter than water.

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This proceſs is applicable to the diſtilling of the eſſential oils from flowers, leaves, barks, roots, woods, gums, and balſams, with a ſlight alteration of circumſtances, as by longer digeſtion, briſker diſtillation, &c. according to the tenacity and hardneſs of the ſubject, the ponderoſity of the oil, &c.

Eſſential oils may be divided into two claſſes, according to their different ſpecific gravities; ſome floating upon water, and others readily ſinking to the bottom. Thus, the *eſſential oils* of cloves, cinnamon, and ſaſſafras, readily ſink; whereas thoſe of lavender, marjoram, mint, &c. ſwim in water: the lighteſt of theſe eſſential oils, is, perhaps, that of citron-peel, which even floats in ſpirit of wine; and the heavieſt ſeems to be oil of ſaſſafras.

For obtaining the full quantity of the more ponderous *oils* from cinnamon, cloves, ſaſſafras, &c. it is proper to reduce the ſubjects to powder; to digeſt this powder for ſome days in a warm place, with thrice its quantity of ſoft river-water, made very ſaline by the addition of ſea-ſalt, or ſharp with oil of vitriol; to uſe the ſtrained decoction, or liquor left behind in the ſtill, inſtead of common water, for freſh digeſtion; to uſe for the ſame purpoſe the water of the ſecond running, after being cleared of its oil; not to diſtil too large a quantity of theſe ſubjects at once; to leave a conſiderable part of the ſtill, or about one fourth empty; to uſe a briſk fire, or a ſtrong boiling heat, at the firſt, but to ſlacken it afterwards; to have a low ſtill-head, with a proper internal ledge and current leading to the noſe of the worm; and, finally, to cohobate the water, or pour back the liquor of the ſecond running upon the matter in the ſtill, repeating this once or twice.

As to the *ſalts*; it is to be remarked that we don't know the preciſe figure of each ſort; but we muſt judge of them by their effects, acid ſalts ſhould ſeem to be pointed, and thoſe points tipped with ſulphureous matter: whereas the urinous and lixivious ſalts ſeem to be like a ſponge, containing a part of the acid, and a little fetid oil.

Acid ſalts are ranged, by *Homberg*, under three claſſes, *viz.* ſuch as contain an animal or *vegetable ſulphur*; as all the acids diſtilled from plants, fruits, woods, &c. and ſpirit of nitre; ſuch as contain a *bituminous ſulphur*, to which belong the acids of vitriol, *common ſulphur*, and alum: and ſuch as contain a *more fixed mineral ſulphur*; as the acids drawn from the ſea-ſalt, and ſal gem.

Thoſe of the firſt claſs act more ſwiftly than thoſe of the others, and thoſe of the ſecond are the leaſt nimble. *Acid ſalts*, joined with *lixivious ones*, compoſe *mixed* or intermediate ſalts: thus, ſpirit of nitre, with ſalt of tartar, produce a true ſalt-petre; ſpirit of ſalt, with ſalt of tartar, produce true common ſalt; and ſpirit of vitriol, with ſalt of tartar, produce true vitriol; which are all mixed or intermediate ſalts, *i. e.* partly fixed and partly volatile, the ingredients ſtill retaining their original natures. *Acids*, joined with *urinous* ſalts, compoſe another ſalt called *ammoniac* ſalts, which are always volatile.

In all *native ſalts*, both *foſſile*, *vegetable*, and *animal*, after the violence of the fire has ſeparated all the volatile parts, there ſtill remains a fixed ſalt, to be drawn from the *fæces* by lotion, or lixiviation; hence called a *lixivious* ſalt, which is no other but the relicks of the acid ſalts, that the fire was not able to ſeparate from the earth of the mixed body, but may be ſeparated by diſſolving them in common water. The taſte of theſe *lixivious* ſalts is very different, according to the quantity of the acids ſtill remaining after calcination; part of which is ſtill capable of being volatilized by a more intenſe heat, or by diſſolution, digeſtion, filtration, and evaporation frequently repeated; or, by adding ſome urinous ſalt, to abſorb the ſame.

We have three ſorts of *urinous* ſalts, *viz.* that of plants or animals, which is the ſame; the ſecond is foſſile; and the third of an intermediate kind, partaking both of the foſſile and vegetable nature: the firſt is volatile, and the two latter fixed.

By *urinous ſalts*, we mean all ſuch as partake of the taſte or ſmell of urine; their effect in volatilizing fixed ſalts is well known; for being added to common ſalt, there ariſes, by fire, a volatile ſalt, called *ſal ammoniac*. However, for volatilizing the fixed ſalts of plants, the urinous ſalts of plants are not ſo proper as the urinous ſalts of the intermediate claſs, ſuch as alum; and for the fixed ſalts of foſſils, the urinous ſalt is fitteſt, *viz.* borax.

All the ſorts of ſalts, then, appear evidently compound and unelementary; and that they are producible *de novo*, and convertible into one another, is ſtrenuouſly argued by Mr. *Boyle*. The two chief qualities wherein they all agree, he obſerves, are to be eaſily diſſoluble in water, and to affect the palate, ſo as to cauſe a ſenſe of taſte. Now that a diſpoſition to be diſſoluble in a liquor, may be acquired by mixture, and a new texture of parts appears from many inſtances; and as for the taſte, it is ſome queſtion, how far the neceſſity thereof may conſiſt with another principle; for the pureſt oils are ſapid, yet will not diſſolve in water; ſo that there does not appear any ſtrict connection between being ſapid and ſoluble in that fluid.

For *acid ſalts*, we may inſtance in nitre; which, though it have no acid taſte, may be made to afford by diſtillation, above three quarters of its weight, of a highly acid liquor: yet it does not appear,

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that fuch a great proportion of acid particles, or poffibly any proportion at all, is employed by nature in the compofition of nitre.

For *urinous falts*, we have an inftance of their production, in the falt obtained by diftillation from foot: for though the wood, we burn in our chimneys, feems to have nothing of the tafte or fmell of urine, nor have the diffolutions of the faline parts of fuch wood been obferved to have any affinity, in tafte or odour, thereto; yet when wood is burnt in the fire, and the foot afforded by it diftilled, we get a white volatile urinous falt, like what is obtained from blood, urine, or the like.

For *lixivious*, or the *fixed falts* of calcined bodies, the *Chymifts* themfelves are not entirely agreed; for however the prevailing opinion may be, that thofe fixed alkalies pre-exift in mixed bodies, *Helmont* very ingenioufly propofes another origin, and holds them, as to their alkaline form, productions of the fire, by whofe violent action a part of the falt, which in the concrete is all naturally volatile, laying hold of fome parts of the fulphur of the fame body, both become melted together, and thus fixed into an *alkali*.

In order to leffen the trouble and expence of procuring the *volatile falt* of *animal fubjects*, they fhould be firft purged of their oil and unctuous parts, by boiling in water; after which, they will afford volatile *falts* and *fpirits*, as pure, or purer, than thofe obtained from unboiled hartfhorn.

Obferve farther, that the unrectified volatile falts of vegetable and animal fubftances, are true *fales volatiles oleofi*; and according to the difference of the oil wherein they abound, they are properly diftinguifhed into falt of hartfhorn, of ox-bone, of human blood, of filk, &c. But that when thefe oils are totally feparated from them, they become one and the fame undiftinguifhable volatile falt; for that it is the admixture of oil that gives the colour to volatile falts, they being permanently white when the oil is feparated.

Thefe *volatile falts* are obtainable from all kinds of land-animals, the amphibious and fubterraneous tribe, birds, fifhes, and reptiles; alfo from alkaline vegetables without putrefaction, and from other vegetables after putrefaction; from foot, horns, hoofs, and all refufe animal and vegetable matters, as urine, the blood of flaughter-houfes, &c. and this as pure and perfect as from hartfhorn; whence volatile alkalies, and fal ammoniac, might be afforded very cheap.

The volatile animal, and fixed vegetable falts, differ chiefly with regard to their volatility, and fixednefs, and the effects thereon depending; but agree in other refpects: thus they both make an effervefcence, and turn neutral, when faturated with acids; they are both corrofive, hot, fiery, &c.

The nature and ufes of *water*, will beft appear from the following *experiments*. 1. That water is contained in many folid bodies, and to appearance in dry bodies, was proved thus: a piece of the hardeft and drieft bone being procured, and diftilled in an earthen retort, with degrees of fire, a very large proportion of water, along with much oil and volatile falt, was obtained: whence it appears, that animal matters are refolvable into the four *chymical principles*, water, oil, falt and earth.

This experiment holds true even of the oldeft hartfhorn, the drieft and hardeft woods, earths and pulverized ftones. Whence it alfo appears, that water may be concealed in folid bodies, and make a conftituent part thereof: for it is not meant that water infinuates itfelf into the fuperficial pores of bodies, fuch as wood, fkins, &c. fo as to fwell them in moift weather, and leave them fhrunk in dry; but that it remains permanently intermixed as an effential ingredient, or as a part of folid bodies.

2. That water may be collected from the drieft air, or in the hotteft climate, was proved by the following experiment. Half a pint of common water was put into a cylindrical glafs wiped perfectly dry on the outfide; then was added to the water two ounces and three quarters of pulverized and dry fal ammoniac; thefe were ftirred brifkly together; whereupon the water floating in the external air was, by the coldnefs thus produced, condenfed on the outfide of the glafs as the falt diffolved within, and trickled down in fmall veins, into the fhallow bafon fet underneath to receive it. This experiment holds in all climates and places of different heights where it has been tried; whence by the law of induction we may make it univerfal, till any contradictory inftance appears. Thus, therefore, it may hold in the moft parching countries, and hotteft feafons, fo as to afford an agreeable method of cooling potable liquors, and rendering them more refrefhing. For if the containing glafs of the falt and water be fet in any liquor, the liquor will be cooled thereby; and if any confiderable improvement could be made in the contrivance, it is obferved, that it might in fome meafure ferve to fupply the thirfty traveller in parched defarts, and the failors with frefh water at fea.

3. To determine the proportion of water contained in an affigned portion of the atmofphere, we are directed by the following experiment. Having by means of the *air-pump*, and an exact pair of *fcales*, found the weight of a certain quantity of air contained in a large glafs-veffel, there was included therein a certain known weight of well dried potential cautery, whofe property it is powerfully

to attract the moiſture of the air. This veſſel was kept cloſe ſtopt for ſeveral hours; during which time, the potential cautery was grown wet, in which ſtate being weighed again, it was found conſiderably to increaſe; which muſt be either owing to the water attracted out of the air in the glaſs, or to a condenſation of the air itſelf, into an aqueous fluid; for ſuch a fluid might now by diſtillation be obtained from the matter thus run per deliquium.

It is obſerved that there is room to ſuſpect, that if this experiment were made in perfection, a weight of water almoſt equal to that of the air included in the veſſel, might be thus obtained, which might prove a very extraordinary diſcovery, and ſhew what ſome have endeavoured to prove, that the matter of common air, is little more than water.

4. That an earthy ſubſtance is naturally contained in water, was proved as follows. Three ſeveral glaſſes were filled with pure rain water, ſpring water, and *Thames* water, and ſuffered to ſtand, cloſe covered, for ſome days before they were exhibited. There was an earthy ſediment then depoſited in all the three, but moſt in the *Thames* water, the ſediment whereof was not only larger, but alſo more foul and muddy than in the rain water; though here, alſo, it was dirty, perhaps, becauſe not carefully collected; whereas, in the pump water, it was white, ſcaly, flaky, and ſhining, like fine ſpangles of talc. This experiment is alſo univerſal, ſo far as it has been tried with care, and holds true of the waters of all ſpecies, and all countries, particularly in thoſe called mineral waters, from which an earthy ſubſtance may uſually be precipitated by art, in a conſiderable proportion.

Certain experiments carefully made, and repeated, ſhew that the terreſtrial matter naturally contained in water, has a principal ſhare in the growth and increaſe of vegetables; all the plants that thrive in water appearing to enlarge their bulk in proportion to the earthy matter they draw from the water. Whence *pure elementary water* ſeems but a kind of vehicle to convey this nutrimental or ſubſtantial part, and depoſite it in the veſſels through which the water moves, in order to its general exit at the ſurface of vegetables. But we are not here to exclude the inſtrumental efficacy of the two other elements, fire and air.

And this appearing to be the general office of water in the whole animal and vegetable kingdoms, *viz.* the conveyance or diſtribution of the alimentary matter to all their parts, it may be proper to conſider its phyſical properties, which would wonderfully fit it for this office.

The figure of its component parts appears to be ſmooth and ſpherical, like thoſe of quickſilver; whence it becomes extremely moving and penetrating. Thus it readily enters the pores of wood, leather, ſkins, chords, muſical ſtrings, &c. thus likewiſe it becomes capable of moving and agitating particles of matter leſs active than itſelf, and ſo proves the more immediate phyſical agent of fermentation, putrefaction, ſolution, &c. and thus it alſo conveys earthy and ſaline matters through our filtres of paper, ſtone, &c. and even raiſes ſome proportion of them in diſtillations. Its particles likewiſe appear to be extremely minute, and ſo have a large ſhare of ſurface. Hence *water* is admirably fitted for a ſolvent, or for readily entering the pores of ſalts, and coming into full contact with all their particles; and thus it will paſs where air cannot, on account of its moiſture, or lubricating power, whereby it faſtens mucilaginous matters, and will therefore ſoak through the cloſe pores of a bladder.

From the experiments of Doctor *Shaw*, made upon water, he deduces the following axioms and canons. *Firſt*, we have ſeen, That *water* is naturally contained in ſome of the drieſt and hardeſt bodies, and in the drieſt air. 2. That itſelf naturally contains an earthy ſubſtance. 3. That it is the proper menſtruum of ſalts, diſſolving more of one, and leſs of another. 4. That one good ſign of its purity and wholeſomneſs is levity. 5. That the ingredients of a mineral water may be diſcovered by chemical expedients: and, 6. That mineral waters are imitable by art from ſuch diſcovery.

Secondly, That *water* is of infinite uſe in all the works both of nature and art, as without it there could be no generation, nutrition, or accretion performed in any of the animal, vegetable, mineral, marine, or atmoſpherical regions. The blood could not flow in the veins, the ſap in the veſſels of vegetables, nor the particles of minerals concrete and grow together, without water. It is this that makes the largeſt part of our blood, our drink, and other aliments. There could be no corruption, fermentation, or diſſolution carried on without it, no brewing, no diſtilling, no wines, no vinegar, no ſpirits, made without it.

Thirdly, That we meet with *water* under an infinite variety of forms, and in an infinite variety of bodies, as that of air, vapour, clouds, ſnow, hail, ice, ſap, wines, blood, fleſh, bone, horn, ſtone, &c. through all which it ſeems to paſs unaltered, as an agent or inſtrument that ſuffers no alteration by re-action, but remains capable of reſuming the form of water again upon occaſion.

Fourthly, That *water* in its own common ſtate appears to be a combination of all the elements together,

together, as containing a quantity of fire, which keeps it fluid, a quantity of air, and a quantity of earth; whence it can be no wonder that water alone, as it appears to the senses, should suffice for vegetation in some cases, where little earth is wanted, or for supporting animal and mineral life, where no great degree of nutriment is required; and hence it proves a gluten, or cement to some bodies, and a solvent to others; thus it consolidates brick, plaister of *Paris*, stone, bone, &c. but dissolves salts, and subtile earths approaching to salts, and becomes the instrumental cause of their action.

Fifthly, That *water* conveys nourishment, or a more fixed and solid matter to the parts of vegetables, where having deposited it, the finer fluid perspires into the atmosphere, which gives us the physical cause of the dampness and unwholesomeness of woody countries, as they remarkably find in *America*. For all large vegetables act after the manner of forcing pumps, and continually draw in large quantities of water at their roots, and discharge it at their leaves, which intimates a method of collecting water in dry countries, and likewise of making salt-water fresh.

Sixthly, That the *water* in passing thro' plants, after having deposited its more terrestrial part, does not always go off pure, but impregnated w[illegible] the finer effluvia, or more subtile particles of the vegetable; thus making an atmosphere round every plant, according to its nature odoriferous or otherwise, which supplies us with a rule for procuring the odoriferous waters of vegetables by distillation.

Seventhly, That the particles, not fine enough to go off thus along with the *water*, are left behind upon the surface of the leaves and flowers of plants, being now thickened or strained from their moister parts, and remaining in the form of honey, manna, gums, balsams, &c. according to the nature of the vegetable. And hence appears the physical cause of plants proving more odoriferous and sweet when the weather is both warm and moist, as immediately after a summer's shower.

Eighthly, That the *chymical* operator should form to himself an *hygrometer* for the service of his laboratory to determine the *proportion of water* at all times contained in the air, which continually mixes with his preparations, differently augments their weight, and promotes or hinders many of his operations.

Ninthly, That *pure water* makes the largest part of *mineral waters*, where it is impregnated as a menstruum, with several ingredients that it dissolves or drinks up in its passage through the earth.

Earth in weight exceeds *water*, *salts*, and the *spirits* of animals and vegetables. When pure, or perfectly separated from other bodies, it is consistent, hard, and fine, though brittle with regard to our senses, and easily reducible by trituration into a certain powder. in which respect it differs from the true metals and gems; though still more in this, that it remains fixed and unchanged in the most violent fire, even so far as not to flow therein.

Boerhaave says, he never could obtain *elementary earth* from *metals*, but it may be obtained from *water*, from calcined *vegetables*, from *smoak* and *soot*, from putrified *animals*, from distilled *animal fluids*, from *fossile salts*, and from fluid and solid *sulphurs*. Whence he concludes, that the same simple elementary earth contributes as a constituent principle to form the particular corporeal fabric of animals, vegetables, and some fossils of a less permanent and less simple nature, and in them all serves as a firm basis to their form, whilst it unites the other principles to itself, and to one another, so as to constitute one determinate individual. Hence also, says he, the property of assimulating other substances into the nature of every body that receives nutriment, and consequently the seminal property of producing their like, is principally owing to the efficacy of this earth; for their properties no longer remain after the particular texture depending principally upon the earth is destroyed, or wanting in any body.

Before the *Chymist* can pretend to work upon these elements, he must be well instructed not only in the different *terms* of art; but how to prepare and manage the *fires*, and chuse *vessels* proper for the work.

The TERMS used in *Chymistry* are thus explained.

Æthiops Mineral is a preparation of *mercury* and *sulphur*; which name has been given to it, to express a mineral matter as black as an *Æthiopean*.

Al, is an *Arabian* particle, signifying *the*: but it is commonly used at the beginning of a word, to express somewhat excellent; because it also signifies GOD in *Hebrew*.

Alchymy, from *al* and χύω, *fundo*, to melt, is that part of *Chymistry* which teaches the transmutation of metals. *See* our Treatise on ALCHYMY.

Alembick, from the *Arabick* particle *al* and ἄμβιξ, *vasis species*, a particular kind of vessel.

Alkahest, is composed of two *German* words *al geest*, that is to say, all spirit: or an universal dissolvent. *See* our Treatise on ALCHYMY.

Alkali, is composed of the *Arabian* particle *al* and of *kali*; as if one should say, the kali, (*which is the standard of an alkaline salt.*)

To *alcoholize*, or reduce into *alcohol*, signifies to subtilize, as when a mixt is beaten into an impalpable

pable powder. This word is alſo uſed to expreſs a very pure ſpirit; thus the ſpirit of wine well rectified, is called the *alcohol* of wine.

Amalgamate is. to mix *mercury* with ſome melted metal; this operation ſerves to render the metal fit to be extended on ſome works, as gold; or elſe to to reduce it into a very ſuitable powder, which is done by putting the *amalgame* into a crucible over the fire: for the *mercury* ſubliming into the air leaves the metal in an impalpable powder; neither iron nor copper can by any means be *amalgamated*.

Aqua Stygia is *aqua regalis*, thus called for its corroſive quality, in compariſon with the water of a river imagined by the poets to be in hell, called *Styx*.

Aqua Regalis, ſo called; becauſe it diſtils gold, the king of metals.

Aqua ſecunda, is *aqua fortis*, watered by the ſilver which it had diſſolved.

Aquila Alba, is a ſweet ſublimate: this name ſeems to have been given to it, as it expreſſes a white matter, that in its ſublimation reſembles the flight of an eagle: but ſince for the ſame reſemblance this matter might be given to other white ſublimations, it is probable that this term has been in particular given to the ſweet ſublimate, which is a medicine uſed inwardly, in order to diſtinguiſh it from the corroſive ſublimate which is a rank poiſon, and to take away the name of ſublimate as that was obnoxious to the people.

Athanor, or *Athanuor*, is derived from *tanuaron*, which ſignifies a furnace. This is very commodious to make ſuch chymical preparations which demand only a moderate fire, ſuch as for digeſtions; ſome call it the philoſophical furnace; others, the furnace for *Arcana*.

Cement is a manner of purifying gold. It is done by ſtratification with a hard paſte made of one part of *ſal armoniack*, two of common ſalt, and four of potters earth, or bricks powdered, the whole having been moiſtened with a ſufficient quantity of urine: this compoſition is called *royal cement*.

Chryſulca, from χρυσὸς, *aurum*, gold. This name is given to the *aqua regalis*; becauſe it diſſolves gold.

Circulation is a motion given to liquors contained in a double veſſel, excited by fire, and cauſing the vapours to aſcend and deſcend to and fro. This operation tends either to ſubtilize the liquors, or to open ſome hard body that is mixed with them.

Coagulate, is to give a conſiſtence to liquids, by evaporating ſome part of them over the fire, or elſe by mixing liquors together that are of a different nature.

Cohobate, ſignifies to repeat the diſtillation of the ſame liquor, having poured it again upon the matter that remains in the veſſel. This operation is uſed to open bodies, or to volatilize the ſpirits.

Concretion, is a thickening coagulation or induration of any fluid; as ſalts diſſolved again ſhoot into figures and chryſtalize.

Congeal, is to let ſome matter that is melted fix, or grow into a conſiſtence, as when we let a metal cool, after it has been melted in a crucible; or elſe it is when wax, fat, butter, or the like, are taken from the fire, and ſet to cool.

Depart, is a ſeparation of one metal from another, with which it was intimately mixed; for example, when we pour *aqua fortis* upon a mixture of gold and ſilver, the ſilver is taken up, but the gold being not penetrated by this diſſolvent, ſubſides at the bottom of the veſſels.

Detonation, is a noiſe that is made when the volatile parts of any mixture do ruſh forth with impetuoſity; it is alſo called *fulmination*.

Digeſtion, is when ſome body is put to ſteep or infuſe in a convenient *menſtruum*, over a very gentle heat.

Diſſolve, is to turn ſome hard matter out of a hard into a liquid form, by means of a certain liquor.

To diſtil *per aſcenſum*, is when fire is put under the veſſel that contains the matter which is to be heated.

To diſtil *per deſcenſum*, is when fire is placed over the matter that is to be heated; for then the moiſt parts being rarified, and the vapour which riſes from them not being able to ariſe away upwards, as it would do if it not hindered, it precipitates and diſtils at the bottom of the veſſel.

Edulcorate, is to ſweeten ſome matter that is impregnated with ſalts, by means of common water.

Effervescency, is the ebullition of a liquor without the ſeparation of its parts; as when new milk, or any other liquor's ſet a boiling on the fire; for after the ebullition is over, it continues of the ſame nature as before.

Evaporate, is to waſte a liquor by the fire or ſun.

Expreſſion, is to preſs any matter hard to get out its juice, or any other liquor with which it is charged.

Extract, is to ſeparate the purer part from the groſſer.

Fermentation, is an ebullition raiſed by the ſpirits that endeavour to get out of a body; for meeting with groſs earthy parts that oppoſe their paſſage, they ſwell and rarify the liquor until they find their way.

way out; now in this ſeparation of parts, the ſpirits do divide, ſubtilize and ſeparate the principles ſo, as to make the matter be of another nature than it was before.

Though there be ſome difference between *efferveſcency* and *fermentation*, as has been ſhewn, yet generally theſe two ſorts of ebullitions are confounded, and no body ſcruples to uſe the one for the other.

Filtrate, is to purify a liquor by paſſing it thro' a coffin of brown paper.

Fumigate, is to make one body receive the fume of another.

Granulate, is to pour a melted metal drop by drop into cold water, that it may congeal into grains.

Levigate, is to reduce a hard body into an impalpable powder upon a marble.

Magiſtery, is a name which the ancient *Chymiſts* gave to certain white and very light precipitates; and by it they underſtood a ſeparation very ſubtile and exquiſite.

Matter Alkaline, (*the ſame as alkali*) is any earthen or ſaltiſh matter, penetrable by acids, and receptive of their influences.

A *Menſtruum* ſignifies in *Chymiſtry* a *diſſolvent*, which is ſo called, becauſe that *Alchymiſts* thought the perfect diſſolution of a mixt body was compleated in one of their philoſophical months, which conſiſts of forty days.

Mortify, is to change the outward form of a mixt, as is done in *mercury*. Alſo ſpirits are ſaid to be *mortified*, when they are mixed with others that hinder and deſtroy their ſtrength.

Piger Henricus, is the athanor furnace, thus called; becauſe it may be managed by any idle perſon without much care and pains.

Precipitate, is to ſeparate a matter that is diſſolved: ſo as to make it fall or ſettle at the bottom.

Projection, is when any matter to be calcined is put into a crucible, ſpoonful after ſpoonful.

Rectify, is to diſtil ſpirits, for the ſeparation of what heterogeneous parts might have been drawn along with them.

Reverberate, is to cauſe the flame of the wood or coals that is lighted in the furnace, to beat back upon the veſſel, by means of a dome placed over it.

Revive, is to reſtore a mixt to its former condition that lies diſguiſed by ſalts or ſulphurs. Thus cinnabar, and the other preparations of *mercury*, are revived into quick ſilver.

Scories, is the ſcum of metals or minerals.

Salt acid, is a ſalt having very cloſe or ſmall pores, which doth not ordinarily ferment with acid, and from whence is extracted by diſtillation an acid ſpirit, as of ſalt-petre, vitriol, and allum.

Salt Alkali, is properly the ſalt of *kali*, but commonly all ſalt is ſo called which ferments with acids, as ſalt of tartar, of wormwood, &c.

Salt Eſſential, is an acid ſalt, extracted from plants by cryſtallization.

Salt fixed, is that which will ſuffer the fire without conſiderable diminution.

Salt Fluid, is an acid ſalt which remains fluid, and which condenſates not without the interpoſition of ſome earthy matter that gives a body to it; ſuch are the acid ſpirits of ſalt-petre, common ſalt, and diſtilled vinegar. And this is called the principle of ſalt.

Sal ſalſum, is an alkaline ſalt, filled with an acid, as the ſal gem and ſea ſalt.

Sal Volatile, is a ſalt which riſes with the leaſt heat, ſuch is that of vipers, hartſhorn, &c.

Stratafy, is to lay different matters bed upon bed. This operation is performed when we would calcine a mineral or metal with a ſalt, or ſome other matter.

Sublime, is to raiſe by fire any volatile matter to the top of the cucurbit, or into its head.

Tranſmutation, is changing the nature of one body into that of another more perfect, as if one would make gold of ſilver, or copper of iron.

The Fires and their ſeveral *degrees* uſed in *Chymiſtry*, may be thus exaplained. (See the *Furnaces*, &c. in the Copper Plate.)

Chymists, in their operations, make uſe of heats with ſand, file-duſt, and aſhes; of the reverberatory fire, of a fire for fuſion, of the lamp, the *balneum mariæ*, the *balneum vaporis*, and the heat of ſuppreſſion. They alſo make uſe of inſolation, the warmth of dung, and of quick-lime.

The fires or heats of ſand, file-duſt, and of aſhes, are uſed when the veſſel, containing the matter to be heated, can be placed in them, and gradually warmed.

The *reverberatory* fire is made in a furnace covered with a dome, to the end that the flame or heat, which always tends upwards, may reverberate upon the veſſel, which is to be placed on two iron bars.

What is properly called a *naked fire*, or putting a veſſel into a furnace of bare fire, is, when nothing is ſet between, ſo that the diſtilling veſſel touches the fire, and immediately receives the heat.

The fire for *fuſion* is, by putting hot coals round a crucible, or another veſſel that contains the matter to be put into fuſion.

The *lamp* is made uſe of, when the matter contained in the veſſel is warmed by that heat only, and which muſt be always equal. It is alſo uſed to heat the necks of ſome veſſels, ſo as they may be hermetically ſealed. The lamp or candle is likewiſe wife employed to heat a fmall matrafs or back of any glafs-head, where one would have it broke by the application of a cold wet rag immediately to that part.

The oil employed for lamps muft be very clear and fit to burn; for if it be foul, it will frequently clog the match, fo as to damp the light and heat. To prevent which inconveniency, the oil may be purified and prepared in the manner following Take fix pound of oil, mix it with a pound of vitriol dried to a whitenefs and powdered; let the mixture boil upon a fmall fire, to the end the vitriol may abforb or dry up the watry humidity of the oil: the vitriol will remain undiffolved, and the oil may be poured off for ufe.

The match, moft commodious for a lamp, ought to be of the *alumen plumofum*; becaufe it will not confume in the fire; but it is inconvenient, upon its aptnefs to go out, when the operation is interrupted in the time of kindling the fame; the beft match is therefore of cotton.

The *balneum mariae* is, when the alembick, which contains the matter to be heated, is placed in a veffel filled with water, under which fire is put, to the end the heated water may alfo heat the matter in the alembick.

The *balneum vaporis* is made when a veffel, which contains the matter, is heated by the vapour of hot water.

The fire of fuppreffion is made, when to diftil *per defcenfum*, fire is put above the matter, fo that the humidity which is forced thence by the heat is conftrained to fubfide in the bottom of the veffel.

Infolation is, by expofing to the rays of the fun any matter to be put into fermentation, or to be digefted.

The *dung-heat*, alfo called the horfe's belly, is, when a veffel containing fome matter to be digefted or diftilled, is placed in a great heap of hot dung.

The heat of quick-lime moiftened or wetted, may ferve in fome diftillations; for in a mixture with *fal ammoniac*, it will occafion a fubtle fpirit to diftil from thence without any other fire.

To make a fire of the firft degree, two or three coals lighted will fuffice to raife a moft gentle heat. For a fire of the fecond degree, three or four coals will ferve, to give fuch a heat as is able fenfibly to warm a veffel, but fo as a hand may be able to bear it fome time. For a fire of the third degree, muft be a good coal fire. For the fourth degree, ufe coals and wood together, fo as to excite a violent heat.

The fires, or heats of fand, file-duft, and of afhes, have ordinarily their degrees from the firft to the third; but the file-duft yields more heat than the other, becaufe it more eafily receives the heat, and grows red hot. The afh heat is moft gentle becaufe they retain lefs heat than the other fubftances.

The *reverberatory* fire has its degrees from the firft to the fourth; but is ordinarily raifed to the greateft violence.

The fire for *fufion* is always violent without degree, becaufe it ferves only for calcinations, and meltings, where only veffels of earth are ufed, and which eafily refift the greateft fires.

It is impoffible to make a veffel receive different degrees of heat from a lighted lamp, by putting it more or lefs near; but when the veffel is once heated, it will be continued always equal, becaufe the match of the lamp burns equally alike in the fame furnace where it is placed.

The *balneum mariae* and *vaporis*, have alfo their degrees; for according as the water is more or lefs warmed, the diftillation is more or lefs forwarded. The heat therefore of the *mariae* or *vaporis* may be faid to be in the firft degree when it is but lukewarm, which they muft neceffarily be in to digeft any matter committed to their influence. The heat of the fecond degree is, when the water or vapour is too hot for one's hand, which they muft be in order but to a foft diftillation. The heat of the third degree is, when the water boils, in order to haften the diftillation.

The fire of fuppreffion has its degrees; hot afhes are only fometimes ufed to excite a gentle heat: and this is the firft degree; at others they are mixed with a few embers, and that is the fecond degree; and fometimes with light coals, and that is the third degree.

Infolation hath alfo its degree, according to the force of the fun to which the matter is expofed. The beft time for this is in *July* or *Auguft*; becaufe then the fun has the moft vigour.

The dung-heat has its degrees, according to the bignefs of the heap, and according to the place where the fame is; for a greater heap will yield a greater heat than a fmall one; and if it be in a ftable, or any other hot and covered place, it will be the warmer, and will confequently be more effectual for digeftion or diftillation, than any other that is expofed to the air.

The heat of quick-lime hath alfo its degrees as we order it to be greater or lefs: it is more or lefs expofed to the air in powder to make it weaker: but if we would have all its heat, it muft be ufed all quick.

The fire is often raifed to fo high a degree as will melt glafs retorts in a reverberatory furnace; wherefore it will be convenient to coat them over with fuch a lute, as, when dry, is able to preferve and contain the matter that is put into them to be diftilled.

diſtilled. This lute may be made after the manner which follows.

Take ſand, the droſs of iron, potters earth in powder, of each five pounds, horſe dung cut ſmall a pound, glaſs beaten into powder, and ſea-ſalt, of each four ounces; mix them all, and with a ſufficient quantity of water make a paſte or lute, with which you muſt coat the retort all round to half its neck, and ſo ſet it a drying. This ſame lute will ſerve to ſtop cloſe the junctures of the retort with the recipient; but becauſe when it dries, it grows exceeding hard, and it proves difficult to unlute it, it is needful to wet it with wet clothes, when you would take the retort aſunder from the receiver.

The *lute*, ſays *Lemery*, that I commonly uſe for ſuch occaſions, is compounded only of two parts of ſand, and one of clay, tempered together with water.

If you would have a lute to ſeparate eaſily when the operation is done, you muſt temper fine and well powdered aſhes in water, and make a paſte of it: but this lute is much more porous than the former, and it may ſerve as often as you pleaſe, only by tempering it over again with water.

As for the conjunction of lembicks, ordinary glue upon paper will ſerve the turn: but when ſomething very ſpirituous is diſtilled, ſuch as the ſpirit of wine, uſe a wet bladder, which carries a glue along with it, that ſticks very well. But if the bladder happens to be eaten or corroded by the ſpirits, have recourſe to the following glue.

Take flower, and lime ſlackt, of each an ounce, potters earth in powder half an ounce, mix them, and make a moiſt paſte with a ſufficient quantity of the whites of eggs well beaten before hand with a little water. This paſte may likewiſe ſerve to ſtop the cracks that happen in glaſs veſſels: there muſt be three lays of the paſte bound on with paper.

To ſeal hermetically, is to ſtop the mouth or neck of a glaſs veſſel with a pair of pincers heated red hot. To do this, the neck is heated by little and little with burning coals, and the fire is encreaſed and continued, until the glaſs is ready to melt. This way of ſealing a veſſel is uſed, when you have put ſome matter within it that is eaſy to be exalted, and you have a mind to make it circulate.

The *furnace* which is moſt in uſe among *Chymiſts* is that which is called the *Reverberatory*; it muſt be large enough to hold a great retort, for the diſtillation of acid ſpirits, and other things. This *furnace* muſt be fixed, and made of brick, joined together with a *lute* compounded of one part of potters earth, ſo much horſe-dung, and twice as much ſand, the whole kneaded together in water; let it be two bricks breadth, that the *furnace* being the thicker, the heat may be retained the longer: let the aſh-hole be a foot high, and the door contrived, if poſſible, on the ſide that the air comes, that when you have a mind to open it, the fire may be lighted or encreaſed the more eaſily: the fire-room need not be quite ſo high; you muſt lay acroſs it two iron bars of the bigneſs of your thumb, which will ſerve you to ſet your retort upon; and the *furnace* muſt be ſtill raiſed near about a foot higher, to cover the retort; fit to it a dome, or cover, that may have a hole in the middle with its ſtopple, and a ſmall chimney a foot high, for to place upon this hole, when the ſtopple is taken out, and when you would raiſe a great heat; for the flame preſerving itſelf by means of this little chimney, it reverberates the more ſtrongly upon the retort. This cover may be made of the ſame paſte, that I ſhall preſently deſcribe, ſpeaking of *portable furnaces*.

It will be neceſſary to have ſeveral *furnaces* of this ſame faſhion; but they muſt be of different ſizes, to work conveniently, according to the bigneſs of the veſſel you would place in it. For that the fire may act more vehemently upon the retort, there muſt be left but only the ſpace of a finger's breadth all round between the *furnace* and the retort. Theſe *furnaces* may alſo ſerve for diſtilling by the refrigeratory, in the ſea bath, the vaporous and the ſand bath; for you may place the copper body upon the iron bars, when you would diſtil by the refrigeratory. It is eaſy to do the ſame with the *balneum mariæ*. As for the ſand bath, lay an iron or earthen pan on the bars, and put ſand enough into it to cover the bottom and ſides of the veſſel you deſire to heat.

There ought alſo to be a *furnace* for many retorts, which one and the ſame fire may act on at once: this *furnace* muſt be made as the former, but only ſo much larger, that the retorts may be placed conveniently upon it, and that the fire, in the fire-room, which hath only one door, may act equally upon all the veſſels.

If you would make this *furnace* large enough to contain ſix or twelve retorts, it muſt be built longways, and the door muſt be at one of the ends. I have obſerved, that in theſe great *furnaces* there is no need of an iron grate or aſh-room, in order to diſtillations, becauſe they generally put in much wood, which burns ſufficiently to heat the retorts, if at the other end there be a hole towards the dome, big enough for one's fiſt, to let in the air to the fire, or to let out the ſmoke of the wood. A *furnace* without a grate waſtes leſs wood and charcoal than that which has one; ſo that by this means there is much leſs expence, eſpecially in diſtillations which continue three or four days.

 The

The fire-place muſt be large, and above it there ought to be placed ſtrong bars of iron for ſupporting the retorts, both on the one ſide and the other.

If the *furnace* be made for twelve retorts, it will require ſix bars of iron acroſs, but three will ſerve, if it be only for ſix. The hole or paſſage to the fire place muſt have a door of iron made proper to ſhut and open, as there is occaſion, for managing the fire. It is convenient alſo to make a border or ledge about the *furnace*, on which the receivers may be ſet, as you may ſee in the figure. The ordinary retorts are not ſo proper for this *furnace*. The receivers muſt be made ſo, that they may not take up too much room.

The dome of this *furnace* muſt be made of the ſame matter with the others, and divided into two or three pieces which may join eaſily: for if they be too great, they will be in hazard of breaking: but I have found it moſt convenient to make a particular dome of tiles at every diſtillation, which I place over the retorts, and plaiſter with a *lute* made of common aſhes, ſifted and moiſtened with water, which *lute* may be kept, after the diſtillation, to ſerve at another time, by diluting or tempering it with new water.

As for *fuſions*, you muſt build a *furnace* of the ſame matter and form as thoſe ſpoken of before; only you muſt forbear laying the two iron bars in it, that you did in the others, for ſupport of the veſſel.

Moveable furnaces are made of a paſte that conſiſts of three parts of broken pots in powder, and two parts of clay tempered together with water. Their ſtructure is juſt like that of the *reverberatory furnace*. You may alſo leave holes through which the iron bars may paſs, which ſupport the retort, that they may be eaſily taken out, when you have a mind to uſe this *furnace* for *fuſions*. A *furnace* of this form, whether fixt or moveable, may be called *polychreſt*, (or general) becauſe ſuch a one may be uſed for all ſorts of operations.

It is likewiſe convenient for *fuſions*, to have a moveable *furnace* of the ſame matter as the others; it muſt be round, and may be ſet upon a ſtool: it is to have only one grate, and ſix regiſters, or holes on the ſides, to let in the air to the fire. The dome may be made of the ſame matter, for to cover it, and a ſmall earthen chimney for to place upon the hole of the dome, that the fire may keep the ſtronger.

You muſt be ſure to put ſand, or broken pots, or ſuch like things, into the paſte that you uſe for the building *furnaces*, either fixt or moveable, to hinder them from cracks, when they come to dry; for theſe matters rendering the clay more porous, the wet breathes out much more eaſily.

A ſmall iron *furnace* with its iron pot, and a cover to it, is convenient for performing many operations; this pot may ſerve for a *balneum mariæ*, and for a vaporous bath, when there is no other. It may be likewiſe uſed to diſtil by an *alembick* in a bath of ſand, aſhes, or of filings of iron.

A great iron *furnace* ſhould likewiſe be had, whereon to place a copper *balneum mariæ*, for to diſtil with four bodies at once. In the middle of this bath there ſhould be a pipe raiſed, the top of which muſt be made like a funnel, into which you are to pour hot water, in place of that which conſumes away in vapour.

It is neceſſary to have a common iron *furnace* with three feet for warming and boiling many things upon occaſion; it ought to be plaiſtered with a *lute*, and ſome pieces of brick or tile, to make the heat more durable.

It is convenient to have a ſmall *furnace* of tin for many operations, to be managed with a lamp; *viz* digeſtions, where the fire ought always to be equal. This *furnace* muſt be round, about two foot high, and one foot diameter; and it muſt have a hearth, or bottom, where the lamp is to be placed. This hearth is to be a foot and half high, and pierced with five or ſix holes, at ſmall diſtances from one another, to give air to the lamp, and continue its burning; the whole muſt contain a ſort of baſon, a little more than half a foot high, and flat at bottom; which is to hold the ſand, and the veſſel that ſuſtains the matter to be digeſted; and it is to be covered with a dome of the ſame metal, a foot and half high. The lamp muſt have three holes, through which three cotton matches are to be put, and theſe ſoaked and ſupplied by the oil in the lamp. The lamp muſt be of ſufficient length, to be taken from time to time from the hearth, and to re-kindle the matches in caſe they go out, and alſo to clean away the ſoot that will gather from them, and damp their heat.

The Vessels (ſee the copper plate) and other *utenſils* neceſſary in this work, are,

Alembicks, *retorts*, *pelicans*, *ſerpentines*, *recipients*, or *receivers*, *matraſſes*, *crucibles*, *moulds* of ſeveral ſorts, *lingotierres*, *bells*, *mortars*, and *funnels* of glaſs, &c.

Alembick, from the *Arabick* particle *al*, and the *Greek* ἀμβιξ, is a *chymical* veſſel conſiſting of a matraſs, fitted with a roundiſh head, terminating in a ſloping tube, for the condenſed vapours to paſs through in the diſtillation. *Alembick* is properly underſtood of the whole inſtrument of diſtillation, with all its *apparatus*; but in the proper ſenſe of the

the word, it is only a part thereof, *viz.* a veſſel, uſually of copper, whereto a concave, globular, [illegible] head is cloſely luted, ſo as to ſtop the riſing vapours, and direct them into its *roſtrum*, or beak. The heat of the fire raiſing the volatile parts of the ſubject expoſed in the bottom of the veſſel, they are received into its head, where they are condenſed, either by the coldneſs of the ambient air, or by water externally applied; and becomes a liquor, which runs out at the beak into another veſſel, called the *recipient.* The head, or capital, of the *alembick*, is ſometimes incompaſſed with a veſſel full of cold water, by way of a refrigeratory; though this intention is now more commonly anſwered by a *ſerpentine.*

There are divers kinds of *alembicks*: an *open alembick*, where the head and cucurbite are two ſeparate parts; a *blind alembick*, or blind head, where the capital is ſealed hermetically upon the *cucurbite*, which *cucurbite* is an earthen or glaſs veſſel, of the figure of a gourd, or a pear, wherein are put the matters to be diſtilled. It is alſo, ſometimes made of tin, and ſometimes of braſs tinned.

Retort, is a kind of crooked matraſs, or a round bellied veſſel, either of earth, or glaſs, with a ſlender crooked beak, or noſe, to which the *recipient* is to be faſtened. When the *retort* is of glaſs, it is uſually lined with a *lute* of paſte an inch thick, to enable it to bear the fire the better. The *retort* ſerves to draw ſpirits and oils from woods, gums, minerals, earths, and other matters which require a ſtrong fire.

The *retort* is a kind of *compendium*, or improvement of the *cucurbite* and *bolthead*, anſwering all the purpoſes of both, without the aſſiſtance of a capital, or head, which the other frequently requires.

Pellican, is a kind of double veſſel, ordinarily of glaſs, uſed in diſtilling liquors by *circulation.*

Serpentine, or *worm*, is a pipe of copper, or pewter, twiſted into a ſpiral, and aſcending from the bottom of the *alembick* to the capital, and ſerving as a *refrigeratory* in the diſtillation of liquors.

Recipient, or *receiver*, is an appendage of an *alembick*, retort, &c. being a veſſel luted to the beak thereof, to receive the liquor raiſed in diſtillation, &c.

Matrass, is a glaſs veſſel uſed in diſtillation, and other operations. The *matraſs* is made in form of a bottle, ſomewhat bellied in the middle, with a long narrow neck. It is luted with earth, when it is to be placed on a very hot fire; when it is required it ſhould be ſtopped very cloſe, we ſeal it hermetically.

Crucible, from the *French*, *creuſet*, which ſignifies the ſame, is a little veſſel, ordinarily of earth, ſometimes iron, without any handle; wherein *Chymiſts*, coiners, goldſmiths, glaziers, and other artificers uſe to melt and calcine gold, ſilver, or other metals, whereon they work. Earthen *crucibles* are made of potters clay, with ſtone potſherds pounded and ſifted. They are of various ſizes, but generally of the ſame form, which reſembles that of an inverted cone, or pyramid. Iron *crucibles* are in form of little buckets, without handles, made of iron well forged and hammered. The beſt, and ſtrongeſt earthen *crucibles*, are thoſe made in *Germany.*

Coppel, *copel*, or *coupelle*, is a veſſel uſed to try, and purify metals. The *coppel of may*, is a little flat veſſel, made of vine aſhes and bones of ſheep's feet calcined, and lixiviated, to ſeparate the ſalts, which would otherwiſe make it crackle. At the bottom of the veſſel is a little cavity filled with a kind of white varniſh, compoſed of hartſhorn, or pike-bones, calcined, and diluted in water. The uſe of this liquor is, that the gold or ſilver to be eſſayed may be more conveniently lodged, and that the button of the eſſay may be ſeparated the more eaſily.

Lingotierre, or *ingotierre*, is a mould, or cavity, wherein we caſt our melted metals, or *regulus* of antimony.

Of Minerals.

Being thus furniſhed with neceſſaries for performing any experiment, let us begin with minerals. And,

Firſt, let us begin with *gold*, that chief of metals. *Gold* cannot be diſſolved radically, ſo as to ſeparate from it ſalt and ſulphur. But though it receives no change for health; yet the preparations made from *gold* with *ſpirits* are highly valued; for it is theſe *ſpirits* that give certain determinations to *gold* according to their nature, and makes it operate, as it is frequently known to do. For example,

The *aurum fulminans*, is *gold* impregnated with ſome ſpirits, which diſperſe its particles with violence when put in the fire. The operation is made in the following manner.

Take what quantity you pleaſe of *gold* reduced into filings, put it into a vial, or matraſs, pour over it three or four times its weight of *aqua regalis*; place the matraſs over a very moderate ſand-heat, and leave it there 'till the *aqua regalis* has diſſolved as much *gold* as it can contain, which you'll know by the ebullitions being over; pour by inclination the liquor into a glaſs; and if any of the *gold* be left in the matraſs, have it diſſolved, as before, with ſome *aqua regalis*. You must mix your dissolutions, and afterwards pour over the mixture slowly, some volatile spirit of sal-ammoniac, or oil of tartar *per deliquium*. There will happen an effervescence with heat, and you'll see the *gold* precipitated at the bottom of the glass in a yellow powder. Leave it to settle a long while; and to lose none of the *gold*, pour over it as much common water; then having poured by inclination all the liquor, you'll wash your powder with warm water 'till it is grown insipid; after which it must be dried on a paper, at a very slow heat, because fire catches it easily, and the powder flies off with much noise. If you have employed a dram of *gold*, you'll extract four scruples of *gold fulminans*, very dry; some call it *chalk of gold*.

This preparation of *gold* is prescribed to provoke sweat, and expel the malignant humours by perspiration; it is administered in the small pox, from two to six grains, in lozenges, or in an electuary. It stops vomiting, and is likewise very proper to moderate the too violent action of mercury.

SILVER, the second in dignity among *metals*, is the finest, the purest, most ductile, and most precious of them, except *gold*. 'Tis called *Moon*, because of its colour, and the influences which astrologers imagine it receives from the moon.

Silver can be administered like gold, in maladies caused by having taken a too great quantity of mercury; for it amalgamates very well with it, and hinders its motion.

The *chymical* preparations of *silver*, which we shall exemplify, are called *crystals of silver*, or *vitriol of the moon*.

This operation is *silver* penetrated and reduced in form of salt, by the acid points of spirits of nitre; which to perform, we cause two ounces of *silver* of *coppel* to be dissolved in two or three times as much spirit of nitre, pouring this dissolution into a small *cucurbite* of glass, and causing a fourth part of the humidity to be evaporated at a very slow sand heat; and what remains being left to cool without moving it, crystals will be formed upon it, which must be separated from the humidity; and having been dried, they are to be kept in a vial very well corked. Then we'll have half of the liquor remaining evaporated, and crystallized, as before; which evaporations and crystallizations must be reiterated, till all the *silver* be extracted in crystals.

These crystals are used outwardly for causticks, and administered inwardly, from one grain to three, for the dropsy, in some waters appropriated to the distemper. It purges the serosities of the abdomen.

Another *chymical* preparation of *silver*, is, the *lapis infernalis*, or the perpetual caustick, which is *silver*, rendered caustick by the salts of spirit of nitre, in the following manner:

We'll take as [illegible] please of refined *silver*, which we'll put to be dissolved in a vial with twice or three times as much of spirit of nitre; and put afterwards our vial, thus filled, to a sand heat, to have two thirds of the humidity evaporated, throwing what remains into a good *German* crucible, and a pretty big one, because of the embullitions which will happen. This crucible must be put into a small fire, and left there till the matter being much rarefied, falls down to the bottom of the crucible; then the fire must be increased, and the matter will become like oil; at which time it must be thrown into a *lingotierre*. or mould, where it will coagulate. This *lapis infernalis* is to be kept in a vial well corked, and will be a perpetual caustick, provided it is not left exposed to the air. If we have employed an ounce of *silver*, we shall have an ounce and five drachms of *lapis infernalis*.

The next metal in order and dignity is *Tin*; which, not being of a malleable nature, cannot be reduced into a powder after the usual ways of powdering. Therefore I'll give you a method how to do it easily enough.

Melt in a crucible what quantity of *tin* you think fit, and cast it into a round wooden box, that has been rubbed within on all sides with a piece of chalk, enough to whiten it, cover this box, and presently shake it about, until your *tin* is become cold, and so you'll find it converted into a gray powder.

Lead may be *pulverized* after the same manner. The wooden box must be round, because that figure is the most proper to shake a thing in; and the clefts of the box must be joined together as close as may be; and but little of the *tin* must be put into the box at a time, that the parts may be the better able to separate and fall into a powder, by means of the motion or agitation. Indeed the thing may be done without rubbing the box with chalk, but by this means the melted *tin* is hindered from burning the box, as it otherwise would.

LEAD, called also *Saturn*, is a coarse, heavy, impure *metal*, of all others the softest and most fusible, when purified.

Lead contains a little mercury, some sulphur, and a great deal of bituminous earth.

There are five *chymical* preparations to be made of *lead*, *viz.* calcination of *lead*, salt of *saturn*, magisterium of *saturn*, balsam or oil of *saturn*, and distillation of the salt of *saturn*.

We'll begin by the *calcination* of *lead*. For the *calcination of lead*, we must have it melted in an earthen pan, which is not glazed, and is not to be stirred with a spatula, 'till it be reduced into powder.

der. If we increase the fire, and calcine the matter for an hour or two longer, the *lead* will be more open, and more proper to be penetrated by acids If we calcine that powder at a reverberatory fire, during three or four hours, it will turn red, and it is what we call *minium*.

Lead is also prepared into *ceruse*, by exposing it to the vapour of vinegar, for then it changes into a white rust, which is gathered and formed into small cakes. To make what we call *plumbum ustum*, or burnt *lead*, we must melt two parts of *lead* in a pot, or in a crucible, and add to it one part of sulphur or brimstone, to which we must set fire, and when the brimstone is burnt, the matter is found in a black powder, which is the *plumbum ustum*.

All these preparations of *lead* are desiccative, they are mixed in unguents and plaisters, and unite themselves in boiling with oils and grease, and give them a consistence.

To make the *salt of saturn*, which is a *lead* penetrated, and reduced in form of salt by the acid of vinegar, we'll reduce the ceruse into powder, which we'll put into a large glass or stone vessel; we'll pour upon it distilled vinegar to the heighth of four fingers, there will happen an effervescence of a sensible heat. The whole is to be put in digestion at a sand-heat for three or four days, stirring the matter from time to time, then leaving it to settle, and pouring out the liquor afterwards by inclination; which done, new distilled vinegar must be poured on the ceruse left in the vessel, proceeding as before, continuing to pour on distilled vinegar, and to pour out the liquor by inclination, 'till very near half the matter be dissolved. Then we'll mix all our impregnations together, and having poured them into a stone or glass vessel, we'll have evaporated, at a very slow sand heat, about two thirds of the humidity, or 'till a small pellicle be formed over it; then we'll take the vessel softly off the fire, and leave it to cool without stirring it: there will be formed crystals upon it, which we must take off, and cause the liquor to be evaporated as before, and put it to cool, continuing the evaporations and crystallisations 'till we have extracted all our salt, which must be dried in the sun, and kept in a glass vessel. If we desire to have our salt whiter, we'll have it melted in an equal quantity of distilled vinegar and common water, then filtrated and crystallised as before.

Salt of saturn is commonly employed in pomatums for ringworms and inflammations; we also use the impregnation of *Saturn*, made with distilled vinegar for all cautaneous distempers; when mixed with a great deal of water, it makes a white liquor, called *lac virginale*.

Salt of saturn taken inwardly is esteemed very good for the squinancy, to stop the immoderate flux of menses, of piles, and the dysenteria. The dose is from two to forty grains in plantain-water, or mixed in gargarisms.

Magisterium of saturn, is *lead* dissolved and precipitated in the following manner: we must dissolve two or three ounces of *salt of saturn*, purified as above, in a sufficient quantity of water and distilled vinegar; we'll filtrate the dissolution, and drop upon it oil of tartar *per deliquium*, which forms at first a sort of milk, then a *coagulum*, which precipitates in a white powder to the bottom of the vessel; the whole must be mixed again together, and poured into a funnel lined with grey paper: the liquor will run thro' clear as water, and the powder remain, which is to be washed several times, by pouring water upon it, to carry off the impression of the vinegar; afterwards it must be dried, and we shall have a very white *magisterium*, employed for beautifying the face; it is also mixed in *pomatum* for ringworms.

Balsam, or *oil of saturn*, is a dissolution of the salt of *saturn* in oil of turpentine; done in this manner: eight ounces of salt of *saturn*, in powder, is put in a matrass, and spirit of turpentine pour'd upon it, that it may swim over to the height of four fingers; the matrass must be placed at a slow fire of sand, in digestion during a whole day; then we shall have a red tincture: we'll pour out the liquor by inclination, and pour more spirit of turpentine on the matter left in the matrass; we'll leave it in digestion, as before, pouring out, likewise, by inclination, the liquor, which will have some colour: then we'll put our dissolutions into a glass retort, which we'll place at a sand-heat, and having adapted a recipient to it, we'll distil, with a moderate fire, very near two thirds of the liquor, which will be the spirit of turpentine: we'll put out the fire, and the retort being cold, we'll pour what it contains into a vial, to keep it. This *balsam of saturn* is excellent to cleanse and cicatrize ulcers. The most malignant shankers are touched with it, because they resist putrefaction.

The *distillation of the salt of saturn*, is a separation of the substances contained in that salt; which ought to be effected thus: two thirds of a stone or glass retort must be filled with salt of *saturn*, which retort is to be placed in a furnace, and a pretty large recipient adapted to it, luting exactly the joints, and giving under the retort a slow fire at first, then increasing it by degrees, and towards the end pushing it with that violence as to make the retort red-hot, then leaving the vessels to grow cold; after which, they must be unluted: what

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is contained in the recipient, muſt be poured into an alembick of glaſs, and rectified by diſtilling at a ſlow ſand-heat, very near half the liquor; which done, we ſhall have a ſpirit of *ſaturn*, as inflammable as brandy, and of an acerb taſte.

This ſpirit is very good to reſiſt the putrefaction of the humours. It is given to hypochondriack melancholicks, from 8 to 16 drops, in broth, or other liquors appropriated to the diſtemper; and it muſt be uſed 15 mornings ſucceſſively.

The other half of the liquor left in the alembick, is improperly called *oil of ſaturn*; it is good to cleanſe the eyes of horſes.

Having done operating upon *lead*, we'll paſs to Copper, which is a hard, dry, heavy, and of all metals the moſt ductile and malleable, after gold and ſilver, and abounds much in vitriol and ſulphur.

Aſtrologers call it *Venus*; and by the analyſis it appears compoſed of a ſulphur ill digeſted, a yellowiſh mercury, and a red ſalt.

The *calcination of copper* is a ſeparation made of its muſt volatile oily particles, by means of common ſulphur and fire, to render it more compact; which to perform, muſt be ſtratified in a large crucible, *laminæ* of *copper*, with brimſtone in powder; the crucible is to be covered with a tile, or ſome thing elſe which has a hole in the middle for the evacuation of the ſmoak. The crucible is placed in a wind furnace, and a great fire made round it, till no more ſmoak appears; when the *laminæ* muſt be taken out quite hot, and ſeparated. This is the *æs uſtum*, or *burnt copper*, employed in external remedies as a deterſive. It may be reduced into powder in a mortar.

Iron, is a hard, fuſible, and malleable metal, very porous, compoſed of vitriolick ſalt and ſulphur, very ill mixed and digeſted together; therefore the diſſolution of its parts is eaſily made. *Iron* is alſo called *Mars*, contains a vitriolick acid, it is nevertheleſs an alkali; becauſe it ferments with the acids, which will not at all appear ſurprizing, when we conſider that there is a great deal more of earth, than ſalt, in that metal; and that this earth keeping the ſalt embarraſſed, it has enough pores left to receive the points of the acids poured over it, and to do the office of an alkali.

The *Mars* is almoſt always aſtringent through the abdomen, becauſe of its terreſtrial particles; and aperitive by urine, not only becauſe of its ſalt, which is penetrating; but, likewiſe, becauſe the abdomen contracting itſelf, the humidities are filtrated by urine.

There are eleven *chymical* preparations made of *iron*, *viz.* three ſorts of *aperitive crocus martis*, *aſtringent crocus martis*, two ſorts of *ſalt*, or *vitriol of mars*, *ſpirit of mars*, *tincture of mars with tartar*, *extract of mars aperitive*, *extract of mars aſtringent*, and *diaphoretick of mars*. Some of which follow.

The *aperitive crocus martis*, is but the ruſt of *iron*, made by *laminæ* of *iron*; which waſhed are expoſed to the dew for a conſiderable time, where they will grow ruſty. This *crocus* is the beſt of all the preparations of *iron* called *crocus*. It is excellent for the obſtructions of the liver, the pancreas, and the meſentery. It is uſed with ſucceſs for the retention of the *menſes*, the dropſy, and other maladies proceeding from opilations. The doſe is from ten grains to two ſcruples, in lozenges, or pills.

We'll prepare next the *ſalt*, or *vitriol of mars*, which is *iron* penetrated, and reduced in the form of ſalt, by an acid liquor, thus: we'll take an *iron* pan, very clean, and pour into it an equal weight of ſpirit of wine, and oil of vitriol extracted from *Engliſh* vitriol; we'll expoſe the pan, for ſome time, to the ſun, and leave it afterwards in a dark place, without ſtirring it; when we ſhall ſee the liquor incorporating itſelf with the *mars*, and forming a ſalt, which muſt be left to dry, or harden: then it muſt be ſeparated from the pan, and kept in a bottle well corked.

This *ſalt* is an excellent remedy for all maladies proceeding from obſtructions The doſe is from ſix grains to a ſcruple, in broth, or ſome other liquor appropriated to the diſtemper.

The preparations of *Quickſilver* are worthy of particular attention.

We won't diſpute whether this be a *metal* or *ſemimetal*: our buſineſs is to make it uſeful to the human body. Which may be done beſt by chymical preparations.

It is called *mercury* in the ſhops, which have fourteen preparations of it, *viz.* the *Æthiops mineral*, the *black mercurial panacea*, the *corroſive ſublimate*, the *ſublimate mercury*, called *aquila alba*, the *mercurial panacea*, the *white precipitate*, another *white precipitate*, the *red precipitate*, the *red precipitate without addition*, the *green precipitate*, the *turbith mineral*, or *yellow precipitate*, the *oil* or *liquor of mercury*, another *oil of mercury*, and another *precipitate of mercury*.

The *Æthiops mineral*, is a mixture of *mercury* and ſulphur, made by putting in fuſion, on the fire, what quantity we pleaſe of ſulphur in an earthen pot, without glazing, and which will bear the fire, and mixing with it, by degrees, with an iron ſpatula, an equal quantity of *quickſilver*; we'll ſet fire to the mixture, and the ſulphur being burnt, it will remain a black maſs, friable and ponderous, which muſt be left to cool, and afterwards ſeparated from the pot, and kept.

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This preparation is good for the aſthma, epilepſy, rheumatiſm, venereal diſeaſe, and for ſcrophula's, and the king's evil. It operates chiefly by perſpiration, and ſeldom by ſalivation. The doſe is from eight grains to two ſcruples, in a bolus.

The *black mercurial panacea*, which is our ſecond operation on *mercury*, is *mercury* penetrated, and impregnated with ſome portions of ſulphur and *ſal ammoniac*, thus: we put in fuſion in an earthen pot without glazing, four ounces of ſulphur, or brimſtone; we take it off the fire, and mix with it, by degrees, three ounces of *ſal ammoniac*, in powder; it then raiſes a ſmoak, proceeding from the phlegm of the *ſal ammoniac*; we ſeparate the matter from the pot before it is quite hardened, and find twelve ounces and ſix drachms of it: which, when cold, we pulverize, and put into a matraſs, to fill but one third of it; we place the matraſs in a ſand-heat, and give but a ſmall fire, at firſt, to heat the veſſel, then we increaſe it gradually to the third degree, and continue it during five hours, or till no more vapours come out through the neck of the matraſs; then we leave the veſſel to cool, and break it afterwards: we find at the top ſome white flowers, which we throw away as uſeleſs, and at the bottom a matter diſpoſed by beds of different colours; the firſt yellow, the ſecond white, the third grey, and the fourth black. We pound this matter, and put it into a matraſs, puſhing it, as before, by a graduated fire, during ſeven hours: then leaving it to cool, and breaking the veſſel, we find the matter diſpoſed by beds of different colours, as in the firſt calcination; which we reduce again into powder, and put into a new matraſs, puſhing it, for the third time, as before, by a graduated fire, during ſeven hours; then breaking the matraſs, we take out the matter, reduce it again into powder, put it in another matraſs and puſh it, for the fourth time, by a graduated fire, as before, but increaſing it towards the end to make the bottom of the veſſel red-hot; then we break it, and find the matter ſeparated into two beds of different colours; that a-top is yellow and light; and that underneath is commonly black; ſometimes, alſo, purple, and ponderous. We take this laſt portion, which is the *black panacea*.

This preparation is ſudorifick, proper for the rheumatiſm, venereal diſeaſe, aſthma, epilepſy, *ſcrophulæ*, worms, and to raiſe the obſtructions. The doſe is from twelve grains to half a drachm in a bolus. The yellow matter a-top is a mixture of ſulphur and *ſal ammoniac* impregnated with ſome portion of *mercury*. It muſt be reduced into powder, and kept. It may be employed externally for the itch, mixing two drachms of it in an ounce of *pomatum*.

Our third preparation, is that of *corroſive ſublimate*, which is *mercury* penetrated by acids, and exalted by the fire, to the top of the veſſel. The *ſublimate mercury* is prepared by putting ſixteen ounces of *mercury* into a matraſs, and pouring upon it eighteen ounces of ſpirit of nitre. The matraſs is placed at a ſmall ſand-heat, and left there till the diſſolution be made; which diſſolution is poured into a glaſs veſſel, or a ſtone pan, to evaporate ſlowly, at a ſand heat, all the humidity, till it remains but a white maſs: which muſt be pounded in a glaſs mortar, and mixed with ſixteen ounces of vitriol calcined white, and as much *decrepitated ſalt*: this mixture is put into a matraſs, two thirds whereof are left empty, its neck having been cut in the middle of its height: this matraſs is placed on the ſand, and the artiſt begins to give a ſmall fire, which he continues during three hours, and then increaſes it; when there will be formed a *ſublimate* at the top of the matraſs: the operation muſt be ended in ſeven or eight hours. The matraſs is left to cool, and then broke, the artiſt avoiding a light powder, which flies into the air when the matter is ſtirred. The red droſs left at the bottom of the veſſel, is thrown away as uſeleſs.

The *corroſive ſublimate* is a violent eſcharotick, and eats away proud fleſh. Half a drachm of it, diſſolved in a pound of lime water, turns it yellow, which is then called *phaged nick water*. It is uſed to waſh ulcers, and tetterous eruptions.

Mercurius dulcis, our fourth operation on *mercury*, is the corroſive ſublimate diveſted of its acid ſheath, in the following manner: ſix ounces of corroſive ſublimate are reduced into powder, in a glaſs or ſtone mortar, and twelve ounces of *quickſilver* mixed with it; the mixture is ſtirred with a wooden peſtle, till the *quickſilver* be imperceptible; that mixture, which will be grey, is put into ſeveral vials, or into a matraſs, two thirds whereof ought to be empty: the veſſel is put in the ſand, and a ſmall fire given to it, at firſt, which is increaſed afterwards to the third degree, and continued in that condition during five hours, to ſublimate, and ſweeten the matter; then the veſſels are left to cool, and afterwards broke, wherein are found three different ſorts of matter, *viz.* a ſmall quantity of a light earth at the bottom, which muſt be rejected as uſeleſs; another matter adhering to the neck of the vials, or of the matraſs, which may be kept to mix with unguents for the itch; and a white one in the middle, which muſt be gathered carefully, pounded, and put into vials to be ſublimated a ſecond and a third time, proceeding in theſe two laſt ſublimations as has been done in the firſt. The matter found in the middle, after the laſt ſublimation, will be very well dulcified.

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This *mercurius dulcis* purges gently by ſtool; it is uſed in all ſorts of venereal diſeaſes; it is diſobſtructive, and kills worms. The doſe is from ſix to thirty grains, in pills. If it be ſublimated twice more, it loſes its purgative virtue, and is more diſpoſed to work by perſpiration and ſalivation. If, on the contrary, it be ſublimated but twice, its purgative virtue will be greater.

The *mercurial panacea*, is a ſublimate of *mercury* dulcified by ſeveral ſublimations, and ſpirits of wine, thus: We'll take what quantity we pleaſe of the *ſublimate mercury* laſt mentioned, which having reduced into powder in a ſtone or glaſs mortar, we'll put into a matraſs, three parts whereof are to be left empty, and its neck cut at the middle of its height; which matraſs muſt be placed in a furnace, at a ſand-bath, and a ſmall fire made under it, during an hour, to heat ſlowly the matter; after which, the fire is to be increaſed to the third degree, and continued in that condition about five hours, during which time, the matter will ſublimate. The veſſel being left to cool, and afterwards broke, a ſmall quantity of red and light earth, found at the bottom, muſt be thrown away as uſeleſs, and all the *ſublimate* ſeparated from the glaſs reduced again into powder, and ſublimated as before; which ſublimations are to be repeated ſeven times more, changing the matraſs each time, and each time rejecting the red earth found at the bottom: this done, the *ſublimate* is to be reduced into an impalpable powder on the porphyry, and put into a glaſs cucurbite, pouring upon it alcoholized ſpirit of wine, to the height of ſix fingers breadth; then the cucurbite muſt be covered with its capital, and the matter left in infuſion during fifteen days, ſtirring it from time to time with a wooden ſpatula: at the end of the fifteen days, the cucurbite muſt be placed at the *balneum mariæ*, or *vaporous bath*, adapting a recipient to it: and having luted exactly the junctures with a wet bladder, all the ſpirits of wine muſt be diſtilled by a moderate fire, which accompliſhed, the veſſel is left to cool, and being unluted afterwards, we ſhall find our *panacea* at the bottom of the cucurbite, which if not dry enough, muſt be dried at a ſmall ſand heat, by ſtirring it with a wooden ſpatula in the ſame cucurbite, till it grows into powder, which muſt be kept in a glaſs veſſel.

This *panacea* is a very good remedy for all the venereal diſeaſes, inveterate rheumatiſms, obſtructions, ſcurvy, king's evil, itch, ſcald heads, worms, *aſcarides*, and old ulcers. The doſe is from ſix grains to two ſcruples, in a bolus, or pills.

The *white precipitate of mercury*, is a *mercury* diſſolved in ſpirit of nitre, and precipitated by ſalt into a white powder, in this manner: ſixteen ounces of crude *mercury* are diſſolved in a glaſs cucurbite with eighteen ounces of ſpirit of nitre: the diſſolution made, we'll pour upon it filtrated ſalt-water, made of ten ounces of ſea ſalt, melted in two pints of water, adding to the whole about an ounce of volatile ſpirit of ſal ammoniac: then there will be made a very *white precipitate*, which is to be left to ſettle, pouring out, afterwards, the water by inclination, and waſhing the *precipitate*, ſeveral times, with ſpring-water, and drying it in the ſun.

This *precipitate* is uſed to excite a ſalivation; it is ſomewhat vomitive. The doſe is from four to fifteen grains, in pills. It is alſo mixed in *pomatum* for cutaneous diſtempers, from half a drachm to a drachm, for an ounce of *pomatum*.

The other ſort of *white precipitate* is the *corroſive ſublimate*, diſſolved with ſal ammoniac melted in water, and precipitated by oil of tartar, thus: Four ounces of ſal ammoniac are melted in ſixteen ounces of water, the liquor is filtrated through a grey paper, and four ounces of *corroſive ſublimate*, in powder added to it which will melt ſoon; then oil of tartar *per deliquium* is poured gently on the diſſolution, whence an ebullition will enſue, and afterwards a *white precipitate*: the artiſt continues pouring the oil of tartar till he ſees that nothing more is precipitated, then pours a great quantity of water into the veſſel, and leaves the matter to ſettle, till the liquor grows clear; then he pours out the matter by inclination, waſhing ſeveral times its *precipitate*, and having it dried, afterwards, from the ſun, it commonly turns a little yellow. This *precipitate* has the ſame virtues as the other, and the doſe is the ſame.

The *red precipitate* is a *mercury* wrapped in ſpirit of nitre, and calcined by fire, in this manner: The artiſt takes eight ounces of crude *mercury*, which he cauſes to be diſſolved in eight or nine ounces of ſpirit of nitre. He pours the diſſolution into a vial, or matraſs, with a ſhort neck, which he places on the ſand and makes under it a moderate fire to evaporate the humidity till it remains nothing but a white maſs: then he puſhes ſlowly the fire to the third degree, and keeps it in that condition till the maſs is turned red, then takes it off the fire, and having left the veſſel to cool, he breaks it to take out the *precipitate*.

This *precipitate* is an excellent eſcarotick, it eats proud fleſh, it is uſed, mixed with burnt allum, Ægyptiack, and ſuppurative, to open the ulcers.

The *green precipitate* is a mixture of *quick-ſilver*, *copper*, and acid ſpirits, made in the following manner. We will put four ounces of *quick-ſilver* into a matraſs, and one ounce of *copper*, cut into ſmall pieces, into another. We will pour upon the quick-

quick-ſilver four ounces of ſpirit of nitre, or of good *aqua fortis*, and on *copper* one ounce and a half of the ſame diſſolvent: we will place our matraſſes on a ſand heat, and leave them there till the *metals* be diſſolved; we will mix our diſſolutions in a ſtone porringer, and cauſe the humidity to be evaporated at a ſand-heat, till they be reduced into a maſs: we will increaſe the fire under the porringer to calcine the maſs for about one hour and a half; we will put the fire out afterwards, and leave the maſs to cool; then we will take out the maſs, and reduce it into powder in a ſtone mortar; which done, we will pour upon it diſtilled vinegar to the heighth of ſix inches, or there abouts; we will ſtir the mixture very well together, and place the matraſs in digeſtion at a ſand-heat, where we will leave it twenty-four hours, ſtirring it from time to time: we will afterwards increaſe the fire to make the liquor boil for about an hour, or 'till the vinegar has took a green colour, inclining to blue, leaving it to cool, and afterwards pouring it out by inclination. We will pour other vinegar upon what remains in the matraſs, and proceed, as before, to extract the tincture, mixing our diſſolutions together, and having the humidity hereof evaporated, in a ſtone or glaſs veſſel, at a ſand heat, 'till the matter appears in the conſiſtence of a thick honey; then we will take it off the fire, it will harden in cooling. We will reduce it into powder and keep it.

The *green precipitate* is a ſpecifick for virulent gonorrhœa's; it is adminiſtered when they run, and to ſtop them after they have ran; it may be uſed in the pox for the phimoſis and ſhankers, given inwardly, and applied outwardly. The doſe is from two grains to ſix, in pills, or in a bolus; it purges upwards and downwards. There will remain in the matraſs a matter which has not been diſſolved by the vinegar, it reſembles much the *turbith mineralis*; it muſt be waſhed and dried, and can be uſed in pomatums for the itch, a drachm to an ounce of pomatum.

The *turbith mineralis*, or *yellow precipitate*, is *mercury* impregnated with the acid particles of the oil of vitriol: thus, the artiſt puts four ounces of *quick-ſilver* into a glaſs retort, and pours upon it ſix ounces of oil of vitriol; he places his retort on the ſand, and when the *mercury* is diſſolved, he makes a fire under it, and diſtils the humidity: then puſhes the fire towards the end to force out one part of the laſt ſpirits: he breaks afterwards his retort and reduces into powder, in a glaſs mortar, a white maſs he has found in the retort; then pours warm water upon it, which water changes the powder yellow, which he mundifies with ſeveral repeated lotions, and afterwards dries it in the ſun.

This *turbith mineralis* purges violently upwards and downwards; it is preſcribed in the venereal diſeaſes. The doſe is from two grains to ſix in pills.

The *oil* or *liquor of mercury* is prepared by putting into a ſtone-pan the lotions of the white maſs, of which the *turbith mineralis* has been made, and cauſing all the humidity to be evaporated, at a ſand-heat 'till a matter remains at the bottom in form of ſalt; then the pan is to be carried to the cave, where it muſt be left 'till almoſt all the matter be reſolved into a liquor, which is uſed to open the venereal ſhankers, and to eat the proud fleſh, by applying it upon them on pledgets.

There is another *oil of mercury*, which is but the corroſive ſublimate diſſolved in ſpirit of wine; thus: One ounce of corroſive ſublimate is reduced into a very ſubtile powder, and put into a matraſs; four ounces of very well rectified ſpirit of wine are poured over it, the matraſs well ſtopped, and the matter left to macerate, in the cold, during ſeven or eight hours, when the ſublimate will be diſſolved; but if ſomething was left at the bottom, the liquor muſt be poured out by inclination, and a ſmall quantity of other ſpirit of wine poured upon the matter left, leaving it to macerate as before, to perfect the diſſolution: theſe diſſolutions are mixed and kept in a bottle well corked.

This *oil of mercury* is ſofter than the firſt, and proper for the venereal ſhankers, eſpecially when we fear the gangrene; it may be uſed on pledgets, as the other.

There are three other ſorts of *precipitate of mercury* beſides thoſe heretofore-mentioned, which are nothing elſe but the corroſive ſublimate precipitated into powders of different colours. Thoſe three *precipitates* are prepared in the following manner.

Four or five ounces of corroſive ſublimate are ſtirred in a glaſs mortar, with eight or nine ounces of warm water, during one hour; then the liquor is left to ſettle, and afterwards poured out by inclination, filtrated, and divided into three parts, in three vials.

Then throwing into one of thoſe vials ſome drops of oil of tartar *per deliquium*, there will be made immediately a *red precipitate*. Pouring into another vial ſome volatile ſpirit of ſal-ammoniac, there will be made a *white precipitate*. And mixing in the laſt vial five or ſix ounces of lime-water, there will be made a yellow water, called *phagedenick*, or *ulcerary*, becauſe it is a deterſive, and proper to cure ulcers. If the water is left to ſettle, there will be made a *yellow precipitate*.

To take out thoſe three ſorts of *precipitates*, the water muſt be poured out by inclination; they muſt be waſhed, dried, and kept.

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The *red precipitate* is used like the other heretofore described, but it is not so strong, it is the true *red precipitate*, which is very much esteemed for the pox. The dose is four grains. The *white precipitate* has the same virtues as the other *white precipitate*. The *yellow precipitate* is employed in pomatums for the itch, mixing half a drachm, or a drachm of it with an ounce of pomatum.

Note, All the preparations of *mercury* heretofore-mentioned are but disguisements of that *metal*, made by acids or alkali spirits, which having ceased it in a different manner, make it produce different effects.

I shall conclude the preparations of mineral subjects with some operations in *antimony*, which assumes as many different forms, as *mercury*. We will begin with the STOMACHIC OF POTERIUS, or *poter*. This is a *martial regulus of antimony* fixed, and mixed with gold, thus: We reduce into powder four ounce of *martial regulus of antimony*, and twelve ounces of salt petre, which we mix exactly with half an ounce of fine gold; and having made a crucible red-hot, between coals, in a furnace, we throw into it a spoonful of our mixture; there happens a small detonation, which being over, we throw another spoonful, and continue thus till the whole mixture be in the crucible; which having left to calcine for about an hour, we throw it, afterwards, into a large quantity of warm water, and leave it there some hours to steep, for the dissolution of the salt-petre: we pour out the water by inclination, and having washed several times the powder left at the bottom, we put it to dry, then calcine it again in another crucible for the space of an hour, stirring it with an iron spatula; then the operation is ended.

This *antimonial* preparation is esteemed proper to strengthen the stomach and the heart, to repair a decayed constitution, to excite the perspiration of humours, to purify the blood, to resist venom, to stop hæmorrhages, for the palsy, and for maladies caused by *mercury*.—The dose is from 10 grains to 30.

GLASS OF ANTIMONY, is a *regulus of antimony* vitrified by a long fusion, in this manner: we calcine, at a slow fire, one pound of *antimony*, in powder, in an earthen pan without glazing, stirring continually the matter with an iron spatula, till it has done smoaking, and is changed into a grey powder, which powder must be put into a good crucible covered with a tile, and placed in a wind furnace, where we will make a very violent fire round the crucible, that the matter be put in fusion; about an hour afterwards, we will uncover the crucible, and introduce into it an iron rod, whereby we shall discover in taking it out, if the matter adhering to it be very diaphane; and if it be so, we will throw it upon a hot porphyry, where it will congeal, and we shall have a very fine *glass of antimony*, which we will leave to grow cold.

This *glass* is excellent in agues, but one of the most violent emeticks made of *antimony*; the emetick wine is a preparation of it: by having it steeped in white wine. It is given in substance from two grains to six.

The DIAPHORETIC ANTIMONY, is the sulphur of that mineral fixed by salt-petre, which hinders it from acting otherwise than by sweat.

To make this preparation, we pulverize, and mix exactly, one part of *antimony* with three parts of refined salt-petre; and having made a crucible red hot, between the coals, we throw into it a spoonful of our mixture: there happens a detonation, which being over, we throw in another spoonful, and continue thus till the whole mixture is in the crucible, leaving a very violent fire round it during two hours, that the matter may liquify, or be in a sort of fusion: then we throw that matter which is white into an earthen pan almost full of spring-water, and leave it to steep during ten or twelve hours, for the dissolution of the fixed salt-petre; afterwards we pour out the liquor by inclination, and wash the powder left at bottom five or six times, with warm water and dry it. This is what we call *diaphoretic antimony*, or *chalk of antimony*.

This *diaphoretic antimony* is supposed to resist venom, and consequently very good for malignant fevers, the pox, plague, and for all other contagious maladies: it is astringent. The dose is from six to thirty grains.

FLOWERS OF ANTIMONY, are the most volatile parts of *antimony* exalted by fire, thus: We place in a furnace a very good earthen pot without glazing which can bear fire, which has a hole in the middle of its height, with a cork to it; and adapt over it three other pots of the same earth, without bottoms to them, and on the superior pot a capital, with a small vial for a recipient: we lute exactly the joints, and take care, by means of some bricks and lutes, that the fire in the furnace does not transpire thro' some hole or other, but only heat the bottom of the inferior pot: then we give a graduate fire, that the pot may heat by degrees, and grow red-hot at last. When red-hot, we throw into it, thro' the hole, a small spoonful of *antimony*, in powder, and spread, at the same time, with a bowed iron spatula, the matter on the bottom of the pot: we take out the spatula, and stop the hole, that the flowers may ascend, and stick against the upper pots; we continue a great fire to keep always the pot red-hot, and when we ſo that nothing more ſublimates, we throw the ſame quantity of *antimony*, obſerving the ſame rules preſcribed before, and continue to throw thus into the pot, till we have flowers enough: then putting out the fire, when the veſſels are cold we unlute them, and find round the three ſuperior pots, and the capital, the flowers, which we gather, and keep in a vial.

Theſe *flowers of antimony* are a ſtrong emetick; they are given for the quartan ague, intermitting fevers, and even for the epilepſy. The doſe is from two grains to ſix, in lozenges, or broth.

Balsam of Sulphur is a diſſolution of the oily particles of *common ſulphur*, in oil of turpentine. The operation is conducted thus: An ounce and a half of *flowers of ſulphur* is put into a matraſs, and eight ounces of oil of turpentine poured upon it: the matraſs is placed on the ſand, and a ſmall fire of digeſtion given to it, during one hour, which fire is a little increaſed afterwards, and continued thus for half an hour longer, and then the oil takes a red colour; and when the veſſel is cold, the clear *balſam* is ſeparated from the *ſulphur*, which could not be diſſolved.

This *balſam* is an excellent remedy for the ulcers of the lungs, and of the breaſt, and for the aſthma. The doſe is from one drop to ſix in ſome liquor appropriated to the diſtemper. Applied outwardly it reſolves the hæmorrhoides or piles.

If the *balſam of ſulphur* be prepared with oil of anniſeed, inſtead of that of turpentine, it will be more agreeable, and not ſo acrimonious.

Under the head of Vegitables, the *Chymiſt* has a vaſt variety of ſubjects to exerciſe his ſkill, for the health and other uſes of life. The deſcription of this part of the creation has been already made in the treatiſe of *Botany*. What remains to be conſidered by the *Chymiſt*, is the analyſis of thoſe ſubjects, and by means of chymical operations, which I propoſe to exemplify by ſuch principles as are beſt known, and of moſt uſe in medicine.

Extract of Rhubarb, is a ſeparation of its pureſt part from the tereſtrial, made in the following manner: We bruiſe ſix or eight ounces of good *rhubarb*, which we put to ſteep warm, for twelve hours, in a ſufficient quantity of water of chicory, ſo that the water ſwims four fingers above the *rhubarb*; making, afterwards, the infuſion to boil, for about a minute; then we ſtrain the liquor through a flannel, pouring again the ſame quantity, as before, of water of chicory, on the *rhubarb*, and leaving it to ſteep for the ſame ſpace of time; after which, we ſtrain it through the ſame flannel; we mix our impregnations, or tinctures, and after we have left them to ſettle, we filtrate them, and cauſe the humidity to be evaporated at a ſlow ſand-heat, till the matter be reduced to the conſiſtence of thick honey. It is what we call *extract of rhubarb*, which we keep in a pot.

This *extract of rhubarb* purges gently, in binding and ſtrengthening; it is proper for the diarrhæa, pain in the ſtomach, and to excite the appetite. It is particularly eſteemed for the maladies of the liver. The doſe is from ten grains to two ſcruples.

The *chymical* preparation of Cinnamon is that of its *oil*, or *eſſence*, of its *æthereal water*, and its tincture is extracted thus: Four pounds of the beſt *cinnamon* are bruiſed, and put to ſteep in ſix quarts or twelve pounds of common water; the whole is left in digeſtion in an earthen veſſel, well corked, for nine or ten hours; and the infuſion poured afterwards into a larger copper alembick, to which is adapted a large recipient, and the joints thereof are exactly luted with wet bladders; then three or four pounds of the liquor are diſtilled at a great fire, and the alembick being unluted afterwards, the diſtilled water in the recipient is decanted into the alembick, and the oil found at the bottom of the recipient put into a vial, which muſt be very well corked; the liquor is diſtilled as before, and the oil found at the bottom of the recipient mixed with that in the vial: thoſe cohobations are reiterated till no more oil aſcends, then the fire is put out, and the water in the recipient rectified in the ſame manner we rectify the ſpirit of wine.

The *oil of cinnamon* is an excellent corroborative; it ſtrengthens the ſtomach, and helps nature in its evacuations; it is given to accelerate the birth to women in labour, and to promote the menſes; it alſo excites the ſeed.

The *ſpirituous water of cinnamon* has the ſame virtues. The doſe of the water is two or three drachms; and that of the oil from ſix to 15 drops.

The *tincture of cinnamon* is an exaltation of the moſt oily particles of *cinnamon* in ſpirit of wine, prepared in the following manner.

We put what quantity we pleaſe of bruiſed *cinnamon* into a matraſs, and pour upon it ſpirit of wine till it riſes a finger's breadth above the *cinnamon*. We ſtop well the matraſs, and put it, in digeſtion, in a dunghill, during four or five days: by that time the ſpirit of wine will have took a tincture of *cinnamon*; we ſeparate that tincture from the *cinnamon*, filtrate it, and keep it in a vial well corked.

This tincture is an excellent cardiack, it ſtrengthens the ſtomach, and rejoices all the vital parts: the doſe is leſs than that of *cinnamon water*.

Our next operations are to be on *Quinquina*, or *Quinaquinæ*, called alſo *China chinæ*, and *Kin kina*.

Quin-

QUINQUINA is a medicinal bark, brought from the *West Indies*, called also by way of eminence, the *bark*; and *Cortex Peruvianus*, the *Peruvian bark*, from the country whence it is brought; and popularly the *Jesuit's bark*, because at its first introduction it was chiefly sold and administered by the Jesuits.

The TINCTURE OF QUINQUINA, is an extraction of its most oleaginous and loose particles in spirit of wine, made in the following manner: we put into a matrass four ounces of good *quinquina*, coarsely pulverised, and when we have poured upon it enough spirit of wine to raise it four fingers breadth above the matter, we stop the matrass with another, to make of it a circulatory vessel, which we lute exactly, and place in dung to the vaporous bath for four days, shaking the vessel from time to time; the four days elapsed, we unlute the vessels, and filtrate the tincture, which is red, through a grey paper, and keep it in a bottle, well corked.

This *tincture* is a febrifuge for intermitting fevers, which must be taken three or four times every day, at some distance from the paroxism, and the use continued for fifteen days successively. The dose is from ten drops to a drachm, in water of centaury, or of juniper-berries, or wormwood, or in red wine.

If we steep some coriander, or cinnamon, in wine, or water, dissolve some sugar in the colature. and mix it with the *tincture of quinquina*, we shall have a sort of febrifuge ratafia, which may be easily given to children.

The EXTRACT OF QUINQUINA, is a separation of the most substantial particles of the *quinquina*, made thus: Eight ounces of *quinquina* are put to steep, warm, in a sufficient quantity of distilled water of walnuts for twenty-four hours, which being expired, the infusion is made to boil gently, and after it has been percolated with a strong expression, the *quinquina* left is put to steep again in other water of walnuts, and the infusion made to boil, and percolated, as before; which done, the colatures are mixed together, and left to settle: when settled, the clear liquor a-top is decanted and the humidity left made to evaporate, in a glass or stone vessel, at a slow sand heat, to the consistence of thick honey.

This *extract* is a febrifuge like the preceding ones. The dose is from twelve grains to half a drachm, in pills, or dissolved in wine.

The distillation of a plant which is not odoriferous, such as CARDUUS BENEDICTUS, is conducted in this manner: we pound in a mortar a good quantity of *Carduus benedictus*, while in its greatest strength, and having filled the third part of an *alembick* with it, we draw by expression a sufficient quantity of the juice of other *Carduus benedictus*, which we pour into the *alembick*, that the herbs swimming in the juice may not be in danger of sticking to the bottom of the *cucurbite* during the distillation: we adapt a capital, with its *recipient*, to the *cucurbite*, and having luted exactly the joints, we cause to be distilled at a fire of the second degree, about half the liquor.

The water of *Carduus benedictus* is sudorifick it is used in the small pox, plague and malignant fevers.

We press through a linen cloth what remains in the *alembick*, and after we have left the juice to settle, and filtrated it, we cause two thirds of the humidity to be evaporated in a glass or stone vessel, at a slow fire, and carry the vessel to a cool place, where we leave it for eight or ten days, during which time, there are crystals formed round the vessel, which we separate, and keep in a vial, well corked. These crystals are called *essential salt*, which is sudorifick. The dose is from six to sixteen grains, in its own water.

Chicory, fumitory, scabious, and all other plants, which are not odoriferous, and have a deal great of juice, are to be distilled like the *Carduus benedictus*; and this method will serve to extract the salt of any plant.

When we want but the *salt fixed* of some plants, we do it by only drying the plant, burning it, to reduce it into ashes, and throwing those ashes into boiling water, leave them there to steep; we afterwards filtrate the infusion, and causing the humidity to be evaporated in an earthen pan, we find left in the vessel a brownish salt, which we calcine afterwards in a crucible till it grows white; which done, we have it melted in water, filtrate the dissolution, and have all the humidity evaporated in an earthen pan: there remains a very pure and white salt, which we keep in a bottle, well corked. The best method to extract salts is, while in the country, in fair weather, and when there is a great quantity of herbs to be burnt, to dig a hole in the earth, to put the plant, well dried, into it, to set fire to it, and to cover the whole with stones, or other earth, leaving no other aperture than what is necessary for the admission of air, to keep the fire: the plant will be burnt gently, and calcined. The operation is ended when the earth a-top is quite cold; then the whole is uncovered gently, and the ashes are found in it, adhering to one another by lumps, which is a mark of a good calcination, and of the reasonable quantity of salt they contain. The best method to burn plants in a laboratory, is, to have a *furnace* of *fusion*, and placing that *furnace* under the chimney, to fill it up with the plant, well dried: and having set fire to it, to cover the *furnace* with its dome, and little chimney. The plant burns slowly: when it is half consumed, the *furnace* is filled up with another quantity of it, continuing thus to put in the plant till it is all gone, or the *furnace* is full of aſhes; then they are left to calcine, for if the plant has been crowded into the *furnace* every time it was put into it, the aſhes will remain lighted for ten or twelve hours after they have done ſmoaking: they are gathered when quite cold.

We'll make two *chymical* preparations of *Roſes*, *viz.* the *water of roſes*, and the *ſpirit of roſes*.

WATER OF ROSES, is a ſeparation of the moſt aqueous and odoriferous part of the *roſes*, by diſtillation, conducted thus: ten or twelve pounds of *roſes*, the moſt odoriferous, gathered ſome time before ſun riſing, in dry weather, and ſeparated from their pecule, are pounded in a mortar till they are reduced to the conſiſtence of paſte; and being put afterwards into a large copper *cucurbite*, the juice of other *roſes*, newly extracted is poured upon them, till they are ſufficiently humected; then a bolt head, with its *refrigeratory*, and a *recipient*, are adapted to the *cucurbite*, and the joints exactly luted: the *cucurbite* thus prepared, is placed in a *furnace* on a moderate fire, and the water in the *refrigeratory* changed as often as it grows hot: when about half the liquor is diſtilled, the fire is put out, for fear the matter ſhould ſtick to the bottom; the veſſels are ſeparated, and what remains in the *cucurbite* ſtrained through a cloth with expreſſion; the liquor, or juice extracted from it, is put into a *cucurbite*, and two thirds of its humidity diſtilled at a ſlow fire: this ſecond diſtillation is mixed with the firſt, and afterwards put in bottles, which are left, uncorked, expoſed to the ſun, for ſeveral days, to excite the fragrancy of it; and the bottles are afterwards corked.

When it is wanted to draw the water of flowers which have but little humidity, as flowers of *lavender*, *betony*, *ſage*, *roſemary*, &c. they muſt be humected with white wine, and having been left two days in maceration, they are diſtilled in *balneo mariae*, or at the vaporous bath.

The SPIRIT OF ROSES, is an exaltation of the moſt oily, ſubtile, and eſſential part of the *roſes*, into a liquor made in the following manner: Fourteen or fifteen pounds of damaſk *roſes*, with their pecule, are pounded, and put into a large ſtone pot, one third whereof, at leaſt, is left empty; ſix pounds of juice of other *roſes*, but of the ſame kind, which has been heated, and eight or ten ounces of beer yeſt, mixed with it, are poured upon it: the mixture is well ſtirred with a ſtick, and the pot, being well ſtopped, is put in digeſtion, in a dunghill for three or four days, which being expired, the matter is put in diſtillation to the vaporous bath; and when about four pounds of the liquor is diſtilled, the fire is put out, the *recipient* taken off, and what it contains rectified in a matraſs.

The *ſpirit of roſes* fortifies the heart and ſtomach, either taken inwardly, or applied outwardly: it is adminiſtered to men for ſyncopes, and the palpitations of the heart; but is not proper for women, becauſe it excites the vapours. The doſe is from half a dram to two drams, in *roſe-water*.

We'll make but one ſingle *chymical* preparation of *ſugar*, which is its *ſpirit*; which *ſpirit* is a mixture of the acid of the *ſugar* with flowers of ſal ammoniac; made thus: We pulverize and mix eight ounces of *ſugar candy* with four ounces of ſal ammoniac, and fill a third part of a ſtone or glaſs *cucurbite* with the mixture; we adapt a capital to it, and a recipient, lute exactly the joints, and place it in a *furnace* on ſand, making a ſmall fire in the *furnace* for an hour, to heat the veſſel, then increaſing it to the ſecond degree, a liquor will drop into the recipient, and towards the end of the operation white vapours riſe to the capital, which when we perceive, we increaſe the fire till nothing comes out of the *cucurbite*; which we unlute, when cold, and find in the recipient four ounces of a brown liquor of a bad ſmell, and a ſmall quantity of black oil ſticking to its ſides. We pour the whole into a glaſs *cucurbite*, and having adapted a capital and a recipient to it, and luted exactly the joints, we diſtil, at a ſand heat, three ounces and a dram of a very acid ſpirit, clear, agreeable to the taſte, and without any ſmell.

This *ſpirit of ſugar* is a very good aperitive againſt the gravel and dropſy; it is proper to ſtop diarrhæa's and dyſenteria's; ſome believe it good for the diſeaſes of the breaſt. The doſe is from ten drops to an agreeable acidity, in ſome liquor appropriated to the diſtemper. What remains at the bottom of the *cucurbite* may be uſed to clean old ulcers.

SPIRIT OF WINE, is the oleaginous part of the *wine*, rarefied by acid ſalts, thus: We fill a large matraſs, with a long neck, half full of brandy, and having adapted a capital and a recipient to it, and luted exactly the junctures, we place it on a pot half full of water, to diſtil, at the vaporous bath, the ſpirit, which will be ſeparated of its phlegm, and aſcend pure: we continue that degree of fire till it has done diſtilling, and we have a *ſpirit of wine* diveſted of its phlegm, in the firſt diſtillation.

Spirit of wine ſerves as a diſſolvent to ſeveral things in *Chymiſtry*; half a ſpoonful of it is given in the apoplexy and lethargy, to make the patient come to himſelf. It is a very good remedy for burns, if applied as ſoon as it is made; it is alſo very good for the palſy, contuſions and other maladies where the pores are to be opened.

Spirit of wine with tartar, is a preparation of the spirit of *wine*, which has exalted a small portion of salt of tartar, in its separation from its phlegm. This preparation is made in the following manner:

A pound of tartar is put in a glass *cucurbite*, and four pounds of spirit of *wine* poured upon it; the vessel is placed in a *furnace*, on the sand, and covered with a capital, and a recipient adapted to it, the junctures having been exactly luted with a wet bladder; a graduate fire is made under it, and continued till about three parts of the *spirit of wine* are distilled; then the fire is put out, and the *spirit* kept in a bottle, well corked.

This *spirit* is more subtile than the common *spirit of wine*, but has the same virtues. The dose is from half a dram to two drams, in some liquor appropriated to the distemper.

Tartar, *tartarus*, or *tartarum*, is a kind of salt which rises from wine, and sticking to the top and sides of the casks, forms a crust, which hardens to the consistence of a stone. *Tartar*, says an ingenious author, has the juice of the grape for its father, fermentation for its mother, and the cask for its matrix.

Crystal, or cream of tartar is but the *tartar* purified of its most terrestrial particles, thus: we boil what quantity we please of *tartar* in water 'till it is melted, and strain the liquor hot, through a flannel, into an earthen vessel; and having caused about half the humidity to be evaporated on the fire, we carry the vessel to a cool place for two or three days; during that time little crystals are formed at the sides of the vessels, which we take out; and have again half of what is left of the humidity evaporated, carrying afterwards the vessel to a cool place, where will be formed crystals as before; we continue thus 'till we have extracted all our *tartar*, which we dry in the sun and keep for use.

The *cream*, or *crystal of tartar* is purgative and aperitive, proper for the dropsy, asthma, tertian and quartan ague. The dose is from half a dram to three drams, in broth, or some other liquor.

When the *crystal of tartar* is taken in a liquor, it must be boiled in that liquor, and the liquor drunk very hot, otherwise the *crystal of tartar* would precipitate to the bottom of the porringer.

The fixed salt of tartar, and its liquor, called *oil per deliquium*, are prepared in the following manner: We break the retort which has served for the distillation of *tartar*, and take out the black mass found in it, which we calcine between the coals, 'till it be white: when white, we throw it into a great deal of water, and make a lixivium of it, which having filtrated into a glass or stone vessel, we cause afterwards all the humidity to be evaporated at a sand-heat. There remains at the bottom of the vessel a white salt, which is called *alkali salt of tartar*.

This *salt* is aperitive, it is used to extract the tincture of vegetables, and given for obstructions. The dose is from ten grains to thirty, in broth, or in laxative infusions.

If this *salt* be exposed for some days in a flat glass or stone vessel, in the cellar, or some other damp place, it will resolve into a liquor, improperly called *oil of tartar per deliquium*.

This *oil of tartar* is used for the ring-worms, and to resolve tumours; ladies mix it with water of white lilies to wash their face and their hands.

The *extract of opium*, called Laudanum, is the only *chymical* preparation made of it. This preparation is the purest part of the *opium*, extracted by rain water and spirit of wine; and sometimes reduced in consistence of extract; thus: we slice four ounces of good *opium*, and put it into a matrass: we pour upon it a quart of rain-water very well filtrated, and stop well the matrass, which having placed on sand, we make a little fire under it at first, which we increase afterwards by degrees, to make the liquor boil for two hours: we percolate that liquor while hot, and pour it into a bottle. We take the *opium* left indissoluble in the rain-water, have it dried in a pan on a little fire, and put it afterwards in a matrass, pouring upon it spirit of wine to the height of four fingers breadth: we stop the matrass, and put the matter in digestion on hot embers for twelve hours, and percolate the liquor afterwards. We cause our two dissolutions of *opium*, viz. That with rain-water, and the other with spirit of wine, to be evaporated separately, in stone or glass vessels, at a sand-heat, to the consistence of honey: then mix them together, and have that mixture dried at a slow fire, to give it the consistence of pills.

There is no other difference between this solid *laudanum* and the liquid; but that in the liquid there is humidity enough left to render it fluid, that it may be kept in a bottle. Which is effected by mixing both impregnations together, without evaporation of the humidity.

The virtue of *opium* is, by calming the too great impetuosity of the spirits, to promote sleep.

Extract of Aloes, is *aloes* depurated of the dross it contains, in the following manner: we melt eight ounces of *succotrine aloes* on the fire, in a sufficient quantity of juice of roses, or in a strong decoction of flowers of violets; we leave the dissolution to settle, for the space of six hours, and then decant it, filtrate it, and make the humidity evaporate gently, till the matter has acquired a consistence of extract, which we keep in a pot.

This

This is a very good remedy to purge the stomach, in fortifying it. The dose is from fifteen grains to a dram, in pills.

They seldom purge before the day following. They excite the piles, and the menses; because *aloes* rarefy the blood, by its fermentative salt, and pushes it, with impetuosity, out of the veins.

To prepare the Oil of Tobacco, we *Chymists* put eight ounces of good *tobacco* hached, into a glass *cucurbite*, and pour upon it about the same weight of phlegm of vitriol; we cover the *cucurbite* with its capital, and leave the matter in digestion, on a sand heat, for a whole day; then adapting a recipient to the vessel, we distil, by a slow fire, about five ounces of the liquor, which we keep in a vial.

This *oil* is a strong vomitive; it is very good for ringworms, and the itch, by anointing, gently the parts with it.

A drop or two of the *chymical* oil of *tobacco*, being put on the tongue of a cat, produces violent convulsions, and death itself, in the space of a minute; yet the same oil used on lint, and applied to the teeth, has been of service in the tooch-ach; though it must be to those who have been used to the taking of *tobacco*, otherwise great sickness, reachings, vomitings, &c. happen; and even in no case is the internal use of it warranted by ordinary practice.

The Tincture of Myrrh, is a dissolution of the oily parts of the *myrrh* in spirit of wine, thus: we put what quantity we please of fine *myrrh*, pulverized, into a matrass, and pour upon it spirit of wine, to the height of four fingers breadth; we stir well the matter, and put it in digestion, on a sand heat, for two or three days, or till the spirit of wine be loaded with the *tincture* of the *myrrh*: we pour then the liquor by inclination, and keep it in a vial, well corked.

Tincture of myrrh can be used to hasten delivery, promote the menses, for the palsy, apoplexy, lethargy, and all other maladies proceeding from the corruption of humours. It is sudorifick, and aperitive. The dose is from six drops to fifteen in some liquor appropriated to the distemper.

Let us now proceed to the *animal kingdom*, and shew what the *chymical art* can do with those principles for the health and uses of life. In these operations we will begin with the *Viper*, famed for its great use in medicine.

The first preparation made of the Viper is the powder, which to make, *vipers* must be taken, while they are in their greatest vigour; the females full of eggs, or with young, are not so good as the others; having been skinned, gutted, and their heads cut off, they are put to dry from the sun, and afterwards pulverized in a mortar: but as this powder is not easily kept, because worms get into it, a paste is made of it, with a sufficient quantity of gum tragacanth and troches, and small balls made of it, which must be pulverized, when wanted.

This *powder* is administered in the small pox, malignant fevers, and all maladies, where it is necessary to resist venom, and to purify the humours by transpiration. The dose is from eight grains to thirty in broth, or some other liquor appropriated to the distemper.

The heart and the liver are dried in the sun, pulverized together, and have the same virtues as the body of the *viper*; but the dose is a little less. This preparation is called *bezoar mineral*.

The gall of the *viper* is sudorifick. The dose is from one to two drops, in water of *carduus benedictus*.

The fat found in the entrails of the *viper*, is melted, then strained, to separate it from its membranes: it is clear as oil, and used in several countries for the small pox, and fevers. The dose is from one drop to six, in broth. It enters, likewise, in plaisters, and resolutive unguents.

But we should prefer the Distillation of the Viper, which is a separation of the principles of the *viper*, *viz.* of its phlegm, volatile salt, and oil, from its terrestriety; which to perform, we put six dozen of *vipers*, dried from the sun, as above, into a stone or glass retort, which we lute, and place in a reverberatory furnace; we adapt a large recipient to it, and having luted exactly the junctures, begin the *distillation* by a little fire, to heat gently the retort, and to bring out a phlematick water: When we perceive that it has done dropping, we increase the fire by degrees, to bring out white clouds, the spirits which fill the recipient, and afterwards a black oil, and the volatile salt which sticks to the inside of the recipient: we continue the fire till nothing more comes out, after which, we leave the vessels to grow cold, and then unlute them; we shake, a little, the recipient, to loosen the volatile salt which sticks to the side, and pour all into a matrass with a long neck, to which we adapt a capital, and a little recipient, luting exactly the junctures: we place our matrass on the sand, and make under it a small fire, to sublimate the volatile salt, which will stick to the capital, and to the superior part of the matrass; which salt we loosen, and keep in a vial well corked.

The *volatile salt of vipers* is one of the best remedies we have in medicine: It is good for malignant and intermitting fevers, the small pox, apoplexy, epilepsy, palsy, hysterick distempers, and for the bite of venomous beasts. The dose is from six

ſix to ſixteen grains, in ſome liquor appropriated to the diſtemper.

We pour what remains in the matraſs into a funnel lined with gray paper; the ſpirit and the phlegm run through, but the ſtinking oil remains on the paper; which oil may be given to ſmell to women attacked with the hyſtericks, and ſerves alſo to anoint the parts in the palſy.

We pour the ſpirit and the phlegm, mixed confuſedly together, into an alembick, and diſtil, at a vaporous bath, about half the liquor, which is the *ſpirit of viper*, and has the ſame virtues as the *ſalt*. The doſe is from ten to thirty drops.

In the ſame manner may be extracted the *volatile ſalt of toads*, *hartſhorn*, *ivory*, *blood*, the *cranium*, *hair*, and other parts of *animals*.

CLOCK-MAKING.

A Clock is a machine compoſed of wheels, weights or ſprings, pendulums or ballances, for an equal horary diviſion of time: which in ſome countries is meaſured by a graduation of twenty-four hours; but moſt commonly, as in *Britain*, by twelve hours.

This machine when it is wrought up into ſuch a volume, as to be fit to carry in the pocket, changes its name, and is called a Watch.

To both theſe are added ſeveral peculiarities both as to uſe and ornament.

The *Clock* has a bell, on which the number of the hour is ſtruck by a hammer regulated by a particular part of the machine; and on which alſo the alarum is rung in ſmall clocks, and the chimes in church and muſical clocks. — But there is a kind of *clocks*, made for the uſe of coffee-houſes and other public places of entertainment and converſation, called *Dials*, which give the hour and the minutes by proper indexes, but have no bell.

The *watch* is made exactly upon the ſame principle, as the *clock*. But a bell is no eſſential part of its compoſition, and is ſeldom uſed in watches for the pocket. Our fore-fathers made a watch with a bell that incloſed the works of the machine, which was thence called a *Cocket-clock*: but this kind was chiefly uſed by ladies at their ſides; and has ſince been improved into thoſe curious *ſtriking* and *repeating watches* now ſo much eſteemed by the fair-ſex and gentlemen of fortune.

It muſt be allowed that the ancients had a machine which ſomewhat reſembled a *clock*; as there is mention of ſuch a one invented by *Boetius*, about the year of Christ 510. But that art was ſo far loſt, that the *Germans* about 225 years ago, who revived it, claimed the honour of its invention. Nor was it till the laſt century that the uſe of pendulums was found out: an invention diſputed between *Galileo* and *Huygens*.

The firſt *pendulum clock* made in *England* was in the year 1622, by M. *Fromentel*, a *Dutchman*, according to M. *Huygen*'s method, which prevailed for ſeveral years; 'till afterwards Mr. *Clement* invented a new method, whereby the pendulum was to go with leſs, and to vibrate but a ſmall compaſs, which is now the univerſal method of the royal pendulums: But Dr. *Hook* denies Mr. *Clement* to have invented this, and ſays that it was his invention, and that he cauſed a piece of this nature to be made, which he ſhewed before the Royal Society ſoon after the fire of *London*.

There is alſo a diſpute between the partiſans of M. *Huygens* and thoſe of Dr. *Hook* for the invention of *pocket-watches*.

Mr. *Derham*, in his artificial *Clock maker*, ſays roundly, that Dr. *Hook* was the inventor, and that he contrived various ways of regulation; one way was with a load-ſtone, another with a tender ſtrait ſpring, one end whereof played backward and forward with the ballance, ſo that the ballance was to ſpring as the bob of a pendulum, and the little ſpring as the rod thereof. A third method was with two ballances, of which there were divers ſorts, ſome have a ſpiral ſpring to the ballance for a regulator, and others without. But the way that prevailed, and which continues in mode, was with one ballance, and one ſpring running round the upper part of the verge thereof. Though this has a diſadvantage, which thoſe with two ſprings were free from, in that a ſudden jerk or confuſed ſhake will alter its vibrations, and put it in an unuſual hurry.

The time of theſe inventions was about the year 1658, as appears, among other evidences, from an inſcription on one of the double ballance watches preſented to King *Charles* II. *viz. Rob. Hook, invent.* 1658. *T. Tompion, fecit*, 1675. The invention preſently got reputation both at home and abroad; and two of them were ſent for by the Dauphin of *France*.

After this M. *Huygens*'s watch, with a ſpiral ſpring, got abroad, and made a great noiſe in *England*, as if the longitude could be found by it. One of theſe the Lord *Brunker* ſent for out of *France*, where M. *Huygens* had a patent for them. This watch of M. *Hugens* agrees with that of Dr. *Hook*, in the application of the ſpring to the ballance: Only M. *Hugens* had a longer ſpiral ſpring, and the pulſes or beats were much ſlower. That wherein it differs is, 1. the verge has a pinion inſtead of pallets; and a contrate wheel runs therein, and drives it round more than one turn. 2. The pallets are on the arbor of the contrate-wheel. 3. Then follows the crown-wheel, *&c.* 4. The ballance inſtead of turning ſcarce quite round, (as Dr. *Hook*'s) does turn ſeveral rounds every vibration.

Mr. *Derham* ſays, that this watch of M. *Hugens*'s is a very pretty and ingenious contrivance, but ſubject to ſome defects, *viz.* That when it ſtands ſtill it will not vibrate, until it is ſet on vibrating: which though it be no defect in a pendulum clock, may be one in a pocket-watch, which is expoſed to continual jogs. That it alſo ſomewhat varies in its vibrations, making ſometimes longer, ſometimes ſhorter turns, and ſo ſome ſlower, ſome quicker vibrations.

The repetition of watches was the invention of Mr. *Barlow*, a *Romiſh prieſt*, and firſt put in practice by him in large movements or *clocks*, about the year 1676. The contrivance immediately ſet the other artiſts to work, who ſoon contrived divers ways of effecting the ſame: but its application to pocket-watches was not known before King *James* II's reign, when the ingenious inventor above-mentioned, having directed Mr. *Tompion* to make a repeating watch, endeavoured with the Lord Chief Juſtice *Allebone*, and ſome others, to get a patent for it. The talk of a patent engaged Mr. *Quare* to reſume the thought of a like contrivance which he had had in view ſome years before: He now effected it, and being preſſed to endeavour to prevent Mr. *Barlow*'s patent, a watch of each kind was produced before the King and council; upon trial of which the preference was given to Mr. *Quare*'s. The difference between them was, that *Barlow*'s was made to repeat by puſhing in two pieces on each ſide the watch-box; one of which repeated the hour, and the other the quarter: whereas *Quare*'s was made to repeat by a pin that ſtuck out near the pendant; which being thruſt in (as now it is done by thruſting the pendant itſelf) repeated both the hour and quarter with the ſame thruſt.

At preſent the variety of works introduced into clocks and watches, ſhews that this art is capable of great improvements for demonſtration in the ſciences, and for delightful recreations. For which we need only view the *Cometarium*, the *Microcoſms*, and *Muſical-clocks*, which fill every ſpectator with admiration, and every ear with pleaſure.

The machine diſpoſed, either in a large or narrow compaſs, is called *movement*. This *movement* is often divided into two parts, *viz.* the *watch-work*, which meaſures the time; and the *clock-work*, which ſtrikes it.

There is no other difference between the watch-work of the movement of a *clock*, and that of the movement of a *pocket-watch*, but in the volume of the different members they are both equally compoſed of; and the rules to make both movements are the ſame, though not the materials; for the movement of a *clock* is made of iron, and that of a *watch* is made part of iron, and part of braſs, *i. e.* that all the wheels are made of braſs, and the ſpindles, or arbors of the wheels, the ſprings, *&c.* made of iron, and ſteel. There is alſo this difference between them, that the *movement* of a *clock* is placed within a frame, compoſed of ſeveral iron bars, diſpoſed ſquare-wiſe; and that of a *watch*, in a caſe, compoſed of two round braſs plates, ſupported, and joined together, by four braſs pillars.

In theſe machines the force required for action is by a *ſpring* or *weight*, and muſt be ſuch as ſhall overcome the *vis inertiæ* and friction of all the parts in motion: which in *watches* is very inconſiderable, but in *clocks* is much greater, and that in proportion as they are more compounded.

The manner that a *weight* acts upon the cylinder, about which the line or cord (to which it hangs) is wound, is eaſy to be underſtood by all: but the action of the ſpring coiled up within the cylindric barrel, or box of a *clock* or *watch*, is ſomewhat more nice and myſterious; and the manner how it acts upon the fuſee always with an equal force, by means of the *chain*, and the proper figure of the *fuſee*, for that purpoſe, is therefore, to be explained.

The *chain* being fixed at one end of the *fuſee*, and at the other to the *barrel*; when the machine is winding up, the *fuſee* is turned round, and of courſe the *barrel*; on the inſide of which is fixed one end of the ſpring, the other end being fixed to an immoveable axis in the center. As the *barrel* moves round, it coils the ſpring ſeveral times about the axis, thereby encreaſing its elaſtic force to a proper degree: all this while the chain is drawn off the barrel upon the fuſee, and then when the inſtrument is wound up, the *ſpring*, by its elaſtic force endeavouring conſtantly to unbend itſelf, acts upon the *barrel*, by carrying it round, by which the chain is drawn off from the *fuſee*; and thus turns the *fuſee*, and conſequently the whole machinery.

Now, as the *ſpring* unbends itſelf by degrees, its elaſtic force, by which it affects the *fuſee*, will gradually decreaſe; and therefore, unleſs there were

were ſome mechanical contrivance in the figure of the ſuperficies of the *fuſee*, to cauſe, that as the *ſpring* grows weak, the *chain* ſhall be removed farther from the center of the *fuſee*, ſo that what is loſt in the *ſpring's* elaſticity, is gained in the length of the *lever:* were it not for this contrivance, the *ſpring's* force would always be unequal upon the *fuſee*, and thus would turn the *fuſee*, and conſequently the whole machinery unequally. All which is remedied by the conical figure of the *fuſee*. The *fuſee* being acted upon, or put in motion, by an uniform force, the *great wheel*, which is fixed to it, is put into motion, and that drives the *pinion* of the *center-wheel*, which *center-wheel* drives the *pinion* of the *third wheel*, and this drives the *pinion* of the *contrate wheel*, and this the *pinion* of the *ballance-wheel*, which plies the two *pallets* on the axis of the *ballance*, and keeps the *ballance* in motion.

The *ballance* in a *watch* is inſtead of the *pendulum* in a *clock*, both ſerving to govern the motion of the whole machinery. To this *ballance* is fixed a ſmall ſteel *ſpiral ſpring*, which regulates the motion thereof, and makes it equable: whence it has its name of regulator.

When the *watch* is wound up, the chain from the *ſpring* exerts a force upon the *fuſee*, which gives motion to all the parts of the machine, in the following manner; as will be eaſy to underſtand, when the number of *teeth* in each *wheel*, and *leaves* in the *pinions*, which they drive, are ſpecified, and theſe in modern *thirty-hour watches* are as follows:

	Teeth.	Leaves.
Great wheel	48	12
Center-wheel	54	6
Third wheel	48	6
Contrate wheel	48	6
Ballance-wheel	15	2 pallets.

Hence it is eaſy to conceive how often any one wheel moves round in the time of one revolution of that which drives it.

Thus the *great wheel* on the *fuſee*, having *forty-eight teeth*, and driving the *center-wheel* by a pinion of *twelve*, muſt cauſe the *center-wheel* to move round four times in *one* turn of the *fuſee*, and ſo for all the reſt, as follows.

$$\left.\begin{array}{l} 12)48(4 = \text{turns of the center} \\ 6)54(9 = \text{turns of the third} \\ 6)48(8 = \text{turns of the contrate} \\ 6)48(8 = \text{turns of the ballance} \end{array}\right\} \text{wheel}$$

Whence it follows, that the turns of each of theſe *wheels* reſpectively, in one turn of the *fuſee*, will be had by multiplying thoſe ſeveral quotients together ſucceſſively as follows,

$$\left.\begin{array}{r} 1 \\ 4 \times 1 = 4 \\ 9 \times 4 \times 1 = 36 \\ 8 \times 9 \times 4 \times 1 = 288 \\ 8 \times 8 \times 9 \times 4 \times 1 = 2304 \end{array}\right\} \text{Turns of the} \left\{\begin{array}{l} \textit{fuſee wheel.} \\ \textit{center-wheel.} \\ \textit{third wheel.} \\ \textit{contrate wheel.} \\ \textit{ballance wheel.} \end{array}\right.$$

The ſeveral members of the watch part are, 1. The *ballance*, conſiſting of the rim, which is its circular part; and the verge, which is its ſpindle, to which belong the two pallets or levers that play in the teeth of the crown-wheel. 2. The *potence*, or *pottance*, which is the ſtrong ſtud in pocket watches, whereon the lower pivot of the verge plays, and in the middle of which one pivot of the ballance-wheel plays; the bottom of the potence is called the *foot*, the middle part the *noſe*, and the upper part the *ſhoulder*. 3. The *cock*, which is the piece covering the ballance. 4. The *regulator* or *pendulum ſpring*, which is the ſmall ſpring in the new pocket watches, underneath the ballance. 5. The *pendulum*, whoſe parts are the *verge*, *pallets*, *cocks*, and the *bob*. 6. The *wheels*, which are the *crown-wheel* in pocket-pieces, and *ſwing-wheel* in *pendulums*, ſerving to drive the *ballance* or *pendulum*. 7. The *contrate-wheel*, which is that next the *crown-wheel*, &c. and whoſe teeth and hoop lie contrary to thoſe of other wheels; whence the name. 8. The *great* or *firſt wheel*, which is that the *fuſee*, &c. immediately drives: after which are the *ſecond wheel*, *third wheel*, &c. 9. Laſtly, between the frame and dial-plate, is the *pinion of report*, which is that fixed on the *arbor* of the *great wheel*, and ſerves to drive the *dial-wheel*, as that ſerves to carry the hand.

Spring or *pendulum* WATCHES, are pretty much upon the ſame principle with *pendulum-clocks:* whence their denomination. If a pendulum deſcribing little arches of a circle makes vibrations of unequal lengths, in equal times, it is becauſe it deſcribes the greater with a greater velocity. For the ſame reaſon a ſpring put in motion, and making greater or leſs vibrations, as it is more or leſs ſtiff, and as it has a greater or leſs degree of motion given it, performs them nearly in equal times. Hence, as the vibrations of the pendulum had been applied to large *clocks* to rectify the inequality of their motions; ſo to correct the unequal motions of the ballance of *watches*, a ſpring is added, by the iſochroniſm of whoſe vibrations the correction is to be effected.

The ſpring is uſually wound into a ſpiral, that, in the little compaſs allotted it, it may be as long as poſſible, and may have ſtrength enough not to be maſtered and dragged about by the inequalities of the ballance it is to regulate. The vibrations of the two parts, *viz.* the ſpring and ballance, ſhould be be of ſome length; only ſo adjuſted, as that the ſpring, being more regular in the length of its vibrations than the ballance, may on occaſion communicate its regularity thereto.

The *Aſtronomical* Watch was invented by that great artiſt and philoſopher, Mr. Neale of London, for ſolving ſeveral *Aſtronomical* problems. It has two glaſſes; that in the front covers a dial-plate, as in common watches; the other, on the back-ſide, covers a plate forming a ſegment of a globe, on which are drawn twenty-four meridian lines, with the names of ſo many countries, at 15° difference of longitude from each other (See *ibid.*) This plate makes an entire revolution in twenty-four hours; and, conſequently, every country thereon paſſes by the ſun, repreſented by A; round this plate, is a circle divided into 24 hours, alſo at reſt; by means of which, when the moveable plate is made to correſpond to the true time ſhewn by the hands on the common ſide, the time of day or night, at the ſeveral countries ſpecified, is ſhewn by the hour-circle. Round the moveable plate, and between it and the circle of hours above deſcribed, moves a narrow circle, on which is engraved the moon's age; and over $29\frac{1}{2}$ is placed an ivory ball, B, repreſenting the moon: and at the right angles each way, are placed two pins, C and D, one eaſtward, and the other weſtward; by means of which, the time of the moon's riſing, ſouthing and ſetting, at thoſe different places, is ſhewn in a very entertaining manner.

To find the *beats* of the *ballance* in all *watches* going, or in one turn of any wheel. Having found the number of *turns* which the *crown-wheel* makes in one turn of the wheel you ſeek for, thoſe turns of the *crown-wheel* multiplied by its notches, give half of the number of beats in that one turn of the wheel. For, the *ballance* or *ſwing* has two ſtrokes to every tooth of the *crown-wheel*, inaſmuch as each of the two *pallets* hath its blow againſt each *tooth* of the *crown-wheel*; whence it is that a *pendulum*, that beats ſeconds, has in its *crown-wheel* only *thirty teeth*.

To explain this, ſuppoſe the numbers of a ſixteen-hour *watch*, in which the pinion of report is 4, the dial-wheel 32, the great wheel 55, the pinion of the ſecond wheel 5, &c. The number of the notches in the *crown-wheel* 17 being multiplied into 6336 (the product ariſing from the continual multiplication of the quotients 8, 9, 11, 8) gives 107712 for half the number of beats in one turn of the dial-wheel; for 8 times 17 is 136, which is half the number of beats in one turn of the centrate-wheel 40; and 9 times 136 is 1224, the half beats in one turn of the ſecond wheel; and 11 times 1224, is 13464, the half beats in one turn of the great wheel 55; and 8 times 13464 makes 107712. If you multiply this by the two pallets, that is double it, the product will be 215424, which is the number of beats in one turn of the dial-wheel, or twelve hours.

4)32(8

5)55(11
5)45(9
5)40(8

17

To know how many beats this watch has in an hour, divide the beats in twelve hours into twelve parts, and it gives 17952, the train of the watch, or beats in an hour. By the beats and turns of the fuſee, the hours that any watch will go, may be found thus. As the beats of the ballance in an hour are to the beats in one turn of the fuſee : : ſo is the number of the turns of the fuſee : to the continuance of the watch's going. Thus 20196 : 26928 : : 12 : 16.

To find the beats of the ballance in an hour, the proportion is, as the hours of the watch's going, to the number of the fuſee : : ſo are the beats in one turn of the fuſee : to the beats in an hour. Thus, 16 : 12 : : 26928 : 20196.

All that has been hitherto ſaid, ſhews only the *minutes* of an *hour*, and *ſeconds*, or *quarter ſeconds* of a *minute*; for nothing has been yet mentioned relating to the mechaniſm for ſhewing the *hour* of the *day*. This part of the work lies concealed from ſight, between the *upper plate* of the watch-frame and the *dial-plate*. In this work, A B C (See the Plate of Mechanic Arts, *Clock-work*, No. 1.) is the uppermoſt ſide of the *frame-plate*, as it appears when detached from the *dial-plate*: the middle of this plate is perforated with a hole, receiving that end of the *arbor* of the *center-wheel*, which carries the *minute-hand*; near the plate is fixed a pinion *a b* of ten teeth: this is called the pinion of report; it drives a wheel *c d* of forty teeth; this wheel *c d* carries a pinion *e f* of twelve teeth; and this drives a wheel *g h* with *thirty ſix* teeth.

As in the body of the *watch* the *wheels* every where divide the *pinions*, here, on the contrary, the *pinions* divide the *wheels*, and by that means decreaſe the motion, which is here neceſſary: for the hour-hand, which is carried on a ſocket fixed on the wheel *g h*, is required to move but once round, while the pinion *a b* moves twelve times round. To this end the motion of the wheel *c d* is $\frac{1}{4}$ of the pinion *a b*: again, while the wheel *c d*, or the pinion *e f* goes once round, it turns the wheel *g h* but

I

but $\frac{1}{3}$ part round; consequently the motion of *g h* is but $\frac{1}{3}$ of $\frac{1}{4}$ of the motion of *a b*; but $\frac{1}{3}$ of $\frac{1}{4}=\frac{1}{12}$, that is, the *hour-wheel g h* moves once round in the time that the pinion of *report*, on the *arbor* of the *center* or *minute-wheel*, makes twelve revolutions, as required.

Having thus shewn the nature and mechanism of a *watch*, the structure of that part of a *clock* which is concerned in the shewing of the time, will easily be understood.

The mechanism of a *clock* consists of two parts, one to shew time, the other to report it, by striking the hour upon a bell. Each part is actuated or moved by *weights*, as in common clocks; or by *springs* included in boxes or barrels, as that represented by A. (*ibid* No. 2.) This cylinder moves the fusee B, and the great wheel C (to which is fixed) by the line or cord that goes round each, and answers to the chain of the watch.

The method of calculating is here much the same as before: for, suppose the great wheel C goes round once in twelve hours, then if it be a royal pendulum-clock, swinging seconds, we have $60\times60\times12=43200$ seconds or beats, in one turn of the great wheel. But because there are 60 swings or seconds in one minute, and the seconds are shewn by an index on the end of the arbor of the swing wheel, which in those clocks is in an horizontal position; therefore, it is necessary that the swing wheel should have thirty teeth, whence 60)432000(=720 the number to be broken into quotients for finding the number of teeth for the other wheels and pinions, as before.

In *spring-clocks*, the disposition of the wheels in the *watch-part* is such as is here represented in the figure, where the swing wheel F is in an horizontal position, the seconds not being shewn there by an index, as is done by the large *pendulum clocks*. Whence in these clocks, the wheels are disposed in a different manner, as represented in No. 3. *ibid.* where C is the great wheel, D the center or minute wheel, both as before; but the contrate wheel E is placed on one side, and F the swing wheel is placed with its center in the same perpendicular line G H, with the minute wheel, and with its plane perpendicular to the horizon, as are all the others. Thus the minute and hour-hands turn on the end of the arbor of the minute-wheel at *a*, and the second hand on the arbor of the swing-wheel at *b*.

With regard to the machinery of the striking part of a *clock*, is to be observed that, as in the *watch* part, the primium mobile is a large spring, in the spring-barrel G, (*ibid.* No. 2.) but in long *pendulums*, it is a weight. Thus, by its cord and fusee, it moves the great wheel H; that gives motion to the pin-wheel I; that continues it to the detent or hoop-wheel K, and that to the warning-wheel L, which at last is spent on the flying pinion Q; this carries the fly or fan; and by its great velocity it meets with much resistance from the air it strikes, and by this means bridles the rapidity of the *clock*'s motion, and renders it equable. All these wheels are quiescent, unless when at the beginning of each hour, the detent O is lifted up, by which means the work is unlocked, and the whole put into motion, by means of the spring in the box G. During this motion the pins *e*, *e*, *e*, *e*, of the pin wheel I, take the tail of the hammer T, and carrying it upwards, removes the head of the hammer S from the bell R; then being let go by the pin, it is made by a strong spring to give a forcible stroke upon the bell, and this is reported as often as the hour requires, by means of a contrivance in another part. This consists of moveable wheels and several leaves and other parts which cannot be understood by a bare description, or even a representation in a draught, so well as any person may have an idea of by taking off the face or dial-plate of a late made eight day clock.

Perhaps we want our *clock* to strike the *quarters*, which are generally a distinct part from that, which strikes the hour. In this case, the *striking-wheel* may be the *first*, *second*, &c. *wheel*, according to our *clock*'s continuance; unto which *wheel* we may fix the *pinion of the report*. The *locking-wheel* must be divided into 4, 8, or more equal parts, so as to strike the *quarter*, and lock at the first notch; the *half hour*, and lock at the second notch, &c. and in doing this, we may make it to chime the *quarters*, or strike them upon two bells, or more.

It is usual for the *pin-wheel*, or the *locking wheel*, to unlock the hour part in these *clocks*, which is easily done by some cog, or latch, at the end of the last *quarter*, to lift up the *detents* of the hour part.

If we would have our *clock* strike the *hour* at the *half hour*, as well as the *whole hour*, we must make the *locking wheel* of the *hour* part double, *i. e.* it must have two notches of a sort, to strike 1, 2, 3, 4, twice a-piece.

To calculate numbers for CHIMES, and to fit and divide the *chime-barrel*, it must be observed, that the *barrel* must be as long in turning round, as we are in singing the tune it is to play.

As for the *chime-barrel*, it may be made up of certain bars, which run athwart it, with a convenient number of holes punched in them, to put in the pins that are to draw each hammer; by this means, the tune may be changed, without changing the *barrel*. In this case, the pins, or nuts, which

which draw the hammers, muſt hang down from the bar, ſome more, ſome leſs, and ſome ſtanding upright in the bar; the reaſon whereof is, to play the time of the tune rightly: for the diſtance of each of theſe bars may be a ſemibreve; but the uſual way is to have the pins which draw the hammers fixed on the *barrel.*

For the placing of theſe pins, we may proceed by the way of changes on bells, *viz.* 1, 2, 3, 4, *&c.* or rather make uſe of the muſical notes; where it muſt be obſerved, what is the compaſs of the tune, or how many notes, or bells, there are from the higheſt to the loweſt; and, accordingly, the *barrel* muſt be divided from end to end. Thus if the tune be of eight notes compaſs, the *barrel* is accordingly divided into eight parts; theſe diviſions are ſtruck round the *barrel*, oppoſite to which are the hammer-tails.

We ſpeak here as if there was only one hammer to each bell, that it may be more clearly apprehended; but when two notes of the ſame ſound come together in a tune, there muſt be two hammers to that bell, to ſtrike it: ſo that if in all the tunes we intend to *chime*, of eight notes compaſs, there ſhould happen to be ſuch double notes on every bell, inſtead of eight, we muſt have ſixteen hammers; and according we muſt divide our *barrel*, and ſtrike ſixteen ſtrokes round it, oppoſite to each hammer-tail; then we are to divide it round about into as many diviſions as there are muſical bars, ſemibreves, minims, *&c.* in our tune.

Thus the hundredth pſalm tune has twenty ſemibreves, and each diviſion of it is a ſemibreve; the firſt note of it is alſo a ſemibreve, and therefore on the *chime-barrel* muſt be a whole diviſion, from five to five.

Indeed, if the *chimes* are to be compleat, we ought to have a ſet of bells to the gamut notes, ſo that each bell having the true ſound of *ſol*, *la*, *mi*, *fa*, &c. we may play any tune, with its flats and ſharps; nay, we may, by this means, play both the baſs and treble with one *barrel*; and by ſetting the names of our bells at the head of any tune, that tune may eaſily be transferred to the *chime-barrel*, without any ſkill in muſic: but it muſt be obſerved, that each line in the muſic is three notes diſtant, that is, there is a note between each line, as well as upon it.

To conclude this treatiſe of *Clock-making*, we will ſet down here numbers ready calculated for ſeveral movements, for the benefit of thoſe who are unacquainted with the art of calculation.

Numbers of an eight Day-Clock, with ſixteen turns of the barrel, the pendulum to vibrate ſeconds, ſhew minutes, ſeconds, *&c.*

The Watch-Part.	*The Clock-Part.*
8)96	8)78
8)60—48)48—6(72	6)48.8 Pins
7)56	6)48
30	

In the *watch-part* the wheel 60 is the minute-wheel, placed in the middle of the *clock*, that its ſpindle may go through the middle of the dial-plate, to carry the minute-hand. Alſo, on this ſpindle is a wheel 48, which drives another wheel of 48, which laſt has a pinion 6, which drives round the wheel 72 in 12 hours. There are two things to be obſerved here: 1. That the two wheels 48, are of no other uſe than to ſet the pinion 6 at a convenient diſtance from the minute-wheel, to drive the wheel 72, which is concentrical with the minute-wheel. For a pinion 6 driving a wheel 72, would be ſufficient, if the minute-hand had two different centers. 2. Theſe numbers 60—48)48—6(72, ſet thus, muſt be read thus, *viz.* the wheel 60 has another wheel 48 on the ſame ſpindle, which wheel 48 turns round another wheel 48, which has a pinion 6 concentrical with it; which pinion drives a wheel of 72. For a line parting two numbers, (as 60—48) denotes thoſe two numbers to be concentrical, or to be placed upon the ſame ſpindle; and when two numbers have a hook between them, (as 48)48) it ſignifies one to run in the other.

In the *ſtriking-part* there are 8 pins on the ſecond wheel 48; the count-wheel may be fixed to the great-wheel, which goes round once in 12 hours.

Numbers of a *clock* of 32 days, with 16, or 12 turns both parts; the *watch* ſhewing hours, minutes, and ſeconds; and the *pendulum* vibrating ſeconds.

The Watch-Part.

With 16 Turns.	With 12 Turns.
16)96	12)96
9)72	9)72
8)60—48)48—6)72	8)60—48)48—6)72
7)56	7)56
30	30

Or thus, with 16 Turns.

12)72
8)64
8)60
7)56

30

The

The Striking Part.

With 16 Turns.	With 12 Turns.
10)130	8)128
8)96 { 24 Pins / 12)39	8)104 { 26 Pins. / 8)24
6)72 double hoop.	8)96 double hoop.
6)60	8)80

The pinion of report is fixed on the end of the arbor of the pin-wheel: this pinion in the first is 12, the count-wheel 39; thus, 12)39, or it may be 8)26: in the latter (with 12 turns) it may be 6)18, or 8)24.

Numbers of a *two-month clock*, of 64 days, with 16 turns; the pendulum vibrates, seconds, and shews minutes, seconds, *&c.*

Watch Part.	*Clock-Part.*
9)90	10)80
8)70	10)65
8)60—48)48—6)72	9)54 { 12 Pins. / 8)52
7)56	5)60 double hoop.
30	5)50

Here the third wheel is the *pin-wheel*, which also carries the pinion of report 8, driving the count-wheel 52.

Or, Thus:

Watch-Part.	*Clock-Part.*
8)80	6)144
8)76	6) 78 { 26 Pins. / 8)24
8)60—48)48—6)72	6)72 double hoop.
7)56	6)60
30	

Numbers for a *clock* of thirteen weeks, with pendulum, turns, and motions, as before.

Watch-Part.	Or, Thus:
8)96	6)72
8)88	6)60
8)60—48)48—6)72	6)48—48)48—6)72
7)56	6)45
30	30

Clock-Part.	Or, Thus:
8)72	5)145
8)64—37)30	6)90 { —30 Pins / —24)62
8)48—12 Pins	6)72
6)48 double hoop	6)60
5)40	

Numbers for a *seventh-month clock*, with turns, pendulum and motions.

The Watch.	*The Clock.*
8)60	8)96
8)56	8)88—27)12
8)48	8)64—16 Pins
6)45—48)48—6)72	6)48 double hoops.
5)40	6)48
30	

Numbers for a *year clock* of 384 days, with turns, pendulum, and motions.

The Watch.	*The Clock.*
12)108	10)120
9) 72	8) 96—36)9
8) 64	6) 78—26 Pins
8) 60—48)48—6)72	6) 72 double hoop.
7) 56	6) 60
30	

If we will rather have the pinion of report on the spindle of the pin-wheel, it must be 13)39.

Numbers for a *clock* of 30 hours, the pendulum about 6 inches.

The Watch.	*The Clock.*
12)8	8)48
6)78	6)78—13 Pins
6)60	6)60
6)42	6)48
15	

Numbers for an *eight-day clock* with 16 turns, pendulum, about 6 inches, to shew minutes, seconds, *&c.*

The Watch.

8)96
8)64—48)48—6)72
8)60
8)40

15

The *clock* may be the same with the eight-day piece.

All the heretofore described *numbers* are for large pieces, but the following ones are for *pocket-watches.*

Numbers

Numbers for a *watch* to go 8 days, with 12 turns, to ſhew minutes and ſeconds, the train 1600.

Note, That the train of a *watch* is the number of beats, which a watch makes in an hour, or any other certain time.

6)96
6)48—12)48—12)36
6)45
6)42
——
19

On the wheel 42 is the ſecond's hand placed, and on the wheel 48 the minute hand.

Numbers of another ſuch a *watch* without minutes and ſeconds, to go with only 8 turns

20)10
——
6)66
6)60
5)50
5)45
——
19

Numbers of a *pocket watch* of 32 hours with 8 turns, to ſhew minutes and ſeconds, train as the laſt.

12)48
6)48—12)48—12)36
6)45——Second's hand.
——
19

If this crown wheel be too large, the following numbers may be uſed.

12)48
6)48
6)45
6)48 Second's hand.
——
15

The uſual *numbers* of 30 hours pendulum *watches* with 8 turns, to ſhew the hour and minute.

12)48
6)54—12)48—12)36
6)48
6)45
——
15

C O I N I N G.

THE *æra* of the invention of money is not eaſy to be determined; the firſt tidings we hear of it is in the time of *Abraham*, who paid 400 ſhekels for a burying-place. The *Greeks* refer the invention of money to *Hermodice*, wife of king *Midas*; and the *Latins* to *Janus*. Money being a common meaſure for reducing wares to a ballance, it was called by the *Greeks Nomiſma*, not from king *Numa*, but from *Nomos*, as being eſtabliſhed by law. By the *Latins* it was called *Pecunia*, either becauſe the wealth of thoſe days conſiſted in their cattle; or, as *Pliny* will have it, becauſe their firſt *coin* was ſtamped with the figure of a cow. They alſo call it *Moneta*, *à monendo*, as *Suidas* obſerves; becauſe when the *Romans* were in want of money, *Juno* admoniſhed them to uſe juſtice, and there ſhould be no want of money. The effect whereof, when they had found, ſhe was ſurnamed *Juno moneta*, and money was *coined* in her temple.

Copper is that money thought to have been firſt *coined*; afterwards *ſilver*, and, laſtly, *gold*.

Among the antient *Britons*, iron rings, or, as ſome ſay, iron plates, were uſed for money; among the *Lacedemonians*, iron bars quenched with vinegar, that they might not ſerve for any other uſe. *Seneca* obſerves, that there was anciently ſtamped money of leather, which was alſo practiſed during the *barons* wars in *England*, and by *Frederick* II. at the ſiege of *Milan*. In 1574, the *Hollanders coined* great quantities of paſteboard, reduced to it by neceſſity; for they had not, then, thoſe tons of gold they have reckoned by ſince. *Numa Pompilius* made money of wood and leather, neither does it appear that the *Romans* were much acquainted with the art of *coining* in metal, during the time of their kings. The firſt ſilver money they *coined* was in the year of *Rome* 484, and their firſt gold money in 546.

Some authors pretend, on the contrary, that the firſt moneys were of metals, and that it was natural for men to have recourſe to them, as being almoſt the only things whoſe goodneſs, and, as it were, integrity, is not diminiſhed by partition, beſides their firmneſs, neatneſs, cleanlineſs, durableneſs, univerſality, and the conveniences of melting and returning them again into a maſs of any ſize, or weight. That it was this property of metals which firſt accuſtomed people, who trafficked together, to account them in lieu of quantities of other merchandizes in their exchanges; and at length to ſubſtitute them wholly in their ſtead. That they would

would not say, that in the first ages, money, or coins of metal, had any determinate form, or shape; that, on the contrary, they are of opinion, that each person could cut his metal into what forms and sizes he pleased, according to the quantity he thought he could give, or according to the demand of the seller, or the quantity stipulated between them; that by degrees it was found more commodious to have pieces ready weighed, and as there were different weights required, according to the value of the different wares, all those of the same weight began to be distinguished with the same mark, or figure; that at length the growing commerce of money beginning to be disturbed by frauds, both in the weight and the matter, the public authority interposed, and hence the first stamp, or impression, on money; to which succeeded the names of the moniers, and at length the effigy of the prince, the date, legend, and other precautions, to prevent the alterations of the species; and that thus were coins compleated, and a right form given to money: which form has much varied, as to the weight, figure, impression, and value.

It is believed by several, that the *Jews* were the first who made any impression on money; it is true, that we find shekels, in the cabinets of antiquaries, one side whereof is stamped with the golden pot, which contained the manna, and the other with *Aaron*'s rod; but we do not know precisely the time when those shekels were stamped: though we have all the reason imaginable to suppose that the shekel was their first coin, which had been perpetuated among them ever since *Abraham*, and, consequently, that they were the first nation who made use of a regular coin. Besides the shekel, they had, in process of time, several other coins, both of gold and silver.

The silver coins were, the *gerah*, *bekah*, *shekel*, *maneh*, or *mina hebraica*, and *talent*. Ten *gerahs* made a *bekah*; twenty *gerahs* made two *bekahs*; and two *bekahs* a *shekel*: Twelve hundred *gerahs* made an hundred and twenty *bekahs*; an hundred and twenty *bekahs* fifty *shekels*; fifty *shekels* a *maneh*, or *mina hebraica*. Sixty thousand *gerahs* made six thousand *bekahs*; six thousand *bekahs* made three thousand *shekels*; three thousand *shekels* sixty *manehs*; and sixty *manehs* a *talent* of silver.

The *Dardans* stamped on their money two cocks fighting; the king of *Macedon*, a horse; the *Athenians*, an owl, or an ox: whence the proverb, on bribed lawyers, *Bos in lingua* They of *Ægina*, a tortoise; whence that other proverb, *Virtutem & sapientiam vincunt testudines*.

The current money of the *Greeks* were of three sorts of metals, *viz.* of copper, silver, and gold. The copper money were the *lepton*, *chalcus*, *dichalcus*, *hemiobolium*, *obolus*, *diabolum*, and *tetrobolum*. That of silver were, the *drachma*, *didrachmon*, *tetradrachmon*, *stater*, and *pentadrachmon*. And that of gold, the *stater aureus*, *stater Cyzicenus*, *stater Philippicus*, *Alexandrinus*, *Daricus*, and *Crœsius*.

Among the *Romans* the *Monetarii* sometimes impressed on the coins the images of men that had been eminent in their families; but no living man's head was ever stamped on a *Roman* coin till after the fall of the commonwealth; from that time they bore the emperor's head on one side, and hence the practice of stamping the prince's image on coins has obtained.

The *Romans* had, likewise, money of copper, silver, and of gold. The copper money were the *teruncius*, *semilibella*, *libella*, and *as*; sometimes *triens*, *sextans*, *uncia*, *sextula*, and *dupondius*. The silver money were, the *sestertius*, *quinarius*, *victoriatus*, and *denarius*. And the gold coin was the *aureus*.

Chamberlayn, and others, say, that it was the *Romans* who brought first the use of gold, silver, and brass coin, into *Great-Britain*, when *Julius Cæsar* invaded the island; that soon after the *Britons* imitated them, *coining* both gold and silver with the images of their kings stamped on them. When the *Romans* had subdued the kings of the *Britons*, they also suppressed their coins, and brought in their own, which were current here from the time of *Claudius* to that of *Valentinian the younger*, about the space of 500 years. *Cambden* observes, that the most ancient *English* coin he had known, was that of *Ethelbert*, king of *Kent*, the first *Christian* king in the island, in whose time all money accounts began to pass by the names of pounds, shillings, pence, and mancuses.

Pence seems borrowed from the *Latin pecunia*, or rather from *pendo*, on account of its just weight, which was about three pence of the present money; these were coarsly stamped with the kings image on one side, and either the mint-master's, or the city's where it was *coined*, on the other. Five of these pence made their scilling, probably so called from *Scilingus*, which the *Romans* used for the fourth part of an ounce. Forty of these scillings made their pound, and 400 of these pounds were a legacy, or a portion for a king's daughter; as appears by the last will of king *Alfred*. By these names they translated all sums of money in their old *English* testaments, talents by *pounds*; *Judas*'s 30 pieces of silver, by *thirty scillinga*; tribute money, by *Penining*; the mite, by *feorthling*. But it must be observed, that they had no other real money but pence only, the rest being imaginary moneys, *i. e.* names of numbers, or weights. Thirty of these pence made a *mancus*, which some take to be the same with a mark; *manca*, as appears by an old manuscript, was *quinta pars unciæ*. These *manca's*, or *mancus*'s were reckoned both in gold and silver; for in the year 680, we read, that *Ina*, king of the west *Saxons*, obliged the *Kentish* men to buy their peace at the price of 30000 *manca's* of gold. In the notes on king *Canute*'s laws, we find this distinction, that *mancusa* was as much as a mark of silver; and *manca* a square piece of gold, valued at thirty pence.

The *Danes* introduced a way of reckoning money by ORES, *per oras*, mentioned in *Doomsday-book*; but whether they were several coins, or a certain sum, does not plainly appear. This, however, may be gathered from the *abbey-book* of *Burton*, that 20 *ores* were equivalent to two marks. They had also a gold coin called *bizantine*, or *bezant*, as being *coined* at *Constantinople*, then called *Byzantium*; the value of which coin is not only now lost, but was so entirely forgot, even in the time of king *Edward* III. that whereas the bishop of *Norwich* was fined a *bizantine* of gold, to be paid the abbot of *St. Edmund's-Bury*, for infringing his liberties, (as it had been enacted by parliament in the time of the *Conqueror*) no man then living could tell how much it was; so it was referred to the king to rate how much he should pay; which is the more unaccountable, because but an hundred years before, two hundred thousand *besants* were exacted by the soldan of *Egypt* for the ransom of St. *Louis*, king of *France*, which were then valued at one hundred thousand livres.

Though the *coining* of money be a special prerogative of the king, yet the antient *Saxon* princes communicated it to their subjects; insomuch, that in every good town there was at least one mint, but at *London* eight, at *Canterbury* four for the king, two for the archbishop, one for the abbot at *Winchester*, six at *Rochester*, at *Hastings* two, &c.

The *Norman* kings continued the same custom of *coining* only pence, with the king's image on one side, and on the other the name of the city where it was *coined*, with a cross so deeply impressed, that it might be easily parted, and broken into two halves, which so broken, they called half-pence; or into four parts, which they called *fourthings*, or farthings.

They who desire a particular account of the variation of the *English* coin, both as to its intrinsic value and form, will find it at large in bishop FLEETWOOD'S *Chronicon. Preciosum*, and the historical account of *English* Coins by STEPHEN MARTIN LEAKE, esq; *Garter*, *king at arms*.

The present current *coins* in *England*, are of gold, silver, and copper. The gold *coins* are, the *guinea* and *half guinea*; the silver are, the *crown*, *half crown*, *shilling*, and *sixpence*; the copper are, the *halfpenny*, and *farthing*.

Two fathings make a halfpenny; 48 farthings, or 24 halfpence, make a shilling; 120 farthings, or 60 halfpence, or $2\frac{1}{2}$ shillings, make half a crown; 240 farthings, or 120 halfpence, or 5 shillings, or 2 half crowns, make a crown; 960 farthings, or 480 halfpence, or 20 shillings, or 8 half crowns, or 4 crowns, make a pound *sterling*; 1008 farthings, or 504 halfpence, or 21 shillings, or 8 half crowns $\frac{1}{3}$ and $\frac{1}{5}$, or 4 crowns and $\frac{1}{5}$, or 1 pound and $\frac{1}{20}$, make a guinea.

In *Scotland*, by the articles of the Union, it is appointed, that all *coins* be reduced to the *English*, and the same accounts observed throughout; till then, the *Scots* had their pounds, shillings, and pence, as in *England*; but their pound was but 20 pence *English*, and the others in proportion. Accordingly, their mark was $13\frac{3}{4}$*s*. *Scotch*, current in *England* at $13\frac{1}{2}$*d*. their noble in proportion Besides these, they had their turnorer pence and halfpence, their penny $\frac{1}{12}$ of that of *England*; besides base *money* of achisons, babees, and placks; the bodle, $\frac{1}{6}$ of the penny, $\frac{1}{4}$ of the achison, $\frac{1}{3}$ of the babee, and $\frac{1}{2}$ of the plack.

In *Ireland*, the *coins* are as in *England*, viz. shillings, pence, &c. with this difference, that their shilling, or harper, is but equal to 9 pence *sterling*; whence their pound is only $\frac{3}{4}$ of the *English* pound, or 15*s*.

The art of making of this money is called COINING; in which act there are two things necessary;

The metals to be coined, and the instruments they are coined with.

The metals most commonly coined, are gold, silver, and copper, though in some countries of *Europe*, besides these three metals, they coin bullion, as in *France*, *Holland*, and the *low-countries*.

The instruments, or rather utensils for *coining* are, 1. *Furnaces* for the melting of metals, of which there are two kinds, *viz.* those with wind, and those with bellows. The *wind-furnace* (thus called, because the air entring through the vent-hole at bottom, which is always open, serves the same purpose as bellows in other *furnaces*) has a bottom, a hearth, made hollow in manner of a cupel, with a vent-hole in the fore-part thereof; over the vent-hole is a grate sealed in the massive of the *furnace*; and over the grate is the place for the crucible *Furnace with bellows* consists of a flat hearth at bottom, into which the air is admitted by a hole contrived therein. On a level with the hearth

hearth is a ſecond aperture. which gives paſſage to the pipe of the bellows, from which the *furnace* is denominated. About a foot over this is a moveable grate, which may be taken off and put on at pleaſure. Over this is the place where the crucible is ſet, which is ſquare, and made of the ſame earth with the crucible; of breadth ſufficient to bear a range of coals around the crucible. Gold is uſually melted in this kind of *furnaces*, as requiring an intenſer heat before it fuſes; and ſilver and copper are commonly melted by the *wind-furnace*.

2. *Earthen crucible* for the melting of gold; and *pots* or *crucibles* of *iron* for ſilver or copper.

3. *Moulds* or *frames* for caſting the metals into long flat-bars.

4. *Models* or *patterns*, which are flat plates of copper, about fifteen inches long, and nearly of the thickneſs of the ſpecies to be ſtruck.

5. A *mill* to prepare the laminæ or plates of metal, and to give them the proper thickneſs, hardneſs, and conſiſtence, before they be ſtruck or ſtamped. This machine conſiſts of ſeveral wheels dented like thoſe of a clock, &c which moves two cylinders of ſteel, between which the metal is paſſed to be brought to its proper thickneſs. It was formerly turned with water, ſince with horſes.

6. A *cutting inſtrument* faſtened to the lower extremity of an arbor, whoſe upper end is formed into a ſcrew, which being turned by an iron handle turns the arbor, and lets the ſteel, well ſharpned in form of a punch-cutter, fall on the plate, and thus is a piece punched out.

7. *Files* or *raſps* to bring the pieces, by filing or raſping, to the weight of the ſtandard, whereby they are to be regulated.

8. *Scales* to adjuſt the pieces, and to ſeparate thoſe which prove too light from thoſe which are too heavy.

9. *Two copper veſſels*, wherein the blanks are blanched or whitened.

10. A *machine*, conſiſting of two plates of ſteel, in form of rulers, about the thickneſs of a line, on which the legend or edging is engraven, half on the one and half on the other, to mark the edges of the planchets, or pieces to be ſtamped, to prevent the clipping or paring of the ſpecies.

11. The *punchions* or *dyes*, which are pieces of good ſteel of a cubick form, wherein are engraven the prince's effigies, with the arms, legend, &c. They are alſo called *matrices*, becauſe in the cavities or indentures thereof the coins ſeem formed or generated, as animals are in the matrix of their mother. See PLATE I. of MECHANIC ARTS.

12. A *mill* or *preſs*, by the *French* called a *balancier*, whoſe chief parts are a beam, ſcrew, arbor, &c. all contained in the body of the machine, except the firſt, which is a long iron bar, with a heavy ball of lead at each end, and rings, to which are faſtened cords, which give it motion; it it placed horizontally over the body of the machine.

In the middle of the beam is faſtened a ſcrew, which, by turning the beam, ſerves to preſs the arbor underneath it; to the lower extremity of which arbor, placed perpendicularly, is faſtened the dye or matrice, of the reverſe or arms ſide, in a kind of box, or caſe, containing the dye of the image ſide, firmly faſtened to the lower part of the engine.

This machine was invented by a *Frenchman*, called *Antoine Brucher*, in 1553, and firſt tried at the *Louvre*, the king of *France*'s palace at *Paris*, for the *coining* of counters; before this invention, *coining* was performed by the hammer, which could never ſtrike the ſpecies with that neatneſs and perfection the *balancier*, or mill, does.

Having thus provided ourſelves with all the neceſſary implements for *coining*, we'll begin by mixing and melting our metal, for the *coining* of guineas, or *louis d'ors*, or *Spaniſh* piſtoles, or what gold ſpecies you pleaſe; we mix the metal, becauſe there are no ſpecies *coined* of pure gold, or ſilver, but always a quantity of alloy of copper is mixed with them: the reaſons are, partly the ſcarcity of thoſe two metals, partly the neceſſity of making them harder by ſome foreign mixture, and partly to defray the expences of *coining*.

There are two kinds of alloying, or mixing; the firſt where the gold or ſilver has not been uſed for money before; the other, where ſeveral kinds of ſpecies, or ingots of different ſtandards, and values, are to be melted down into a new money. The proportioning of the alloy with the fine metal, is eaſy in the firſt caſe, in the other more difficult; though M. *Boiſard* has given us a ready and eaſy method of doing it, by adviſing us to write down the ſeveral matters to be melted, their quality, weight, and fineneſs, in two diſtinct articles; the one containing thoſe above the ſtandard; the other thoſe under it. He ſays, that by caſting up the firſt, we ſhall have the exceſs; and, by the latter, the defect: and by comparing the two ſums, afterwards, we ſhall find, by ſubtraction, how much alloy muſt be added, to bring the ſeveral matters to the fineneſs required. We have followed this method, and mixed our metal accordingly, *i. e.* two carats of ſilver and copper (which is the alloy for gold) with a pound *troy* of gold, to bring our ſpecies to the *Engliſh* ſtandard.

We put our metal, thus mixed, in an earthen crucible, place our crucible on a little plate of forged iron, which we have before took care to lay over the grate of our bellows-furnace; we cover our crucible with an iron or earthen lid, then fill the *furnace* with charcoal, and when it is well lighted, and the crucible ſufficiently hot, we ſtop the vent-hole, and throwing on freſh coals, ſtop the *furnace* with an iron lid, thus continuing to work the bellows, and ſupply freſh fuel till the metal being in *balneo*, *i. e.* entirely melted, we ſtir it with a ſtirrer of baked earth; then take our crucible off the fire, with a kind of tongs, and pour the metal into our moulds, which we have had the precaution to range near the *furnace*, to be in readineſs to receive it, as it comes out of the crucible.

We take our bars, or plates, out of the mould, when cold, and after we have ſcraped and bruſhed them, we heat them again in a *furnace*, and quench them in water, to ſoften, and render them more ductile; then paſs them ſeveral times through the mill, to flatten them further, and bring them to the juſt thickneſs of the ſpecies to be *coined*.

Theſe plates, thus reduced, as near as poſſible, to their thickneſs, are cut, with our cutting inſtrument, into round pieces, called *blanks*, or *planchets*, near the ſize of the intended ſpecies; theſe pieces are given to be adjuſted, and brought, by filing, or raſping, to the weight of the ſtandard whereby they are to be regulated, ſaving what remains of the plate between the circles of the inſtrument, to be melted again.

To know if the pieces thus prepared are brought at laſt to the weight of the ſtandard, they are weighed in a balance, and thoſe too light ſeparated from thoſe too heavy; thoſe too light are melted again, and thoſe too heavy filed down: this difference in the weight, proceeds either from that the mill through which the plates have paſſed to be flattened, can never be ſo juſt, but there will be ſome inequality, whence will ariſe a difference in the *blanks*, as from the inequality of the matter, ſome parts being more porous than others.

When the *blanks*, or *planchets*, are exactly brought to the ſtandard, they are ſent to the blanching, or whitening houſe, to be coloured, which is done by heating them in a *furnace*; and when taken out, and cool, boiling them ſucceſſively in two copper veſſels, with water, common ſalt, and tartar; when they are of the colour intended, they are taken out of the boiler, and put in a copper ſieve; then ſcoured well with ſand, waſhed with common water, and dried over a wood fire, in the ſame copper ſieve they were put in when taken out of the boilers.

When dry, they are ſent to be edged, which is performed by means of thoſe two plates of ſteel in form of rulers, abovementioned, one whereof is immoveable, and ſtrongly bound with ſcrews to a copper plate, and that again to a ſtrong board, or table; the other is moveable, and ſlides on the copper plate, by means of a handle, and a wheel or pinion of iron, the teeth whereof catch in a kind of other teeth, on the ſurface of a ſliding plate. The *planchet*, or piece of plate, is placed horizontally between theſe two plates, and by that time it has made half a turn, it is found marked all round.

The *planchets*, thus edged, are carried to the *balancier*, and laid one after another on the image matrice, upon which two men draw, each on his ſide, one of the ropes of the beam, and turns the ſcrew faſtened to it; which by this motion lowers the arbor to which the dye of the arms is faſtened; by which means, the metal being in the middle, at once receives an impreſſion on each ſide, from each dye.

Silver is *coined* in the ſame manner, with theſe few differences; 1. That the alloy of ſilver is copper alone, 18 pennyweights of which are allowed in a pound *troy* for ſtandard ſilver in *England*. 2. Silver is melted in a *wind furnace*. 3. When melted, it is taken with a ladle out of the crucible, to be poured into the aperture of the mould.

When the *blanks*, either of gold, ſilver, copper, or bullion, have all their marks and impreſſions both on the edges and faces, they become money, but have no currency till they have been weighed and examined; for which reaſon, monſieur *Boiſard* very pertinently defines money, a piece of matter, to which public authority has affixed a certain value and weight, to ſerve as a medium in commerce.

The place where the money is *coined* is called the Mint. In *France* there are as many *mints* as there are letters in the alphabet, and it is known by the letter of the alphabet placed in the exergue of the *coin*, where the piece has been ſtruck. All the ſpecies *coined* at *Paris* are marked with the letter A. Thoſe *coined* at *Rouen* in *Normandy* with the letter B, &c. In the province of *Britanny* there are two *mints*; one at *Rennes*, where the money is marked 9. and another at *Nantz*, where they are marked with the letter T.

Though there were antiently *mints* in moſt cities of *England*, there is at preſent but one, and that in the *Tower of London*. This *Mint* was made a corporation by a charter of king *Edward* III. and conſiſts, 1. Of the warden or keeper of the exchange and *mint*, whoſe office is to receive the bullion brought in by merchants, goldſmiths and others, to pay them for it, and to over-ſee all the other

other officers. 2. The maſter-worker, who receives the bullion from the warden, cauſes it to be melted, delivers it to the moneyers, and takes it from them again, when *coined:* his allowance formerly was not any ſet-fee, but according to the pound weight; as by an indenture under the great ſeal. 3. The comptroller, who ſees that the money be made to the juſt aſſize, to overſee the officers, and reprimand them if the money be not as it ought to be. 4. The aſſay-maſter, who weighs the ſilver and gold, and ſees whether it be ſtandard. 5. The auditor, who takes and makes up the accounts. 6. The ſurveyor of the melting, who is to ſee the ſilver caſt out, and that it be not altered after it is delivered to the melter, *i. e.* after the aſſay-maſter has made trial of it. 7. The clerk of the irons, who is to ſee that the irons be clean, and fit to work with. 8. The graver who engraves the dies and ſtamps for the *coinage* of money. 9. The melters, who melt the bullion before it comes to *coining.* 10. The blanchers, who anneal or boil and cleanſe the money. 11. The porters, who keep the gate of the *mint.* 12. The provoſt of the *mint*, who provides for all the moneyers, and overſees them. And *laſtly*, the moneyers, ſome of which ſhear the money, ſome forge it, ſome ſtamp or *coin* it, and ſome round and mill it.

Of CONFECTIONARY.

THE art of the CONFECTIONER is to preſerve all ſorts of *vegetables*, as flowers, fruits, herbs, roots, and their juices, in ſuch a manner, as to preſerve their natural form, colour, taſte, ſmell, &c. for a conſiderable length of time.

This may be performed by *honey*, but the moderns do it with *ſugar* prepared different ways; which, according to its different degrees of conſiſtence acquired by boiling, is known by the name of *icy ſugar*, *pearl ſugar*, *feather ſugar* and *breaking ſugar*.

Sugar is boiled to the conſiſtence of *ice*, if the middle finger, being dipped into it, and applied afterwards to the thumb, the *ſugar* remains immoveable, and round, like a ſmall pea, upon the thumb. It is ſaid to be boiled to a *pearl*, when, by opening the finger and the thumb, which had been before joined, the *ſugar* forms a ſmall thread. It is boiled to *feathers*, when a ſpatula, having been dipped into it, and ſhaken afterwards, the *ſugar* flies into the air; for if it runs yet, it is not done. And, laſtly, it is reduced to the conſiſtence of *breaking*, if a ſmall ſtick, which has been before dipped into cold water, being dipped afterwards into the boiling *ſugar*, and dipped again into cold water, the *ſugar* breaks, and grows dry in the water; for if it be yet ſticky, it is not of a right conſiſtence. Of theſe four preparations of *ſugar*, all ſorts of *confects* are made.

Mix about a quarter of a pint of water for every pound of prepared *ſugar*, and no more, for if there was more, it muſt be evaporated, before the *ſugar* can acquire its due conſiſtence.

Confects are reduced to eight kinds, *viz. liquid confects*, *marmalades*, *jellies*, *paſtes*, *dry confects*, *conſerves*, *candies*, and *dragees*, or *ſugar plumbs*.

LIQUID CONFECTS, are thoſe whoſe fruits, either whole, in pieces, ſeeds, or cluſters, are *confited* in a fluid tranſparent ſyrup, which takes its colour from that of the fruit boiled in it; if they be too little ſugared, and too little boiled, they turn; and if too much ſugared, or too much boiled, they candy.

All fruits for *confects* muſt be a little green, and gathered when they begin to ripen, except *gooſeberries*, *cherries*, *pears*, and *quinces*, theſe muſt be ripe, and *confected* at a great fire, except *quinces*, which want but a ſlow fire, as well as the fruits, which are to be green; which fruits muſt be boiled in water at a ſlow fire, pouring upon them ſome acid, as vinegar, or ſpirit of vitriol, to render them of a ſtill more beautiful green: but when they are in the *ſugar*, they muſt be diſpatched at a great fire.

There muſt be a pound of *ſugar* to every pound of fruit; except *cherries*, a pound of which wants but half a pound, or three quarters of a pound of *ſugar*; but every pound of *quinces* wants a pound and a quarter of *ſugar*

The manner of performing this art may be ſufficiently known by the following preparations, to which examples all others may be reduced

All ſorts of PLUMBS, for *confects*, muſt be taken when they begin to ripen: pare them, and put them into cold water, and afterwards into hot water, ready to boil, in which leave them till they begin to grow green: then take them off the fire, and let them grow cold, in the ſame water. Being cold

cold take them out, and put them into cold water; from that water, and after they have been well drained of their water throw them into *feathered ſugar* boiled at a great fire, and ſkim them; then boil them, which done, they are to be taken off the fire, and left to grow cold, and put again on the fire, and boiled, till the ſyrup has acquired the conſiſtence of *pearl*; then they are to be taken off the fire, and put into pots: which pots are to be covered, when the *plumbs* are cold.

CHERRIES are preſerved either with their ſtones, or without. If with their ſtones, the ſtalk muſt be cut very ſhort; if, without, they muſt be pulled out gently by the ſtalk, without bruiſing the *cherries*; which are to be gathered very ripe. the *cherries* called *morelia's* are the moſt proper for *confects*; the *cherries* are put into *feathered ſugar*, boiled at a great fire, ard ſkimmed; which done they are taken off the fire, and left to grow cold; then put again on the fire, and made to boil faſt, and ſkimmed again, if it be neceſſary. When taken off the fire, for the laſt time, put them into pots and cover them when cold.

Raſberries muſt be gathered as whole as poſſible, and before they are quite ripe. Their ſtalks muſt be pulled off. Then put them into a glazed earthen pan, flat at the bottom; *feathered ſugar* poured upon them, and having been left to grow cold, the whole mixture is poured afterwards gently into a copper baſon, and made to boil, and ſkimmed, till the ſyrup be reduced to the conſiſtence of pearl, which done, they are taken off the fire, and put into pots as before.

For green liquid APRICOCKS; they muſt be gathered green and tender, pared, and thrown into cold water, and afterwards put into warm water, where they are left till they begin to grow green; then they are taken off the fire, and left to grow cold in the ſame water: being cold, they are put into freſh water, out of which being taken afterwards, and drained, they are put into *icy ſugar*; where they are left to boil for a very ſhort ſpace of time; then they are taken off the fire, and left to grow cold a little, and afterwards put again on the fire, and left to boil till the ſyrup be reduced to a pearl conſiſtence: Then they are put into pots, as other *liquid confects*.

For ripe liquid APRICOCKS, they muſt be pared as well as poſſible, without bruiſing or disfiguring them, and afterwards put into boiling water, where they muſt boil gently for the ſpace of two minutes. Then they are taken off the fire, and thrown into cold water: while they are in the water, *ſugar* is boiled in form of a conſerve, in which the *apricocks* muſt boil two or three gallops; which done, they are carried to the ſtove, where they are left till the next morning, keeping all the while a ſmall fire under it.

Peaches are preſerved after the ſame manner; except that they muſt be ſtoned, and boiled in *pearl ſugar*.

Quinces muſt be taken very ripe, cut into halves, or quarters, pared, and cleanſed of their cores: as they are pared, they are thrown into cold water, and from thence into boiling water, where they are left till they are grown ſoft; which done, they are taken out, and put into cold water: While they are in the freſh water, *ſugar* muſt be boiled according to our firſt preparation, into which the *quinces* are put, and made to boil at a ſlow fire, covering them, if they be wanted very red; they muſt be taken off the fire by intervals, and put again upon it, till the ſyrup has acquired the conſiſtence of jelly; then they are put into pots, and covered when cold.

MARMALADES, are a kind of *paſtes* half liquid, made of the pulp of fruits or flowers.

PASTS are thickened to a degree, by boiling, ſo as to aſſuume any form, when put into little moulds, and dried in an oven. The moſt in uſe, are thoſe of *gooſeberries*, *quinces*, *apples*, *apricocks*, and *orange*, *flowers*.

To make a *paſte* of *cherries*, take the largeſt, and ripeſt, take off the ſtalks and ſtones, and boil the fruit a little in a very ſmall quantity of water, ſtrain it afterwards through a cullender putting under it a diſh, to receive what paſſes through while you ſtir and ſqueeze the *cherries*. When all the fruit is ſtrained through, it muſt be put into a very clean copper baſon, and dried on the fire, ſtirring it without intermiſſion, leſt it ſhould burn, and till your *cherries* begin to dry, which you'll perceive by their ſticking no longer to the baſon. Then mix with them half, or three quarters of a pound of ſugar, in powder; which done, you muſt ſpread your *paſte* upon ſlates, giving it what form you pleaſe, and carrying it afterwards to the ſtove to dry.

To make a *paſte* of *raſberries*, you muſt take them very ripe, pull off the ſtalks, and ſtrain them through a ſieve, proceeding afterwards as in the *paſte* of *cherries*.

The *paſte* of *apricocks* is made by paring them, when very ripe, taking out the ſtones, boiling them in water; draining them; ſtraining them through a ſieve, and making a *paſte* like that of *cherries*.

To make a *paſte* of *quinces*, you muſt take them very ripe, pare them, take out the cores and ſtones, boil them in water till they be very ſoft, ſtrain them through a coarſe ſieve, and afterwards make your *paſte* as you did that of *cherries*.

There are *pastes* of *sugar*, called *biskets*; as common *biskets*, *biskets* of *orange-flowers*, *jessamine*, *citron*, *savoy biskets*, common, royal, and curled *massepains*, &c.

The *common biskets* are made, by taking eight eggs, or thereabouts, breaking them, and putting the yolks and whites together in a copper bason, and beating them for half an hour with a wooden spatula; which done, a pound of sugar, in powder, must be added to it, and the whole very well mixed, and beat together for another half hour: then the *paste* must be left at rest for some time, and afterwards put into moulds of tin, or paper, mixing with it some sugar, in powder, to glaze it. The moulds, thus filled, are put into an oven, not so hot as one could not bear his hand in it, or into a copper stove, which must have lighted coals a-top and underneath, but a little more a-top than underneath; where they must be left till the *biskets* be very well risen, and assumed a golden colour; for then they are taken out of the moulds, with the point of a knife, and put into a hot place, till they be thoroughly dry.

The *common massepain* is made in this manner: Take a pound of sweet almonds, blanch them in hot water, and put them afterwards in cold; take them out, dry them upon a napkin, and pound them in a stone mortar, with a wooden pestle, moistening them often with whites of eggs, and rose or orange-flower water, till they be reduced to a paste; which done, it must be thrown into *feathered* sugar, mixed together, put on the fire, stirred continually with a spatula, taking care that nothing burn at the bottom or sides of the bason; and when you perceive that nothing sticks to it, you must take out your *paste*, and spin it in what form you please, and carry afterwards your *massepains* to the oven to be baked.

Jellies, are juices of several fruits, wherein *sugar* has been dissolved, and the whole, by boiling, reduced to a pretty thick consistence; so as, upon cooling, to resemble a kind of thin transparent glue, *jellies* are made of various kinds of fruits, especially *gooseberries*, *apples*, and *quinces*. There are other *jellies* made of flesh, fish, hartshorn, &c.

To make *jellies*, you may take what sort of fruits you please, cut them into pieces, and boil them in water till they be very soft; they must be strained, with a strong expression, through a clean piece of cloth, to extract from it as much decoction as possible. A quart of that decoction must be put into a bason, with a pound of *sugar*, and boiled together, till the *jelly* be formed, which will be known, if by taking some of the composition with a spoon, it falls from the spoon in large lumps, and not in running or spinning. When it has acquired that consistence, it must be taken off the fire, and put into pots.

The *jelly of hartshorn* is made by boiling a sufficient quantity of hartshorn shavings in white wine for the space of two hours, more or less, at the *confectioner's* discretion; when boiled, it is strained thro' a cloth, and afterwards put in a bason with a sufficient quantity of *sugar*, (*i. e.* a pound of *sugar* for two pounds of hartshorn) and lemon juice; when it is ready to boil, whites of new-laid eggs must be mixed with it, and immediately after the whole mixture must be thrown in the flannel, and kept in a cool place. The *green*, *yellow*, *blue*, &c. *jellies*, are the same *jelly*, only coloured with those different colours.

The *blanc manger* is made of the same *jelly*, warmed with almonds very well pounded, and the whole strained through a cloth.

All sorts of red or green *jellies* must be done at a slow fire, and covered; and all white *jellies* at a great fire, and uncovered.

The *jelly* of *gooseberries* is made by straining them through a napkin, or other cloth, adding three quarters of a pound of *sugar* to a quart of the juice, and boiling them together till the mixture has acquired the consistence abovementioned.

Dry Confects, are those, whose *fruits*, after having been boiled in the syrup, are taken out again, and put to dry in an oven. The most considerable are, *citron* and *orange-peel*, *plumbs*, *pears*, *cherries*, *apricocks*, &c.

Oranges are often preserved whole, *i. e.* without being cut in pieces; which is done in this manner: pare oranges, as thin as possible; slit them at the eye; put them in boiling water, and make them boil for about half a quarter of an hour; take them out, and put them in cold water; then, with a spoon or scoop made for that purpose, take out all the pulp; throw them into more cold water, and afterwards into boiling water, making them boil as before; and again into boiling water, repeating the same operation three times successively; and, lastly, put them into the finest *lisse sugar*; where they must boil for half a quarter of an hour, and afterwards be taken off the fire, and left to cool: when cold, they are put again on the fire, to boil till the sugar be reduced to the consistence of being shaken into flakes; which done, they must be taken off the fire, and when cold, and well drained of the sugar, disposed upon clean straw.

There is as much sugar wanted to preserve *oranges* and *citrons*, that the fruit may swim in it; but what is left of it, may serve for other things.

Apri-

APRICOCKS are confected, by taking small green *apricocks* very tender, paring them, and having them done in hot water, without boiling, till they begin to grow green; for then they must be taken out, and put in cold water, and after they have been very well drained, boiled in sugar of the consistence of our first preparation, till the syrup be reduced to the consistence of our second preparation of sugar; then they are put into an earthen pan, where they are left for eight days: that time expired, they are put into a copper bason, and boiled till the syrup be once more reduced to a pearl consistence; which done, they are put again into the earthen pan, and when cold they are disposed on slates, and put to dry in the stove, where they are often turned, till they be thoroughly dry. Then they are put into boxes, upon paper, so that they may not touch one another.

For *cherries*, after the stones have been taken out, they must be boiled in a small quantity of water, that they may pour out their juice; and when they have been well drained, they are boiled in sugar reduced to a pearl consistence, till the syrup has acquired, likewise, a pearl consistence; which done, they are put in an earthen pan; where they are left for eight days; after which, they are once more boiled till the syrup has acquired the same consistence as before: when they are done, they are left to grow cold, when cold they are disposed upon slates, and put to dry in the stove, where they must be turned twice every day, if they want it, till they be quite dry: being dry, they are put in boxes upon paper, making one bed of paper, and another of *cherries*, and thus successively, till they are all packed up. The paper must be changed at least every fortnight, and if they be kept long, and the paper under them is found wet, it must be changed likewise, as well as that under all sorts of dry confects, if we design to keep them long. They must even be put, from time to time, to the stove, when they want it.

Plumbs must be neatly pared, and as they are pared thrown into cold water, and afterwards into other water ready to boil, where they must be left on the fire, covered, and without boiling, till they grow green; which done, they are thrown again into cold water, and afterwards preserved, and dried like *cherries*. All sorts of *plumbs* are done in the same manner; as also *peaches*.

CANDIES are ordinarily entire fruits, and flowers, *candied* over with sugar, after having been boiled in the syrup; which renders them like little rocks crystallized, of various figures and colours, according to the fruits inclosed within them.

Oranges are *candied* whole, by taking whole *oranges* newly confected, and not much loaded with sugar, and putting them in sugar reduced to the consistence of being shaken into flakes; but the vessel which contains the sugar must be flat, that the *oranges* may not touch one another, nor the bottom of the pan: then they are carried to the stove, where they are left twice twenty four hours, which being expired, they are taken out, and put upon straw to dry. *Apricots*, *peaches*, and all other fruits, are *candied* in the same manner.

CONSERVES, are a kind of *dry confects*, made with sugar, and pastes of flowers, fruits, &c.

To make the *conserve* of *cherries*; take out the stones, and make the fruit boil in a small quantity of water; when boiled, you must drain them, cut them to pieces, and throw them afterwards in sugar reduced to the consistence of being shaken into flakes; then dress your *conserve* upon paper. The sugar must be off the fire when you throw the fruit into it.

Conserve of *roses*, is made by taking *red roses*, in powder, dissolving them in the juice of lemon, and mixing the dissolution with sugar reduced to the consistence of being shaken into flakes.

To make the *conserve* of *violets*, you must take the leaves of flowers of *violets*, pound them in a mortar, strain them through a cloth, to extract the juice, and mix that juice with sugar reduced to the same consistence as above; when you dress the *conserve*, you must mix with it some juice of lemon, to give it a livelier colour.

SUGAR PLUMBS, are made of small fruits, or seeds, little pieces of bark, or odoriferous and aromatick roots, &c. incrustated, and covered over with a very hard sugar, ordinarily very white.

To make all sorts of *sugar-plumbs*, there must be had a large copper bason, with two handles to it, suspended with two cords, at the height of the wasteband; under which, there must be an earthen pan, or chafing-dish, with a moderate fire, to make the *pearled sugar-plumbs*: there is wanted, besides, a kind of funnel, through which the sugar must pass, to make *pearled sugar-plumbs*.

Pearled almonds, are made of sweet *almonds*, very well dried over the fire, pouring upon them, through a funnel, the sugar, reduced to the consistence of our first preparation, shaking the bason all the while, and turning the *sugar-plumbs*, that they may all take, as near as possible, an equal quantity of sugar. They may also be stirred with the hand, and parted, if they stick together. The syrup can likewise be stopped running, to give time to the *sugar-plumbs* to dry.

The *glazed almonds* are made, by pouring upon them in the bason, with a ladle, about a quarter of a pint at once of sugar, reduced to the consistence of our first preparation, stirring often the *almonds* with

with the hands, and leaving them sometimes at rest. *Carraways*, *anniseeds*, &c. are prepared in the same manner, after they have been very well cleansed of all their dust, stalks, &c.

Of COOKERY.

COOKERY, is the art of preparing meats for food, that they may be both wholesome and agreeable to the palate.

I'll begin with the manner of making SOUPS.

Take that piece of beef called the *mouse buttock*, some mutton, and fowls, regulating the quantity of meat, according to the quantity of broth wanted: put that meat in a pot, with a bunch of parsley, young onions, and thyme, tyed together, and a few cloves; fill the pot with water, keeping always warm water ready to re-place that of the pot, which evaporates in boiling; and when the meat is boiled almost to rags, strain the *broth* through a napkin, to use it as occasion serves.

These sorts of *broths* may be eaten without any other addition, except pulse, if one likes it, *viz.* cabbages, turnips, &c. which pulse are to be boiled in a pot a-part, and after they are well drained of their liquor, they are put in the *broth*, to boil two or three gallops more, and afterwards put in a dish, and carried to table.

To make the *soup of jiblets*, after they have been well scalded, they must be fried like a fricassy of fowls, and afterwards put in a pot with our best broth, where they are left to stew at a slow fire, for three quarters of an hour.

To make *pease soup with a green goose*, we put our green goose to boil very well in a pot, and our pease in another; when the pease are well mashed, we put in it a bundle of sweet herbs, and fat bacon melted in a frying-pan: we have bread stewed in the broth of the green goose, and pour the pease soup upon it.

To make the *soup of fowls with green pease*, put the fowls to boil with broth, and skim them well; then pass the green pease through a frying-pan, with butter, or melted bacon; and afterwards have them stewed a-part, with lettices: and when the fowls are done, mix the broth and pease together, and send it to the table.

To make the *soup of a capon with rice*; boil the capon in broth well seasoned; pick the rice, wash it, and have it dried before the fire; then put it to boil slowly in a very good broth, with a blade or two of mace; and when the capon and rice are done, we mix them together, and send them to the table.

The fowls used to make these sorts of *soups*, are commonly served whole a-top of the *soup*, and the dish garnished either with chicory, mushrooms, truffles, capers, or onions, according to the different sorts of *soups*.

To make *herb soup*, you must hash very well together, sorrel, buglos, burrage, and a good quantity of lettices; then fry them in fresh butter, and put them afterwards in boiling water, with other fesh butter, and a crust of bread, making it boil slowly, for the space of an hour, at least. When the *soup* is to be carried to table, you may whiten it if you please, with yolks of eggs beaten with some of the *soup*.

To make a *soup of crawfish*; after the crawfish have been cleaned well, they are boiled in wine, vinegar, salt, and pepper; being done, the claws and tails are fried with fresh butter and some parsley, and the bodies beaten in a mortar with an onion, hard eggs, and crumbs of bread: this done, the mixture is put to stew with some of the *herb soup*, or other *soup*; when stewed, it is strained through a cloth, and put afterwards before the fire, to keep it hot; then you fry some parsley in fresh butter, which you put, when fried, together with the butter, in your *soup*, well seasoned, which must stew a little longer. When the *soup* is carried to table, the dish must be garnished with the claws and tails of the *crawfish*.

To make a *soup of carps*, we take out all the bones, and put them to boil in pease soup, with some onions, and crumbs of bread; being boiled, they must be fried with some parsley, and put again in the *soup*: while they are boiling, we make a hash of the flesh of the *carps*, which, when done, is put over the toasted bread, and the broth poured upon it, garnishing the dish with slices of lemon and mushrooms.

To make a *soup of stuffed mushrooms*; we pick and wash them well, then put them to boil in water, with an onion larded with cloves, thyme, pepper, and salt; when boiled, we strain the broth through a cloth, and put it in a pot; then fry the mushrooms with butter, parsley, and capers, and put them afterwards in the broth; and when ready to be carried to table, we fill the bottom of the dish with a hash of carps, and pour the broth upon it, garnishing the dish with mushrooms stuffed with the same hash.

To make *onion soup*, we slice the *onions* very thin, and then fry them; we put them in a pot with water, and more butter, making them boil till they are well done; then we put a cruſt of bread in it, with ſome ſalt and pepper, leaving it to boil for a little while longer. When fit to be carried to table, we beat yolks of eggs with a drop or two of vinegar or verjuice, with which we thicken and blanch the *ſoup*. Some add to it, while it is boiling, a few ſpoonfuls of peaſe ſoup, and then it wants no eggs.

To make a *ſoup of green peaſe*, you muſt take them as young as poſſible, and having been fried in freſh butter, they are put to ſtew, well ſeaſoned with parſley and young onions; when ſtewed, they are mixed with *herb ſoup*, and carried to table.

To make a *ragout of ducks*, they muſt be larded, fried, very well ſeaſoned with ſalt, pepper, ſpices, young onions, and parſley, and put in a pot to ſtew, with a little of our beſt broth.

To make a *ragout of pigeons*; they muſt be larded, fried in lard, ſeaſoned, and put to ſtew in a little of our beſt broth, with a ſmall bundle of fine herbs.

To make a *ragout of fowls*; they muſt be larded, cut in halves, ſeaſoned, and put to ſtew in broth, with a ſmall bundle of fine herbs, truffles, muſhrooms, and a few ſmall pieces of roaſted pork, to give them a reliſh.

To make a *ragout of a pig*; it muſt be cut in four quarters, well ſeaſoned, and fried; when done, it is garniſhed with capers, truffles, and muſhrooms.

To make a *ragout of calves feet*; when they are well done, they muſt be floured and fried in lard, and afterwards put to ſtew in broth, with verjuice, a ſmall bundle of fine herbs, and a piece of lemon, the whole well ſeaſoned, and the ſauce ſhort. They muſt be carried to table with capers.

A *ragout of double tripes*, is made by cutting the tripes very ſmall, frying them in lard, with parſley and onion, and having been ſeaſoned with capers and vinegar, they are left to ſtew a little while in the frying-pan.

To make a *ragout of a fillet of veal*, it muſt be larded, and a little more than half roaſted on a ſpit, and afterwards put to ſtew with very good broth, a ſmall bundle of fine herbs, pepper, and cloves, in a pot covered cloſe. When done, the ſauce muſt be thickened with yolks of eggs well beaten, with a little verjuice, or the juice of a lemon, or ſome vinegar.

To make a *ragout of the loin of a deer*, after it has been larded, and half roaſted, it muſt be baſted till it is quite done, with a ſauce made of pepper, vinegar, and broth, and the ſauce thickened afterwards with crumbs of bread.

To make a *ragout of a hare*, after it has been half roaſted, it is cut in pieces, fried, and then put to ſtew, ſlowly in a diſh, with the juice of oranges, capers, and crumbs of bread.

To make a *ragout of ſoles*, they muſt be floured, and half fried; then they are opened all along the bone, and the bone taken out; which done, they are filled with a ſtuffing made of capers, muſhrooms, truffles, ſoft rows, and crumbs of bread; and put afterwards to ſtew in a pot, with freſh butter, an onion cut ſmall, verjuice, and ſome broth. When carried to table, the diſh muſt be garniſhed with ſlices of lemon.

To make a *ragout of pikes*, they muſt be cut in ſlices, and put to ſtew with white wine, a bundle of ſweet herbs, freſh butter, and well ſeaſoned with ſalt, pepper, capers, and muſhrooms; when done, the ſauce is thickened with yolks of eggs, beaten with ſome vinegar, or verjuice.

To make a *ragout of tench*, they muſt be cut in pieces, well waſhed, and boiled in water, with ſalt, pepper, and an onion, adding to it, afterwards, half a pint of white wine, and ſome haſhed parſley. When done, the ſauce is thickened with yolks of eggs, as above.

To make a *ſtew of carps*, they muſt be cut in pieces, put to boil in a pot with white or red wine, and well ſeaſoned with haſhed onion, ſalt, cloves, pepper, capers, and ſome cruſts of bread; when they are well done, the ſauce is thickened with yolks of eggs.

To make a *ragout of ſtuffed carps*, the *carps* muſt be opened all along the back bone, the ſkin raiſed, the fleſh haſhed, and ſeaſoned with parſley, freſh butter, ſalt, pepper, and yolks of eggs, with which we fill the ſkin; then we make it boil in broth, ſeaſoned with verjuice, muſhrooms, aſparagus, young onions, and freſh butter: when almoſt done, the ſauce muſt be thickened with crumbs of bread, adding capers to it.

To make a *ragout of ſalmon*, it muſt be larded with cloves, and roaſted; when roaſted, it muſt be ſtewed ſlowly in wine, with ſalt, pepper, and freſh butter, till the ſauce grows very ſhort.

To *ſtew ſalmon*, it muſt be cut in ſlices, larded with cloves, and put to ſtew in white or red wine, well ſeaſoned, with freſh butter, ſalt, pepper, capers, and an onion haſhed, till the ſauce grows very ſhort.

To make a *ragout of oyſters*, they muſt be put to ſtew in their own liquor, with freſh butter, onions, haſhed parſley, capers, and crumbs of bread, well ſeaſoned with pepper and ſalt.

To make a *ragout of flounders*, they muſt be put in a ſtew-pan, with butter, young onions, beaten cloves, ſalt, pepper, capers, ſome white wine, or vinegar, and muſhrooms; when done

th,

the ſauce is thickened with yolks of eggs. *Plaiſe* are done in the ſame manner.

To *ſtew eels*, we cut them in pieces, and ſtew them in white wine or water, with parſley, capers, and freſh butter, the whole very well ſeaſoned, with ſalt, pepper, and beaten cloves.

To *dreſs collared eels*; ſlit the *eel* in half, take out the bone, beat the fleſh well, and ſeaſon the two pieces with pepper, ſalt, butter, and haſhed parſley; then roll them, and tye them very tight with packthread: thus prepared, put them to boil in white wine, well ſeaſoned; and when done, take them out and ſend them to table in ſlices.

To *ſtuff a pike*, it muſt be ſlit all along the back-bone, the ſkin left from the head to the tail, half the fleſh taken off with the ſmall bones, and the back-bone left, to keep up the *pike* when ſtuffed; then we take half the fleſh of the *pike*, and half fleſh of *carps*, or *eels*, and haſh them together, with yolks of eggs raw, parſley, ſalt, pepper, ſweet herbs, butter and milk mixed together, and muſhrooms; with which we ſtuff the *pike*, ſew it up, and then put it to boil, making the ſauce with fiſh broth, a drop or two of vinegar, or verjuice, parſley, capers, and muſhrooms, well ſeaſoned.

To *broil mackerel*, they muſt be wrapped in fennel, and put upon the gridiron, at a charcoal fire, turning them often; when roaſted, they muſt be opened, and a good ſauce made under them, with butter, parſley, and gooſeberries, the whole very well ſeaſoned.

To *broil freſh herrings*, they muſt be put on the gridiron, and when they begin to roaſt, rubbed over with butter; when roaſted, a ſauce muſt be made with freſh butter, a drop or two of vinegar, ſalt, pepper, nutmeg, and ſome muſtard.

To make a *ragout of freſh cod*, it muſt be rubbed over with butter, put upon the gridiron, ſeaſoned with ſalt and cloves, and while roaſting, baſted with butter, in which we put parſley haſhed and onions, mixing with it ſome broth, vinegar, and haſhed capers; then we put the roaſted *freſh cod* to ſtew a little, in that ſauce, and carry it to table with ſome muſtard.

To make *à la mode beef*, you muſt take a piece of the buttock, beat it well, and lard it; then it muſt be put in a pot, with good broth, pepper, beaten cloves, and a ſmall bundle of fine herbs; and the pot being covered cloſe, is put on a ſlow fire, where it remains till the beef is done.

To dreſs *capons with oyſter-ſauce*, the *capon* muſt be *larded*, *i. e.* the fore and hind-part covered with a thin ſlice of bacon, and over it a buttered paper; then it is put to roaſt; the oyſters muſt be fried with the dripping of the capon, and ſeaſoned, while frying, with muſhrooms and onion, and a ſmall bundle of fine herbs: when they are well fried, they are put in the body of the capon, the bundle of herbs excepted, before it is quite done.

To make a *ragout of calf's liver*, it muſt be larded with big *lardons*, well ſeaſoned, with a ſmall bundle of ſweet herbs, orange-peel, and capers, and put in a pot to ſtew with ſome good broth.

To make a *ſtew of fowls*, they muſt be cut in ſmall pieces, and put to ſtew with very good broth, white wine, and freſh butter, and well ſeaſoned with onions and parſley haſhed together; when they are done, the ſauce muſt be thickened with yolks of eggs well beaten with verjuice, or vinegar.

To *fry a calf's head*, after it has been well boiled, the bones muſt be taken off; then make a batter, or liquid paſte, with flour and eggs, which muſt be ſeaſoned well with pepper and ſalt, and in which the fleſh of the head muſt be dipped, and then fried in lard: when well fried, it muſt be ſerved with ſlices of oranges, and fried parſley, round the diſh.

To *fry calves feet*, after they are well boiled, they are cut in ſmall pieces, and fried with butter; after they have been turned three or four times in the frying-pan, we throw into it onions and parſley, well haſhed together, a little good broth, and ſeaſon well the whole: when they are ready to be carried to the table, we beat ſome yolks of eggs, with verjuice or vinegar, in proportion to the meat, *viz.* to four calves feet, three yolks of eggs, with which we thicken the ſauce.

To *haſh roaſted mutton*, the meat muſt be haſhed as fine as for minced pies; which done, it muſt be put to ſtew ſlowly with ſome gravy, an onion, ſome freſh butter, and crumbs of bread. *Haſhed partridges* are prepared in the ſame manner.

To make a *pigeon pye*, we ſeaſon well the pigeons with ſalt and pepper, then put them in the paſte, with beef marrow, aſparagus, muſhrooms, bottoms of artichokes, yolks of eggs, truffles, and ſome verjuice or gooſeberries.

To make a *veal pye*, it muſt be haſhed well with twice as much marrow, or beef ſuet, well ſeaſoned, and afterwards put in paſte.

To make a *capon pye*, all the bones of the capon being taken out, it muſt be ſtuffed with cocks-combs and ſtones, muſhrooms, truffles, marrow, capers, and veal ſweetbreads; and being well ſeaſoned, it is put in paſte.

To *roaſt a pheaſant*, there muſt be left to it a wing, the neck, and the tail; and after it is well larded, the wing, tail, neck, and head, where the feathers are are left, muſt be wrapped in buttered paper, then ſpitted, and roaſted; the paper muſt be taken off before the pheaſant is carried to table.

A *hare*, before it is put to roast, must be rubbed over with its blood, and larded; when done, it is served with a sweet sauce, made of white wine, sugar, mace, *&c.* or with a *poivrade*, gravy, and plain melted butter.

Partridges are roasted larded.

Green geese are roasted without being larded, but you must make under them a stuffing, with the liver, thyme, parsley, *&c.* hashed well together, and well seasoned; and fried afterwards in butter, with a few yolks of eggs.

A *young turkey* is roasted larded.

A *plover* is roasted larded, and carried to table with a toast, and sauce under it.

A *haunch of venison* is roasted larded, and a *poivrade* made under it, when carried to table, or a sweet sauce.

An *ortolan* is roasted *larded*, and wrapped in vine leaves, in their season; in the spring it must be drawn.

A *woodcock* is roasted larded, and a toast made under it, while roasting, with which, and some slices of seville oranges, it is carried to table.

A *fawn* is roasted larded, and with its head on, which must be wrapped in buttered paper, lest the hairs should be singed. It is carried to table with a sweet sauce.

The sweet sauce is made with vinegar, salt, onion, and lemon, or orange-peel, boiled together. The *green sauce* is made with green corn, a toast burnt with vinegar, some pepper, and salt; the whole pounded very well in a mortar, and strained through a cloth. *Pigs* and *lamb* are served with this sauce. The *rabbet* with the juice of oranges, and pepper. The *plover* with a sauce made of verjuice, lemon-peel, vinegar, pepper, salt, and onion; without forgetting a toast.

To dress *pig's ears*, and *feet*, after they have been well boiled, they must be cut in pieces, fried in butter with onions, and well seasoned; when fried, two or three spoonfuls of good broth are put into the pan, and when they have been left to stew for five or six minutes, the sauce is thickened with yolks of eggs beaten with vinegar, and some mustard.

To make a *venison pasty*, if the flesh is hard, it must be well beaten, skinned, larded, well seasoned with pepper, salt, beaten cloves, and vinegar; and afterwards put in paste, and carried to the oven, where it is left for the space of three hours. When done, the hole, which had been left to give it vent, must be stopped.

To make a *ham pye*, after it has been well soaked, it must boil a gallop or two, and afterwards be skinned; when skinned, it is put in paste, like venison, and seasoned with pepper, cloves, and parsley: if it be a big one, it must stay five hours in the oven, and thus in proportion to its bigness.

To make a *ragout of truffles*, they must be pared very clean, cut very thin, and fried with butter, some hashed parsley, and broth, where they are left to stew for a little while; they must also be very well seasoned.

To make *fritters of marrow*, we take the biggest pieces of beef marrow we can get, slice, and dip them in a paste, or batter, made of flour, eggs, and milk, well seasoned; and afterwards fry them in butter. The *fritters of apples* are made in the same manner.

Fritters of artichokes, are made of bottoms of *artichokes* half boiled, sliced, and dipped in batter, made as above.

To *fry artichokes*, they must be cut in pieces, the choke, and all the leaves, except one of the smallest, left on each piece, taken off, and thrown into boiling water, to blanch them; afterwards they are dried, floured, and fried in lard, or burnt butter. They are carried to table hot, and garnished with fried parsley.

To make a *ragout of mushrooms*, after they have been well cleaned, they are fried in fresh butter, with parsley and young onions hashed together, well seasoned, and lemon-juice added to it, with some *blanc manger*, when they are ready to be carried to table.

To *fry mushrooms*, they must be blanched in cold water, dried, and afterwards pickled in vinegar, salt, pepper, and onions; and when they are to be fried, a batter must be made, with flour and yolks of eggs, in which the mushrooms are put, and then fried.

To make a *Westphalia ham*, we put our pork in a wine or beer cellar for four days; during which time, a sort of water will come from it, which must be wiped very often; if it be wet weather, it must be left there but two days, and two nights: it is afterwards put to be pressed between two boards, and left there as long as the hog has been dead; after which, it is salted, and seasoned with pepper, beaten cloves, and aniseed. The *hams* must be left in salt for the space of nine days, and afterwards taken out, and put in lees of wine, for nine days more; which elapsed, they are wrapped in hay, and buried in the cellar, in a place not too damp: being taken out, they are hung to smoke, and must be perfumed twice a day, with the smoak of burnt juniper; when dry, and little smoken, they are carried to a dry place, where they are kept, and visited often, lest they should rot, till they be wanted; when, after they have been cleaned, and soaked, they are boiled in a pot full of water, seasoned with fine herbs, and without wine. When done, the rind must be raised, and the flesh larded with cloves, and spread over with pepper, and hashed parsley; then the rind, or skin, is put upon it, and the *ham* kept in a cool place till wanted.

To make a *rabbet pye*, they must be larded with big lardons, and well seasoned with salt, pepper, beaten cloves, and vinegar.

To make a *chicken pye*, they must be larded, well seasoned, and put in a fine paste.

To make a *veal pye*, you must take a fillet of veal, lard it, season it well, and put it in paste. Another manner of making a *veal pye*, is, to hash the veal with marrow, or beef suet, to season it well, and to garnish it, while in paste, with mushrooms, bottoms of artichokes, sweetbreads, and yolks of eggs hard.

To make a *lamb pye*, the lamb must be larded with big lardons, seasoned with hashed parsley, pepper, salt, beaten cloves, and garnished with mushrooms, morilles, and capers. When baked, it must be carried to table with a white sauce, made of yolks of eggs, beaten with verjuice.

To make an *eel pye*, we cut the *eels* in pieces, and put them in paste, very well seasoned, with yolks of eggs, parsley, mushrooms, asparagus, verjuice, or gooseberries, in the season, butter, salt, and pepper.

To *dress a turbut*, it must be put to boil gently in white wine, seasoned with salt, pepper, cloves and sweet herbs, as rosemary, thyme, and onions; being done, it must be sent to table garnished with parsley.

Puffed paste is made in this manner: Take four pounds of flour, mix that flour with cold water and a little salt; when mixed, leave it a little at rest, and afterwards work it with two pounds of butter, extending it to cover it with that butter, after which, fold it up in three, extending it again to fold it in four; this done, make again three or four such turns, then carry it to a cool place, to use it as wanted. The *fine paste* is made with four pounds of flour, and a pound and a half of butter, very well work[illegible] with *warm w*[illegible] cept that you [illegible]

All *fish pies* are ba[illegible]

To make a *pye of* [illegible] eels, or carps, and [illegible] beaten cloves; then i[illegible] bay-leaf, with a goo[illegible] a little vinegar; whic[illegible] form of the fish.

To make a *tart of oyst*[illegible] in warm water, and after [illegible] with parsley and onions [illegible] the whole well seasoned. [illegible] pufied paste, and garnished [illegible] bottoms of artichokes, m[illegible] When the *tart* is baked a[illegible] with two or three young onions, whole pepper, salt, and a little vinegar, tossed in the frying pan with butter; when the sauce is brown, the onions must be taken out, and two yolks of eggs mixed with it; then the sauce is thrown, boiling hot, into the *pye*.

I'll conclude this treatise of *Cookery*, with a catalogue of all the different meats in season, thoroughout the whole year.

From Easter *to* Midsummer, *are in season*,

Chickens, young turkies, green geese, lamb, pigeons, young hares, partridges, pheasants, ortolans, and rabbets.

From Midsummer *to the middle of* October, *are in season*,

Young partridges, young pigeons, turtles, young pheasants, young quails, young hares, turkies, young capons, pigeons, fat geese, fat fowls, ortolans, young ducks, fawns, *&c.*

From the middle of October, *to* Lent, *are in season*,

Fat capons, fat fowls, turkies, lamb, hares, partridges, woodcocks, plovers, teals, wood-pheasants, fat quails, fat geese, ducks, both wild and tame, larks, pigs, *&c.*

C O S M O G R A P H Y.

COSMOGRAPHY (from *Greek* κοσμος, the world, and γραφω, to describe) is the art which teaches, the construction, figure and disposition of all parts of the world, and how to represent them on a plane. This art consists of two parts, *Astronomy* and *Geography*. Therefore the reader will find under these two heads all that is necessary to explain it.

Of

Of CURRYING.

CURRYING is the preparation of leather with oil, tallow, or ſome other matter, to make it pliable, more ſightly, and fit for uſe. By this art the leather receives either a black, white, red, yellow, or green colour on the hair ſide of the ſkin.

A *Currier's* ſhop muſt be provided with long two-handed knives, to pare the leather with; a ſteel, made ſomewhat in form of a bodkin, to turn in the edge of the knife; a flat iron inſtrument, to beat down the grain; a pommel, or call; a table to ſtretch the leather upon; a horſe, or leg, to pare, and pommel the leather upon; pumice ſtones, oil, tallow, colours, &c.

There are four manners of *currying* leather, in black, with the grain; for the ſkins are either put in tallow on both ſides, or oil is uſed in lieu of tallow on the fleſh-ſide: or tallow is uſed alone, on the hair-ſide, and nothing on the other: or tallow is uſed on both ſides, and no grain raiſed.

The two firſt, are uſed for *cows* and *calves* leather; the ſecond, is the only way uſed for *ſheep*; and the two laſt, are uſed occaſionally, for *cow* and *bullock*: for *calf* and *ſheep*, they uſe ſumach on the fleſh-ſide, which gives an orange-caſt.

For *neat's-ſkin*, in black; the ſkin coming from the tanner, is wet ſeveral times with a broom, rolled, and trod under foot to make it tractable, drained, and as much of the remaining fleſh as poſſible, taken off with the knife; hung in the air till half dry, then wet and trampled again and again. This done it is rubbed over with a pommel, having niches in manner of teeth, to render it ſtill more pliant, and ſinged with ſtraw to prepare it to receive the tallow; which is applied boiling hot on both ſides. The ſkin is then ſinged a ſecond time, laid four hours in a veſſel of freſh water, trampled, and worked a ſecond time with the pommel, on each ſide, and ſtoutly drained; ſmeared over with its firſt black, made of galls and ferailles, boiled in beer-agre, or ſour-beer; half dried, ſtretched on a table, and the grain beat down with the flat iron inſtrument drawn over it from place to place.

It now receives its ſecond black, made of galls, copperas, and gum-arabick; when dry, and ſtretched on the table; it is ſmeared over with beer-agre; then folded from corner to corner, upon the bench, and the pommel drawn over it to cut the grain, firſt, on the hair-ſide, then on the fleſh-ſide; the laſt with a pommel of cork: the beer hanging in it, is taken out with a hair rubber boiled in hatter's lye; and the ſkin faſtened to the table, and cleaned with the iron inſtrument above-mentioned, and again wiped with a piece of worſted ſtocking. The ſkin is now brightened, on the hair-ſide, with a luſtre made of barberries, to prepare it to receive its laſt grain. The grain, we already obſerved, is begun by folding the ſkin, the hair-ſide inwards, ſeveral ways: to finiſh it, it is again folded, after its firſt luſtre, two ways firſt; firſt from corner to corner, a little ſlanting, then acroſs, *i. e.* firſt directly, or from eye to eye; then from head to tail. The grain thus formed, the laſt luſtre, which makes the laſt preparation is given; compoſed of gum-arabic, garlick, beer, vinegar, and *Flanders* ſize, boiled together, and applied cold.

Calf-ſkin in black is prepared much after the ſame manner; though begun differently. After wetting, taking off as much of the fleſh remaining as poſſible, and drying, they pounce the fleſh with a hard, rough, pumice-ſtone, which makes it more ſmooth and gentle; then give the grain with the pommel, put on the tallow; the reſt as before.

What *ſheep ſkins* in black have peculiar in their preparations, is, that they are firſt ſtretched on a table to get off the bourre, or tan, wherewith they are laden; then wet, trod under foot, and tallow added on the hair-ſide: they are again wet, again trod, ſtretched on the table, and the water ſqueezed out with the pommel; then blacked, repaſſed under the pommel on each ſide; dyed, and all the roughneſs and inequality pared off with a flat, round, cutting inſtrument: the reſt as before.

Sleek-leather, or that without any grain, made of cows or bullocks ſkins, differs a little in its preparation from the former. The ſkins being wet, trod, and paſſed under the pommel, the fleſh is taken off; the reſt as in the firſt article: obſerving that the tallow be applied on both ſides as thick as poſſible: being now ſteeped in water, trod, frized, and blacked the firſt time; the ſecond black is next laid on, till the hair-ſide be quite ſmooth; laſtly, after receiving the two luſtres, they are preſſed between two tables; without plaiting or folding them in any manner during the whole preparation.

The method of preparing the *leather*, called *Morocco*, is alſo a branch of the art of *Currying*.

The *Morocco* is the ſkin of a goat, or ſome other animal reſembling it, called *menon*, frequent in the *Levant*, dreſſed in ſumach, or galls, and coloured of any colour at pleaſure, much uſed in tapiſtry, book-binding, ſlippers, &c.

To

To prepare *black Morocco*, the ſkins having been dried, are ſteeped in clear water three days and nights, ſtretched on a wooden horſe or leg, beaten with a large knife for that purpoſe, and ſteeped afreſh in water, changed daily till they be well come again. In this ſtate they are thrown into a large vault in the ground, full of water, wherein quick lime has been ſlaked, where they lie 15 days; whence however they are taken and again returned night and morning: they are then thrown into a freſh vault of lime and water, and ſhifted night and morning as before, for 15 days longer; then rinſed in clear water, and the hair taken off, on the leg with the knife, returned into a third vault, and ſhifted as before, for about 18 days; ſteeped 12 hours in a river, taken out, rinſed, put in pails, where they are pounded with wooden peſtles, changing the water twice, then laid on the horſe, and the fleſh taken off, returned into pails of new water, taken out, and the hair ſide ſcraped; returned into freſh pails, taken out, and thrown into a pail of a particular form, having holes at bottom: here they are beaten the ſpace of an hour, and freſh water poured on from time to time; ſtretched on the leg, and ſcraped on either ſide; returned into pails of freſh water, taken out, ſtretched, and ſewed up all around in manner of bags, leaving out the hind legs, which ſerve to make an aperture for the conveyance of a mixture mentioned hereafter.

The ſkins thus ſewed, are put in luke-warm water, where dogs excrement has been diſſolved. Here they are ſtirred with long poles half an hour, left at reſt a dozen hours, taken out, rinſed in fair water, and filled by a tunnel with a preparation of water and ſumach, and kept ſtirring four hours ſucceſſively, taken out, and heaped on one another; after a little time their ſides are changed; and thus they continue an hour and a half, till drained: this done, they are looſened and filled a ſecond time with the ſame preparation, ſewed up again, and kept ſtirring two hours, piled up, and drained as before. This is again repeated a third time, with this difference, that they are now only ſtirred a quarter of an hour; after which they are left till the next morning, when they are taken out, drained on a rack, unſewed, the ſumach taken out, folded in two from head to tail, the hair-ſide outwards, laid over each other on the leg, to perfect their draining, ſtretched out, and dried; then trampled under foot by two and two, ſtretched on a wooden table, what fleſh and ſumach remains ſcraped off, and the hair-ſide rubbed over with oil, and that again with water.

Having thus received their oil and water, they are wrung in the hands, then ſtretched and preſſed tight on the table, with the iron inſtrument uſed for common leather, the fleſh-ſide uppermoſt; then turned, and the hair-ſide rubbed ſtrongly over with a handful of ruſhes, to ſqueeze out as much of the oil remaining within as poſſible. The firſt courſe of black is now laid on the hair-ſide by means of a lock of hair twiſted, and ſteeped in a kind of black dye, prepared of ſour beer, wherein pieces of ruſty iron have been thrown. When half dry, by hanging in the air, they are ſtretched on a table, and rubbed over every way with the pumice, to raiſe the grain, over which is paſſed a light couch of water, then ſleeked, by rubbing them with ruſhes prepared for the purpoſe. Thus ſleeked, they have a ſecond couch of black, then dried, laid on the table, rubbed over with a pommel of cork, to raiſe the grain again; and after a light couch of water, ſleeked over anew, and to raiſe the grain a third time, a pommel of wood is uſed.

After the hair ſide has thus received all its preparations, the fleſh-ſide is pared with the knife; the hair-ſide rubbed ſtrongly over with a woollen cap, having firſt given it a luſtre with barberries, citron, or orange. The whole is finiſhed by raiſing the grain lightly, for the laſt time, with the pommel of cork, which leaves them in a condition for ſale and uſe.

They prepare the *red Morocco*, by ſteeping the ſkins 24 hours in a river, taking them out, ſtretching them on the leg, beating them with the knife, returning them into the water for 24 hours, rebeating them on the leg, reſteeping, throwing them into a vault, for three weeks, taking them out, and turning them every morning, to diſpoſe them to peel. Being taken out for the laſt time, they are ſcraped with the knife, and when the hair is quite off, thrown into pails of freſh water, where they are rinſed; then the fleſh-ſide ſcraped, thrown into the pails, and thus alternately from the leg to the pails, till they leave the water quite clean: then they are put in luke-warm water, with the ſumach as before, and after 12 hours rinſed in clear water, and ſcraped on the leg on both ſides, pounded in pails, and the water changed three times; then wrung, and ſtretched on the leg, and paſſed after each other into water, with allum diſſolved in it. Thus allumed, they are left to drain till the morning, then wrung out, pulled on the leg, and folded from head to tail, the fleſh inwards.

In this ſtate they received their firſt dye, by paſſing them after one another into a red liquor, prepared with lacca, and ſome other ingredients, kept ſecret among the *Moroquineers*. This they repeat again and again, till the ſkins have got their firſt colour: they are then rinſed in clear water, ſtretched on the leg, and left to drain 12 hours; thrown into water, into which white galls pulverized

rized have been paſſed through a ſieve, and ſtirred inceſſantly for a day with long poles, taken out, hang on a bar a-croſs the water all night, white againſt red, and red againſt white, and in the morning the water ſtirred up, and the ſkin returned into it for 24 hours.

CUTLERY.

CUTLERY is the art of making knives, razors, ſciſſars, lancets, and all other edged tools and inſtruments.

This art is divided by workmen into ſeveral branches; ſome *Cutlers* make only knives, and underſtand little, or nothing of the other branches; others razors; others lancets; others inſtruments of ſurgery; others tools for joiners, carpenters, ſculptors, &c. with this difference, that thoſe who can make lancets, and other inſtruments, can likewiſe make razors, knives, ſciſſars, penknives, &c. whereas few of thoſe who make knives, or ſciſſars only, don't underſtand how to make a good razor, a lancet, or any other inſtruments.

The ſhop of a *Cutler*, practiſing any of the abovementioned branches of *Cutlery*, muſt be fitted with a forge, anvils, hammers, round whet-ſtones of different ſizes and grain, ſome coarſer, ſome finer; a large wheel, in the form of a ſpinning one, to turn round the ſtones, and the poliſhing tools, a ſink, to keep the water, with which the whet ſtones are wetted, and on which they are fixed; beſides the whet-ſtones, and the poliſhing wheels, made of walnut-tree an inch thick, and of a diameter at pleaſure: the *Cutlers* for razors, lancets, and other ſuch inſtruments, muſt alſo have hones, to ſet thoſe inſtruments upon.

The chief art of *Cutlery* conſiſts in forging, tempering, and poliſhing well the work.

A *Cutler* cannot uſe too much precaution, in *forging* his work; not only in giving it a proper ſhape, and ſuitable to the inſtrument he deſigns to make, that it may both be uſeful, and ſtrike agreeably to the eye; but likewiſe that heat neceſſary to render it fit for *tempering*: which heat muſt neither be too cold nor too hot. For if too cold the igneous particles do not penetrate intimately enough, thoſe of the work, to diſpoſe them to that cloſer coadunation, which they muſt acquire in the *tempering*; and if too hot, it would redſear, and crackle, and thereby cauſe a very great deformity in the piece of work.

The *tempering* of the work (which is done to render it more compact, hard, and firm; or even more ſoft, or pliant, according to the reſpective occaſions) is to plunge it, while red-hot, in ſome liquor, prepared for the purpoſe: ſometimes into pure water, and in effect, lockſmiths, &c. ſcarce uſe any other; ſometimes into a compoſition of divers juices, liquors, &c. which is varied according to the manner, and experience of the workman; as vinegar, mouſe-ear-water, nettles, or *Spaniſh* raddiſh-water, the water oozing from broken glaſſes, ſoot, ſalt, oil, diſtilled wine, ſal-ammoniack, &c. A *French* Cutler, told me once, that there could be no better *tempering* than tallow.

To *harden* and *temper English*, *Flemiſh*, and *Swediſh* ſteel, we muſt give them a pretty high heat, then ſuddenly quench them in liquor, to make them hard; but *Spaniſh* and *Venice* ſteel, will need but a blood-red-heat, before it be quenched.

After the *inſtrument* has been *tempered*, it is grinded upon a grind-ſtone, or whet-ſtone, to take off the roughneſs, and to form the edge; which done, it is poliſhed on the poliſher (turned by the great wheel) with emmery and putty: And laſtly, (if it be a razor, lancet, &c.) it is ſet on the *hone*; and rubbed afterwards, on a ſtrap of leather, prepared for that purpoſe.

The making of *Sword-blades*, and *foils*, is alſo another branch of *cutlery*, different from all others. *Sword-blades*, are commonly forged, with the help of a mill, which works heavy hammers for that purpoſe.

Of DAMASKEENING.

DAMASKEENING, is the art of adorning iron and ſteel, by making inciſions therein, and filling them up with gold or ſilver-wire: firſt practiſed at *Damaſcus* in *Syria*, and chiefly uſed in enriching ſword-blades, guards, and gripes, locks of piſtols, &c.

Damaſkeening, is partly moſaick work, partly engraving, and partly carving. As moſaick work, it conſiſts of pieces inlaid; as engraving, the metal is indented, or cut in *creux*; and, as carving, gold and ſilver are wrought thereby in *relievo*.

There

There are two manners of *damaskeening*; in the first, which is the most beautiful, the artist cuts into the metal with a graver, and other tools, proper for engraving on steel; and afterwards fills up the incisions, or notches, with a pretty thick silver, or gold-wire. In the other, which is only superficial, they content themselves to make hatches, or strokes across the iron, *&c.*

For the first manner of *damaskeening*, it is necessary, the gravings and incisions, be made in the dove-tail form, that the gold or silver-wire, which is thrust forcibly into them, may adhere the more strongly.

The second method is the most usual, and practised, by heating the steel till it changes to a violet, or blue colour, hatching it over and across with a knife; then drawing the design, or ornament intended, on this hatching, with a fine brass point, or bodkin. This done, a fine gold or silver-wire is taken, and conducting, or chasing it according to the figures already designed, it must be sunk carefully into the hatches of the metal, with a copper tool.

This art of *damaskeening*, was much in vogue in the two last centuries, but is so much disregarded in ours, that we find no artificers capable to imitate the curious pieces of workmanship we have left in that taste.

Chasing, or *enchasing*, is used in lieu thereof; for those pieces, which in past ages were *damaskeened*, as guards, and gripes of swords, *&c.* and which is the art of enriching and beautifying gold, silver, and other metal works, by some design, or figures, represented thereon, in low *relievo*.

Chasing is only practised on hollow, thin works; as watches, cane-heads, tweezer-cases, or the like. It is performed by punching, or driving out the metal, to form the figures from within side, so as to stand out prominent from the plain, or surface of the metal. In order to this, they have a number of fine steel blocks or puncheons, of divers sizes; and the design being drawn on the surface of the the metal, they apply the inside upon the heads or tips of these blocks, directly under the lines or parts of these figures. Then with a fine hammer, striking on the metal sustained by the block, the metal yields, and the block makes an indenture, or cavity on the inside; correspondent to which, there is a prominence on the outside, which is to stand for part of the figure. Thus, the workman proceeds to *chase*, and finishes all the parts by successive applications of the block and hammer, to the several parts of the design. And it is surprizing, with what beauty, and exactness, by this simple piece of mechanism, the artists, in this kind, will represent foliages, grotesques, animals, histories, *&c.*

Of DANCING.

DANCE is an agreeable motion of the body adjusted by art to the measures, or tune of instruments, or of the voice.

Dancing, has always been in use among all nations, both civilized and barbarous; though held in esteem among some, and in conempt among others. Almost every body is of opinion, that of itself, *dancing* is harmless. There is a time, says the preacher, to *dance*, and sometimes it is even made an act of religion. Thus *David danced* before the ark, to honour God, and express his excess of joy for his return into the city of *Sion*. *Socrates* learned to *dance* of *Aspasia*; and the people of *Crete* and *Sparta* went to the attack *dancing*. On the other hand, *Cicero* reproaches *Gabinius*, a consular man, with having *danced*. *Castor* and *Pollux* are said to be the first who taught the art of *dancing*; and that to the *Lacedemonians*: though others attribute the inventlon to *Minerva*, who *danced* for joy after the defeat of the giants.

The antient had three kinds of *dances*, the first grave, called *emmelia*, answering to our low *dances* and pavanes; the second gay, called *cordax*, answering to our courants, galliards, gavots, and vaults; the third called *sicinis*, was a mixture of gravity and gaiety. *Neoptolemus*, son of *Achilles*, taught the *Cretans* a new sort of *dance*, called *pirricha*, or the *armed dance*, to be used in going to war; altho' according to the Mythologists, the *Curetes* first invented this *dance*, to amuse and divert the infant *Jupiter*, with the noise and clash of their swords, beating against their bucklers.

Diodorus Siculus, in the 4th of his *bibliotheca*, assures us, that *Cybele*, daughter of *Menos*, king of *Phrygia*, and *Dindymenis*, his wife, invented divers things, and among others, the flageolet of several pipes, *dancing*, the tabor, and the cymbal. It is certain, that *Numa* instituted a sort of *dance* for the *Salii*, priests of *Mars*, who made use of weapons therein. From these *dances* were composed another, called *saltatio mimicorum*, or the *buffoon's dance*; wherein the dancers were dressed in little corslets, with gilt morions, bells on their legs, and swords and bucklers in their hands.

The chief end of the art of *dancing*, is, that a person should learn to present himself in company, with an easy and unaffected air, and to step gracefully; the generality of mankind, consider *dancing*, as a noble exercife, or diverfion, practifed with pleafure by perfons of all ranks and conditions, even by princes and heroes.

Dancing is not like feveral other arts, for it cannot be learned perfectly, without the affiduous attendance of a mafter, and a continual practice. A beginner, or pupil, befides the voice of his mafter, finging to his ears, one two, one two three, &c. muft be led by him, by the hand, as an infant who learns to walk, that he may ftep forward, ftop, *cadence*, and bow his knees, when wanted. The man, in a *minuet*, *rigadoon*, &c. muft have a gentle motion of his hands, but only as if it was natural, and without the leaft affectation; and the woman muft let fall her hands as gently, clofe to her fides, the head modeftly erected, alfo without affectation; both enlivening and cadencing their fteps, according to the meafures of the inftruments.

A *country-dance* is nothing but a couplet, or part of a *dance*, always repeated, firft by two, by four, fix, eight, ten, &c. and at laft, by as many couple as the number of people amounts to. I call *couple*, the man and the woman that figure together. A *couplet*, in *country dances*, is a certain quantity of figures that fill up the tune: the fame *country dance*, may have feveral couplets or parts, which are like feveral verfes of fongs upon the fame tune.

Each couplet of a *country dance*, is divided by figures, *viz.* 1 fig. 2 fig. 3 fig. 4 fig. 5 fig. &c. The firft figure is always that by which one begins, and goes on till you arrive at the laft, which will be the end of the part, and is to be repeated, not only by them who have begun, but alfo by all the other couples, who muft follow the fame way as the firft, and fhall likewife continue in the fame order, till every body be arrived at the fame place, from whence they begun; and then the whole part will be entirely finifhed, and every couple make their honour as they finifh. But if there be a fecond part, you muft inftead of making your honour go on in the fame order, as you have done in the firft, and put off making your honour, till you come to the end of the laft part.

Country dances, are *danced* with as many perfons as you pleafe, provided it be an even number, I mean as many men as women, placed upon two lines, the men on one fide, and the women on the other, of which all the couples ought to be diftinguifhed, *viz.* firft couple, fecond, third, fourth, fifth, fixth, couple, &c

There are two chief defigns of *country dances*, upon which all the different figures, that may be invented, are founded. The firft defign, is, that every perfon, whatever figure he makes, ends all the repetitions to the fame fide; that is to fay, that the man muft not change his place, but with another man, and the woman, but with another woman. The fecond defign, is, when the men end all their repetitions in the women's places, and the women in the men's places.

In the firft defign, four things are to be obferved 1. When a couple have begun to *dance*, they muft not give off till they are come down to the laft couple. 2. Every repetition muft begin always at the firft couple, at the upper end of the room, and end at the fecond couple, then to the third couple, to the fourth, &c. and fo to come down from couple to couple, till you arrive to the laft couple; where then all the repetitions of the laft couple are at an end; and that couple *dances* no more, till another couple coming down, in their turn they move up. 3. That a couple ought not to begin to *dance* till they are come into the firft couple's place. 4. That a couple that is come to the firft couple's place, muft not begin to *dance*, till the preceding couple have made two repetitions before.

It muft be obferved, likewife, that every time that a couple end their repetitions under another couple, the couple that is above muft move up, and take the place of them that go down.

In the fecond defign, there are alfo four things to be obferved. 1. When a couple begins to *dance*, from whatever place they begin, they muft not difcontinue, till they are arrrived, not only to the laft couple's place, but alfo to the very place where they have begun. 2. Every time that a repetition begins again, the fame increafes always by couples, fo that the *dance* which before was but of two, comes to be of four, then of fix, of eight, ten, &c. till every body be in motion. 3. When a couple comes into the firft couple's place, they muft follow the fame way which the preceding couples have gone. 4. When a couple is come down to the laft couple, and finds there nobody more to *dance* with, then that fame couple *dances* again together, and afterwards moves up, always *dancing*, till they come to the fame place where they have begun, and then all the repetitions of that couple are at an end.

Of

Of DESIGNING.

DESIGN is uſed in painting, for the firſt idea of a large work, drawn roughly, and in little. with an intention to be executed and finiſhed in large.

It is the ſimple contour, or outlines of the figures intended to be repreſented, or the lines that terminate and circumſcribe them: ſuch deſign is ſometimes drawn in crayons, or ink, without any ſhadows at all; ſometimes it is hatched, that is, the ſhadows are expreſſed by ſenſible outlines, uſually drawn acroſs each other with the pen, crayon, or graver. Sometimes, again, the ſhadows are done with the crayon rubbed ſo as that there do not appear any lines: at other times, the grains or ſtrokes of the crayon appear, as not being rubbed: ſometimes the deſign is waſhed, that is, the ſhadows are done with a pencil in indian ink, or ſome other liquor; and ſometimes the deſign is coloured, that is, colours are laid on much like thoſe intended for the grand work.

The eſſential requiſites of a deſign are correctneſs, good taſte, elegance, character, diverſity, expreſſion, and perſpective. Correctneſs depends on the juſtneſs of the proportions, and knowledge of Anatomy. Taſte is a certain manner of correctneſs peculiar to one's ſelf, derived either from nature, maſters, or ſtudies, or all of them united. Elegance gives a delicacy that not only ſtrikes perſons of judgment, but communicates an agreeableneſs that pleaſes univerſally. The character is what is peculiar to each thing, wherein there muſt be diverſity, inſomuch that every thing has its peculiar character to diſtinguiſh it. The expreſſion is the repreſentation of an object, according to the circumſtances it is ſuppoſed to be in. Perſpective is the repreſentation of the parts of a pain ing, or a figure, according to the ſituation they are in with regard to the point of ſight.

The deſign or draught, is a part of the greateſt import and extent in painting. It is acquired chiefly by genius and application, rules being of leſs avail here than in any other branches of the art, as colouring, *&c.* The principal rules that regard deſign are, that novices accuſtom themſelves to copy good originals at firſt ſight; not to uſe ſquares in drawing. leſt they ſtint and confine their judgment; to deſign well from life, before they practiſe perſpective, to learn to adjuſt the ſize of their figures to the viſual angle, and the diſtance of the eye from the model or object; to mark out all the parts of their deſign before they begin to ſhade; to make their contours in great pieces, without taking notice of the little muſcles, and other breaks; to make themſelves maſters of the rules of perſpective; to obſerve the perpendicular, parallel, and diſtance of every ſtroke to compare and oppoſe the parts that meet and traverſe the perpendicular, ſo as to form a kind of ſquare in the mind. which is the great and almoſt the only rule of deſigning juſtly; to have a regard not only to the model, but to the parts already deſigned, there being no ſuch thing as deſigning with ſtrict juſtneſs, but by comparing and proportioning every part to the firſt. All the other rules relate to perſpective.

There are ſeveral methods of deſigning mechanically. The following is the method of the learned Sir CHRISTOPHER WREN, and may be put in practice with great eaſe.

A is a ſmall ſight, with a ſhort arm B (See plate of MECHANIC ARTS) which may be turned round about, and moved up and down the ſmall cylinder C D, which is ſcrewed into the piece E D at D; this piece E D moving round about the center E, by which means the ſight may be removed either towards E or F.

F F is a ruler faſtened on the two rulers G G, which rulers ſerve both to keep the ſquare frame S S S S perpendicular, and, by their ſliding through the ſquare holes T T, they ſerve to ſtay the ſight, either farther from, or nearer, to the ſaid frame; on which frame is ſtuck on, with a little wax, the paper O O O O, whereon the picture is to be drawn by the pen I. The pen I is, by a ſmall braſs-handle V, ſo fixed to the ruler H H, that the point I may be kept very firm, ſo as always to touch the paper. H H is a ruler that is conſtantly, by means of the ſmall ſtrings *aaa*, *bbb*, moved horizontally, or parallel to itſelf at the end of which is ſtuck a ſmall pin, whoſe head P is the ſight, which is to be moved up and down on the out-lines of any object.

The contrivance of the ſtrings is this: the two ſtrings *aaa*, *bbb*. are exactly of an equal length Two ends of them are faſtened into a ſmall leaden weight, which is employed in a ſocket on the backſide of the frame, and ſerves exactly to counterpoiſe the ruler H H, being of an equal weight with it. The other two ends of them are faſtened to the ſmall pins H H, after they have rolled about the ſmall pullies M M, L L, K K, by means of which pullies, if the pen I be taken hold of, and moved up and down the paper, the ſtring moving very eaſily,

 the

the ruler will always remain in an horizontal poſition.

The manner of uſing it is this: ſet the inſtrument upon a table, and fix the ſight A at what height above the table, and at what diſtance from the frame SSSS, you pleaſe. Then looking thro' the ſight A, holding the pen I in your hand, move the head of the pin P up and down the out-lines of the object, and the point of the pen I will deſcribe on the paper OOOO the ſhape of the object ſo traced.

Of D I A L I N G.

DIALING is the art of drawing ſchemes upon a plane or ſurface of any given body, ſo contrived as to find out the meaſure of juſt time, by the ſun, moon and ſtars.

The antiquity of *dials* is beyond doubt: ſome attribute their invention to *Anaximenes Mileſius*; others to *Thales. Vitruvius* mentions one made by the antient *Chaldee* hiſtorian *Beroſus*, on a reclining plane, almoſt parallel to the equinoctial. *Ariſtarchus Samius* invented the hemiſpherical *dial.* And there were ſome ſpherical ones with a needle for a gnomon. The diſcus of *Ariſtarchus* was an horizontal *dial*, with its limb raiſed up all around, to prevent the ſhadow ſtretching too far: but it was late ere the *Romans* became acquainted with *dials*. The firſt *ſun dial* at *Rome* was ſet up by *Papyrius Curſor*, about the year of the city 460, before which time, ſays *Pliny*, there is no mention of any account of time, but by the ſun's riſing and ſetting; it was ſet up at or near the temple of *Quirinus*, but went ill: about 30 years after, *M. Valerius Meſſala* being conſul, brought out of *Sicily* another *dial*, which he ſet up on a pillar near the *Roſtrum*; but for want of its being made for that latitude, it could not go true. They made uſe of it 99 years, till *Martius Philippus* ſet up another more exact.

But there ſeem to have been *dials* among the *Jews* much earlier than any of theſe. Witneſs the *dial* of *Ahaz*, who began to reign 400 years before *Alexander*, and within 12 years of the building of *Rome*.

The firſt profeſſed writer on *Dialing*, is *Clavius*, who demonſtrates all, both the theory and the operations, after the rigid manner of the antient mathematicians; but ſo intricately, that nobody, we dare ſay, ever read them all. *Dechales* and *Ozanam*, give much eaſier in their *courſes*, and *Wolfius* in his *elements*. M. *Picard* has given a new method of making large *dials*, by calculating the hour lines; and M. *de la Hire*, in his *dialing*, printed in 1683, a geometrical method of drawing hour lines, from certain points determined by obſervation. *Eberhardus Welperus*, in 1625, publiſhed his *dialling*, wherein he lays down a method of drawing the primary *dials* on very eaſy foundation: the ſame foundation is deſcribed at length by *Sebaſtian Munſter*, in his *Rudimenta Mathematica*, publiſhed in 1551. *Sturmius* in 1672, publiſhed a new edition of *Welperius*'s *dialing*, with the addition of a whole ſecond part, about inclining and declining *dials*, &c. In 1708, the ſame work with *Sturmius*'s additions, was republiſhed with the addition of a fourth part, containing *Picard*'s and *de la Hire*'s methods of drawing large *dials*, which makes much the beſt and fulleſt book on the ſubject.

In order to perform this art, it will be neceſſary to be thoroughly acquainted with the circle of the ſphere, which is an inſtrument (as we have already obſerved in our treatiſe of *Aſtronomy*) whereby we explain the daily motion of the celeſtial bodies, according as they appear to us to move always from eaſt to weſt, and alſo the proper motion of the ſun, which moves from weſt to eaſt, and makes its revolution through the twelve celeſtial ſigns, in the ſpace of one year. We will only deſcribe here, thoſe circles of which the *ſphere* is compoſed, that belong to our preſent ſubject: thoſe circles, whoſe planes paſs through the center of the earth, are called great circles of the *ſphere*, and all the others are leſs; but before we ſpeak of theſe circles, we ought to conſider the *axis* of the *ſphere*, which we have already conceived to be a ſtrait line, about which the inſtrument is turned. The earth is placed in the middle of this inſtrument, and conſequently the *axis* paſſes through the center thereof. The plane of the *equinoctial circle*, or *equator*, is at right angles to the *axis*, and we have been informed in our treatiſe of *Aſtronomy*, that this circle divides the *ſphere* into two equal parts, whereof one is called *ſeptentrional*, and the other *meridional*. The *ecliptick*, is another great circle, whoſe plane makes an angle with the *equinoctial*, of 23 degrees 30 minutes; the ſun moves under this circle, going from the weſt towards the eaſt, and makes one entire revolution in 365 days and near 6 hours. The inclination of this circle towards the *equinoctial*, cauſes the different declinations of the ſun, in regard to the *equinoctial*: it is divided into twelve equal parts, called ſigns; and we begin from the interſection thereof with the *equinoctial*, proceeding towards the north.

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The *tropicks* are two circles parallel to the *equinoctial*, which touch the *ecliptick* in the points of its greatest distance from the *equinoctial*; therefore these circles are distant from the *equinoctial* 23 degrees 30 minutes, on one side towards the north, and on the other side towards the south; so that it is manifest, that when the sun is in the common interfection of the *ecliptick* and *equator*, the motion of the *sphere* about its *axis*, which goes from east to west, and is called the motion of the *primum mobile*, makes him appear to us in the *equinoctial*; and also when he is in his greatest distance of the *equinoctial*, the same motion of the *primum mobile* makes him appear to us to move in the *tropicks*. The *zenith* is an imaginary point in the *sphere*, marked by a strait line coming from the center of the earth, and passing by some place of the superficies thereof. This line is called the vertical line of that place. The *horizon* is a great circle, whose plane cuts the vertical line, at right angles. The *horizon* of a place distinguishes the visible part of the heaven of that place. from that part of the heaven which is not there seen. The *meridian* is a great circle which passes through the *poles* and *zenith*, the plane whereof, at right angles with the planes of the *equinoctial* and *horizon*; because this circle passes through the *zenith* and *poles*.

If we suppose the *equinoctial* to be divided into 24 equal parts, beginning from the *meridian*, the 6th and 8th part shall fall on the interfections of the *horizon* and *equinoctial*, because the *meridian* and *horizon* are at right angles to one another; and if we imagine other circles, like the *meridian*, that is to say, that pass through the poles of the world, and point of division of the *equinoctial*; those circles, which we call *meridians*, shall be the hour circles, among which is the *meridian* of the place whereof all the planes interfect one with another in the *axis*. We may also conceive others, which divide each parts into two, or four, to mark the half hours, and quarter hours; for if we suppose these circles to be fixed, then when the *primum mobile*, turns the sun with his *ecliptick* about the *axis*, the time of his apparent course shall be divided into hours, halves, and quarters, by these *meridians*. Also we number the declination of the sun, upon the like *meridians*, which do all interfect the *equinoctial* at right angles, which we make to pass through the center of the sun in the *ecliptick*: we number this declination from the *equinoctial* towards the poles; therefore, if it is either south or north, the angles of declination are measured by arches or circles.

Those circles that pass through the vertical lines, are called vertical circles, or *azimuth*, and their planes are perpendicular to the plane of the *horizon*; they serve to measure the heighth of the sun above the *horizon*, which is numbered from the *horizon* towards the *zenith*.

It is manifest from that which has been said before, that there are infinite *horizons* and *meridians*, and that there are only these two great circles, which may change according to the different places on the earth, for they are established by the vertical line. The amplitude of rising or setting, is counted on the *horizon*, beginning from the points where the *equinoctial* cuts the *horizon*, and is numbered towards the south or north. If we conceive that in the revolution of one day the *horizon* moves, as being fastened to the *axis*, so as it cannot change its inclination, then when it shall pass by the 24 equal divisions of the *equinoctial*, it shall represent the 24 circles of the *Italian* or *Babylonian* hours.

There are different sorts of *sun dials*, which diversity arises from the different situation of the plane, and the different figure of the surfaces, whereon they are described; whence they become denominated, *equinoctial*, *horizontal*, *vertical*, *polar*, *direct*, *erect*, *declining*, *inclining*, *reclining*, *cylindrical*, &c.

We will begin with a *sun dial*. The principal parts of a *sun dial* are the center of the *dial*, and the different lines it is divided into. The center of the *dial* is any point taken on the superficies of the earth, and considered as its center in relation to the motion of the sun; therefore, if we place a style (which is a pointed rod) upon any plain surface, and then consider the point of that style, as the center of the earth, the interfection of that surface, with the planes of the hour circles, of the *equinoctial* or *equator*, of the *horizon*, and of the other great circles, shall be strait lines, which retain the names of the planes of the circles from whence they are produced. All these lines on that plain surface with the style, make the *sun dial*. The shadow of the point of the style, which is one of the points of the *axis*, shews the hours: and if the *axis* which passes by the points of that style, meets with the plane of the *dial* in any point, that point is called the *center* of the *dial*, for it is evident that all the hour lines shall meet in that point. It is also evident that the shadow of the point of the style gives the hours, and shews when the sun meets with any one of the circles of the *sphere*; for when the sun comes to a great circle, the shadow of the *axis* is extended in the plane of that circle, if that circle passes by the *axis*; and if it passes not by the *axis*, the shadow of the point of the style shall be in the plane of that circle; for the planes of great circles pass by the point of the style.

If we conceive a conical ſuperficies, which has for its baſe a leſs circle of the *ſphere*, and for its *vertex* the point of the ſtyle, that conical ſuperficies ſhall meet the ſurface of the *dial* in a curve line; ſo as when the center of the ſun ſhall touch that leſs circle, which is the baſe of the conical ſuperficies, the ſhadow of the point of the ſtyle ſhall touch the curve line, which is the meeting of that curve ſuperficies with the plane of the *dial*; for the point of the ſtyle is on that ſuperficies whereof it is the *vertex*. The foot of the ſtyle is that point on the plane of the *dial*, which is the meeting of a ſtrait line drawn perpendicularly to that plane, and which paſſes by the point of the ſtyle.

If the plane of the *dial* be conſidered as the plane of the *horizon* of any place, the ſtrait line that paſſes by the point of the ſtyle, and by its foot, ſhall be the vertical line of that place; and the plane that paſſes by the vertical and by the *axis* ſhall be the proper *meridian* of that place, conſidered as the *horizontal* of a place.

The meeting of the *meridian* and ſurface of the *dial*, is called the *ſubſtylar line*, or the *meridian* of the plane or ſurface of the *dial*, which we ought to diſtinguiſh from the *meridian* of the place, which is the meeting of the *meridian* proper to that place, and of the ſurface of the *dial*, at leaſt if they be not coincident, which happens when the *dial* does not decline from the eaſt or weſt. We ſee by the poſition of theſe lines, that the *ſubſtylar line* is always at right angles with the *equinoctial line*.

We ought to make the *dial* ſo as the foot of the ſtyle be not incumbered, for that point ſerves for many operations; therefore, the ſtyle muſt be planted a little obliquely upon the ſurface. By the height and length of the ſtyle, is underſtood the ſtrait line drawn from the point to the foot thereof. The arches of the *ſigns* on the ſurface of the *dial*, are the deſcriptions of the parallels to the *equinoctial*, which paſs through the 12 equal diviſions of the *ecliptick line*, which ſhews the beginning of the ſigns.

How to find thoſe principal parts, and how to mark or draw thoſe lines; or rather, how to reduce the *Art of Dialing* into practice, is our next enquiry.

This practice has for its chief foundation, the marking exactly the *points of ſhadow*, which the *penumbra* renders very difficult; but which, however, can be effected two ways.

The firſt is to fit a ſmall round plate to the point of the ſtyle, which may be parallel to the plane of the *dial*, whereof the center may be joined to the point of the ſtyle; then having drawn the ſhadow of the ſaid plate on the plane of the *dial*, take the middle of that ſhadow, which ſhall be the ſhadow of the end of the ſtyle, at the ſame time when we obſerved the ſhadow of the plate.

The ſecond way is to make a ſmall round hole in a little piece of paſte-board, or thin plate, or other like body, and having applied it to the end of the ſtyle, ſo as the center of the hole may be joined to the point of the ſtyle, and that the ſmall plate may regard the ſun perpendicularly; the light of the ſun ſhining through the hole, ſhall make a clear circle, or oval, D E, Fig. 2. in the ſhadow of the plate on the plane of the *dial*, which we draw on the ſaid plane; and if it be an oval, having drawn a ſtrait line, D P E from the point P; which is the foot of the ſtyle, whereof F is the point, which may paſs through the center of that oval, and cut it in D and E, or draw D G and E F, parallel to one another, and making any angle with D E, D G being made equal to D S, and E F, equal to E S, the line G F, ſhall cut D E, in the point A, which ſhall be the ſhadow of the point of the ſtyle S, at that time when the oval was drawn. But we may take the center of the oval for the point A, without falling into any ſenſible error, as we may ſee by the operation in the plate. But if the ſhadow be a circle, the center of that circle ſhall be the ſhadow of the point of the ſtyle.

After we have marked the points of ſhadow, we muſt draw the *horizontal line*, by applying a rule, Fig. 3. A S, ſo as one of the edges thereof may be level, and touch the point S, of the ſtyle, which is planted upon the plane of the *dial*, and that end of the edge of the ruler, may touch the plane of the *dial* at the point A, which ſhall be one of the points of the *horizontal line*. By the point A, we draw a level line on the plane of the *dial*, which ſhall be the *horizontal line*.

From this we paſs to the *ſubſtylar line*, which is eaſily found by the amplitude of the ſun's riſing and ſetting upon the plane of the *dial*, in this manner: when the ſun begins to riſe on the plane of the *dial*, we muſt mark the ſhadow of a ſmall thread extended from the foot of the ſtyle to its point; and do the ſame when the ſun ſets on the plane of the *dial*, the angle comprehended between theſe two lines of ſhadow, whoſe *vertex* is at the foot of the ſtyle, being divided into equal parts, ſhall give the *ſubſtylar line*.

The *ſubſtylar line* being made, we find the *center of the dial*, by placing a ſtyle on the plane of the *dial*, whoſe foot we ſuppoſe to be P, and point S, Fig. 4. and the point of ſhadow A, and *ſubſtylar line* C P, we make the angle *d* S *a*, equal to the ſum or difference of a right angle, and of the ſun's declination: S *a* being made equal to S A, we take any point, as *d*, upon the line S *d*, and draw the ſtrait line *a d*. From the point A, we draw the ſtrait line A R, perpendicular to the *ſubſtylar line* C P, and from the ſame point A, as a center, and at the diſtance *a d*, we deſcribe the arch N, cutting the *ſubſtylar line* in N. From the point R as a center, and at the diſtance R N, we deſcribe the arch N D; then we erect the perpendicular P Z at right angles to the *ſubſtylar line*, and equal to P S the height of the ſtyle, then from the point Z, as a center at the diſtance S *d*, deſcribe the arch G D cutting the arch N D in D: the line Z D determines the ſituation of the *axis*, in reſpect of the *ſubſtylar line*, and if it meets at the *ſubſtylar line*, as at the point C, that point C ſhall be the center of the *dial*.

The center of the *dial* being found, we'll draw the *equinoctial line*, by drawing the ſtrait line Z E, perpendicular to Z D, meeting the *ſubſtylar line* in E; the line V E perpendicular to the *ſubſtylar line* drawn through the point E, ſhall be the *equinoctial line*.

Our next operation is to place the *ſubſtylar* and *equinoctial lines*, and the center of the *dial*, and to determine the poſition of the *axis* (any two points of ſhadow being given, with the declination of the ſun at the time of obſervation of the points of ſhadow) which cannot be done without having placed, firſt, a ſtyle on the plane of the *dial*, whereof the point may be S and P. Fig. 5. the foot, and any two points of ſhadow, A and B taken at pleaſure; making, beſides, upon a certain plane, the angle *d* S *a*, equal to the ſum or difference of a right angle, and that of the declination of the ſun, on that day on which the points of the ſhadow were marked, according as the declination is north or ſouth; for we will have a point of the *ſubſtylar line* as Q, which may anſwer to a point of the *axis*, which may be more north than the point of the ſtyle; we muſt make the angle *d* S *a*, equal to the ſum of a right angle, and angle of the declination of the ſun, if the declination be north; but equal to the difference of a right angle, and angle of the declination if it be ſouth.

This done, we'll take two ſmall rods of any firm matter, as of wood of a ſufficient thickneſs, or of iron; and make them pointed at the ends, and equal in length to the ſtrait lines *a d*, *b d*; it is not material whether they be ſtrait or crooked, if the diſtances between their points be equal to *a d* and *b d*. We'll put one of the points of that rod which is equal to *a d*, on the point of ſhadow A, and one of the points of the other rod to the point of ſhadow B and join them together by the other points, but ſo as the points that are joined together, may approach or fall back from the point of the ſtyle, without altering the other points of the rods, which are ſet on the points of ſhadow A and B; then we take with the compaſſes, or otherwiſe, the diſtance between the points *a* and *d*, and ſet that diſtance between the points of the ſtyle and the points of the rods that are joined together: by this means the common points of the rods being fixed, ſhall be one of the points of the *axis*, which ought to paſs by the point of the ſtyle, therefore the ſituation of the *axis* ſhall be determined.

By the common point of the rods ſo fixt, which I call D, having drawn a line perpendicular to the plane of the *dial* which ſhall meet it in the point Q, the line P Q ſhall be the *ſubſtylar line*. The point C, on the plane of the *dial*, where it is met by the line D S, drawn by the point of the *ſtyle*, S, and by the end of the rod D, ſhall be the *center* of the *dial*; from whence we may draw the *equinoctial line* in the manner above-mentioned.

But ſuppoſe we had but one ſingle point of ſhadow given, with the declination of the ſun, and the height of the pole above the horizon; we muſt place the *ſubſtylar line*, the center of the *dial*, and the *equinoctial line* in the following manner:

Having placed a *ſtyle* upon the plane of the *dial*, whoſe *point* may be S P, Fig. 6. the *foot*, and A one *point of the ſhadow*, we draw a horizontal line, in the manner abovedemonſtrated, and by the point P draw the lines B P H, perpendicular to the horizontal line *b* H, and P Z parallel to H *b*, and equal to the height of the *ſtyle* P S; then from the point H, where P H meets with the horizontal line, we draw H Z and Z B perpendicular to Z H, which ſhall meet with H P at the point B; if the horizontal line paſſes not through the point P, firſt we let it meet at the point B.

Then we make the angle *d* S *a*, upon ſome plane, equal to the ſum or difference of a right angle, and of the declination of the ſun at the time when the point of ſhadow was obſerved; and make the angle *d* S *b* equal to the ſum of a right angle, and the height of the pole above the horizon. Taking afterwards at pleaſure, the point *d* on the line S *d*, we make S *b* equal to Z B, and S *a* equal to the length of the ſhadow from the point of the *ſtyle* S to the point of ſhadow A, and draw the ſtrait lines *a d*, *b d*. By the points A and B we draw the ſtrait line A B, and from the point B, as a center, at the diſtance *b d*, we deſcribe the arch *f b*, either above or below the line A B; and likewiſe from the point A as a center, and at the diſtance *a d*, deſcribe the arch *g d*, cutting the arch L F at the point L, and from the point L draw the ſtrait line O L perpendicular to A B.

From the point O as a center, at the diſtance O L we deſcribe the arch D L; and from the point P draw

P draw the ſtrait line P G K, perpendicular to O L; and from the ſame point P, at the diſtance *I S*, deſcribe the arch I, either on the one or the other ſide of G, cutting the line L O at the point I. Then we make G K equal to P S, the heighth of the *ſtyle*, and from the point K, at the diſtance G I deſcribe the arch R D, cutting the arch D L in D, and from the point D draw the ſtrait line D Q perpendicular to L *b*, and the line P Q, which paſſes through the points P and Q, is the *ſubſtylar line*. If the point Q be too near to P, we may find another, by taking another point *d* on the line *f d*; conſequently we place the *equinoctial line*, and the center of the *dial*, as we have done it in the preceding practices; having this advantage, beſides, that the line which paſſes through the point B, and through the center of the *dial*, ſhall be the *meridian line*.

If the *horizontal line*, paſſes through the point P, or if the point B be too far diſtant from the point P, we muſt faſten another *ſtyle* upon the plane of the *dial*, whereof the point may paſs by the line of the plummet hanged from the point S of the *ſtyle*, the point of that ſecond *ſtyle* being called B, we perform the operation as before to find the lines *d a*, *d b*; but we may uſe the ſmall rods above-mentioned, otherwiſe the operation would be too long.

Next we muſt endeavour to find the points of the hours of 6 and 12 on the *equinoctial line*, Fig. 14. and to draw the *meridian line*, which muſt be done by ſuppoſing P S to be the height of the *ſtyle*, whereof P is the foot, and S the point; and ſuppoſing, likewiſe, N S to be the *horizontal line*, and M N the *equinoctial line*; the point N where the *equinoctial line* meets with the *horizontal line*, is the point where the hour of 6 interſects the *equinoctial line*.

From the center N, and at the diſtance N S, equal to the height of the *ſtyle*, we deſcribe the arch K H, and taking any point as O, in the *equinoctial line*, for a center, at the diſtance O S we deſcribe the arch I H interſecting the arch K H in H, then draw the ſtrait line N H, and H M perpendicular to N H, the point M where H M meets the *equinoctial line*, is the point where the *meridian line* ought to interſect the *equinoctial line*.

Then having hanged up a line with a plummet *f*, ſo as the line may paſs by S the point of the ſtyle, we mark any point as C on the plane of the *dial*, ſo as we may ſee with one eye, the points M and C both hid together by the line of the plummet, this is called burning, and the line M C ſhall be the *meridian line*. But if the center of the *dial* was given, and that it was the point C, we muſt mark ſome point, as M, on the plane of the *dial*, which we may ſee to paſs by the line of the plummet, with the point C, and the line C M ſhall be the *meridian*. We may alſo draw this *meridian line* in the night with a candle, in holding it at a diſtance from the line of the plummet, ſo as the ſhadow thereof may paſs by M, or by the point C, which of them is given; for the ſhadow of that line ſhall be the *meridian line*.

When only one point of ſhadow is given with the height of the pole, and the declination of the ſun, we draw the *meridian line*, and find the point of the hour-line of 6, on the *horizontal line*, by placing a ſtyle on the plane of the *dial*, whoſe point be S, and the foot P. Fig. 15. drawing the *horizontal line* H *b*; and from the point P drawing likewiſe P H perpendicular to H *b*; drawing afterwards P Z parallel to H *b*, and equal to P S the height of the ſtyle, and making H E equal to H Z.

Then having marked the point of ſhadow A, as far from noon as it is poſſible, we hang a plummet T, ſo as the line thereof may paſs by S the point of the ſtyle, and burn it (as we did in the foregoing practice for the *meridian*) marking the point *b* on the *horizontal line*, by which we ſee the line paſs, then when it alſo paſſes by the point of the ſhadow A, we draw the ſtrait line *b* E; drawing afterwards an arch of a circle Z *o f* on the center C at any diſtance, and making Z *o* equal to the height of the pole above the *horizon*, and drawing the lines *o c*, *z c*, to *c* the center of the circle.

We then make the arch *o m* equal to the declination of the ſun, at the time when the point of ſhadow was made towards Z, if the ſun be in the north ſigns, and towards *f* if it be in the ſouth ſigns, for thoſe that have their *zenith* in the north part of the ſphere; but on the contrary, for thoſe that have it in the ſouth part; and draw *a m* parallel to *o c*. We afterwards draw *c f* perpendicular to *c z*, from the center *c*, and make the angle *d c f*, equal to the angle *b* S A, and draw the line *d e* parallel to *f c*, meeting *c z* in *o*, and *a m* in *a*.

On the point E, as a center, at the diſtance *d e*, we deſcribe the circle B D, meeting E *b* (prolonged if it be neceſſary) at the point B; we make B M equal to *d a*, and from M raiſe D M, perpendicular to E B, interſecting the circle B D in D, then drawing E D (prolonged if it be neceſſary) and the point *f* where it interſects the *horizontal line*, ſhall be the point of the *meridian* upon the *horizon*; and E G being drawn perpendicular to E D, gives the point G, where the hour-line of 6 meets with the *horizontal line*.

The Line M D, which is drawn perpendicular to B E, may meet with the circle B D on either ſide of the point B; but we muſt take care that if the point of ſhadow A, is marked before noon, to make

make use of the point D, which is on the right hand of the point B, as in the example; and if the point A was marked after noon, we must take the point D where M D meets the circle on the left hand of B, to have the position of the *meridian line*; if D E meets not with the *horizontal line*, but is prolonged towards E, the point F shall appertain to the line of midnight: all this must be understood of those that have their *zenith* on the north-side of the *equinoctial*, for it is contrary with those which have their *zenith* in the southern hemisphere. If the line E D meets not not the *horizontal line*, being likewise prolonged towards E, then the *dial* shall have no line of mid-day, nor of mid-night, and the plane of the *dial* shall be either oriental, or occidental.

The angle H E F, made by the line E D, with the *horizontal line* E H, is the angle of the declination of the plane. By the foregoing practice, the *meridian line*, or the line of midnight, may be drawn by the point *f*.

Some of the foregoing operations may be abridged in the following manners.

1. Having found the *substylar line* p e, Fig. 18. and the *equinoctial line e v* for the style S *p*, if we would remove the *substylar* and *equinoctial lines* to another place of the plane of the *dial*; the line P E parallel to *p e* shall be another *substylar line*, and V E parallel to *e v*, or perpendicular to P E, shall be the *equinoctial line*, and we determine by the following method, the position of a style for the two lines P E, E V, whereof the height shall be given of any length, or we will determine the height of a style, whereof the position shall be given upon the *substylar line* P E. First, we'll let the line A R be given for the height of the style, which ought to be set for the *substylar* and *equinoctial lines* P E, E V. We'll make E P equal to *e p*, and set it the same way, (that is, we'll set the point P above the point E, if the point *p* be above the point *e*; and below it, if it be below it) and make E Z equal to *p s*, and E Z equal to R A given; and we'll draw z P and Z R parallel to Z P, meeting E P in R; and the point R shall be the foot of the style, the height whereof, R A, is given: therefore if we fix a style, whereof the foot may be R, and the distance between the point thereof A, and foot R may be the height equal to the line Z E, the proposition is satisfied: but if the point R were given for the foot of the style, and the height were required, we'll draw P Z as before, and by the point R, draw R Z parallel to P z, and E Z shall be the height of the style, whose foot is the given point R.

2. The *substylar line* C E, the *equinoctial line* E V, and the *meridian line* C M, answerable to the style S P, being given, we may take what point we will in the *substylar line*, ask for the center of the *dial*, without altering the *substylar line*, or *equinoctial*; and the line K *m* drawn parallel to C M, shall be the *meridian line*; but if the height and position of the style must be changed, by making E *z* equal to P S, and drawing M P and P Z, and *m* R and R Z parallels to M P and P Z, and the point R shall be on the *substylar line*, which is the foot of the style, whereof the height R Z is perpendicular to the point R on the plane of the *dial*.

3. If the *substylar line* C E, was given with the *meridian line* C M, answering to the style P S, we may take any point, as *p*, to be the foot of a style, whereof tbe height is to be determined; or the style being given of any height, to determine the position of the foot *p*, without changing either the *meridian*, or the center of the *dial*. If the foot of the style be given, and we are to determine its height by the foot of the style P, for the finding of the *meridian* and *substylar line*, we'll draw P S, perpendicular to the *substylar line*, and equal to the height of the same style, drawing C S by the center of the *dial*, and from the given point *p*, drawing likewise *p s*, parallel to P S, till it meets C S in the point S, and *p* S shall be the length of the height of the style, which ought to be placed at the point *p*, and the *meridian* C M, and the center of the *dial* C, are not changed But if *p* S were given for the height of the style, it must be put upon P S prolonged, if it be necessary, then P z and z S must be drawn parallel to C P, to meet with the line C S in *m* S, and S *p* being drawn parallel to S P, shall give the point *p*, on the *substylar line*, for the foot of the style required, whereof the height is given.

4. The *meridian* C M, Fig 19 being given, with the *equinoctial line* E M, we may find another *equinoctial* as *e* M, without changing the *meridian*, the which *equinoctial e* M, shall make the angle E M C, but we must find another style by the following method: If the center of the *dial* be given at the point C, having drawn (by the foot of the style *p*, which has served to find the *meridian* and the center C) *p* S perpendicular to the *substylar line* C *p*, and equal in length to the same style, we'll draw *e* S parallel to E S, and from the point S, S *p* parallel to S *p*, meeting the *substylar line* in the point *p*, which shall be the foot of the style required, whereof *p* S shall be the height. But if we have not the center of the *dial*, we must draw the line S *f* by the point S, which determines the inclination of the *axis* by the *substylar line*, and we shall find as before, the point *p* for the foot of the style required, whereof the height shall be *p* S.

5. If after we have drawn the *meridian line* CM, Fig. 20. and the *substylar line* B *p*, we cannot have the *equinoctial*, because the *style* has been put too long, we may diminish it as much as we please, without changing the foot thereof, or the *substylar line*; but we must find another *meridian* and another *horizontal line*, which may answer to that *style*, and these *meridian* and *horizontal lines*, shall be parallel to the *first meridian* and *horizontal lines*. Therefore we draw the line *e m* by any point of the *substylar line* at *e*, which may be perpendicular to it; that line may be the *equinoctial line*: but the height of the *style* must be changed in drawing *e* S perpendicular to the line S *s*, which determines the inclination of the *axis* with the *substyle*, and that line *e* S meeting S *p*, which is perpendicular to the *substylar line* by the foot of the *style*, and which is its height, so that for the *equinoctial line e m*, *p* z shall be the height of the *style* required; but there must be another *meridian* found, whether the center of the *dial* be found or not.

6. A *dial* being drawn on a plane, we may transfer it into what other place we will on the same plane, by drawing of parallel lines to those that are drawn, so that we keep the same order and the same proportion between them in their meetings, but the *style* ought to be put at the point which answers to the point of the first, which is for its foot.

Though all the foregoing practices seem to be clearly enough demonstrated, as well in the plate, as by the reasoning, they nevertheless, cannot be well executed without some farther instructions, *viz.* With regard to the different expositions of the planes proposed, on which the *sun-dials* are to be drawn. 2. How to mark the points of the *astronomical* hours on the *equinoctial line*, and how to draw by those points, the hour-lines. 3. How to mark the points of the *astronomical* hours on the *horizontal line*, and how to draw the hour-line by those points. 4. Six intervals of hours following one another being given, how to draw all the other hours. 5. How to draw the parallels of the twelve signs. 6. The *equinoctial line* being given, if we draw a parallel to it by a point given on an hour-line. 7. How to draw the *Italian* and *Babylonian* hours upon an *horizontal* plane. 8. How to draw the *Italian* and *Babylonian* hours on a plane which is not *horizontal*. 9. How to continue the description of the *Italian* and *Babylonian* hours, when the parallel of the *equator* is wanting on the plane of the *dial*. 10. Four *astronomical* hours being given, following one another in order, with the *equinoctial line*, how to find the other hours. 11. A *dial* being given, which is already drawn, how to find the foot of the style, which served to draw it, and to determine the height thereof. 12. How to place the *axis*. 13. How to draw *dials* by reflexion.

1. We may know the disposition of the plane in regard of north or south (which must be necessarily known before we begin any thing) by a small declinatory, which presently shews on what side is the north, south, east, or west; which those that are used to observe the sun, may know by seeing in what manner it shines upon the plane, according to the hour and season of the year. Then we may well conceive after what manner the *axis* shall meet with the surface, and consequently may judge of the position of the *substylar line*, of the *equinoctial*, and also of the whole *dial*. But considering a *dial* wholly made, it is not difficult to know, among divers manners, which we may use, that may be most fit, and most easy for the construction of the *dial*; therefore we may easily see that it would be useless to find the center of a *dial*, or the *meridian* of a plane which comes near either to the east or west, and that the *equinoctial line* being set on such a plane, we need not find the point of mid day, and that we must use the point of the sixth hour, to begin the divisions of the horary intervals on that line, or on the *horizontal line*. That on these sorts of planes we cannot use the practices where we ought to have the points of shadows after mid-day, which may be answerable to others taken in the morning; for if the first point has been marked a little too far from the *meridian*, we can never have its correspondent point: that we must not use the practice of correspondent points of shadows, or the tract of the shadow, if the circle that is described from the foot of the *style* as a center, meets that tract in angles too acute; for we cannot determine exactly that meeting, and this inconveniency may happen to all practices on all sorts of planes in any season of the year: that if the *dial* be large, and the declination of the sun has changed considerably between the observations of the points of shadow, we have not exactly the lines which we seek by those practices, where we suppose that it has not been changed between the observations.

In the following practices, we suppose always that the *equinoctial* or *horizontal line* is drawn, and that we have marked on that line, the point where the hour 12 or 6 meets with it; at which points we begin the division of the hours on those lines; but to draw them we must have the center of the *dial*, or at least the inclination of the *axis* to the *substylar line*.

2. We mark the points of the astronomical hours on the *equinoctial line*, and by those points draw the hour lines in this manner; we suppose P S, Fig. 21. to be a *style*, whereof S is the point, and P the foot, and E 7 is the *equinoctial line*, on which the

the point 7 is the meeting of the *equinoctial* with the *meridian*, and the point 8 is the meeting thereof with the hour of 6 and with the *horizon*; P E A is the *subſtylar line*, which meets with the *equinoctial* in E.

This preſuppoſed, we make E A on the *ſubſtyle* equal to E S, which is the diſtance between the point E of the *equinoctial*, and S the point of the *ſtyle*; we draw A 7 or A 8, or both of them, if we have theſe two points on the *equinoctial line*; which two lines A 7, A 8, ought to make a right angle at the point A. Then on the point A as a center, at any diſtance, we deſcribe an arch of a circle *b c*, which cut the lines A 7 and A 8, at the points *b* and *c*, and divide the circle from 15, to 15 degrees, beginning at the point *b*, or at the point C; then we draw ſtrait lines from the center A, and by the points of the diviſion of the circle, which muſt be prolonged, if it be neceſſary, to the *equinoctial line*, on which it gives the diviſion of the hours, which are to be marked according to the apparent motion of the ſun from eaſt or weſt: then by the center of the *dial*, and by the points of the hours which are marked upon the *equinoctial line*, we draw ſtrait lines, which are the hour lines.

But if we have not the center of the *dial*, and have only the inclination of the *axis* I z, to the *ſubſtylar line e* E, we muſt take any point as *e*, on the *ſubſtylar line e* 12, parallel to the *equinoctial line* E *x* 11, and drawing *e* z perpendicular to Z z, make *e a* equal to *e* z, and by the point *a* draw the ſtrait lines *a* 11, *a* 12, *a* 1, &c. parallel to the lines A 11, A 12, A 1, &c. and by theſe points, where theſe lines meet with the line *e* 12, and by thoſe which are correſpondent to them on the *equinoctial line*, draw the hour-lines 11 XI, 12 XII, 1 I, 2 II, &c.

3. We mark the points of the *aſtronomical hours* on the *horizontal line*, and draw the hour-line by thoſe points, in the following manner:

We make the line M H D, Fig. 22. the *horizontal line*, and S the point of the *ſtyle* given, whereof P is the foot; by that point P, we draw the line P H perpendicular to the *horizontal line*; making M the point, where the *meridian line* interſects the *horizontal line*; upon the line H P, we ſet H S equal to H S, and draw the ſtrait line S M *a*, and make the angle M S A equal to the angle of the elevation of the pole above the *horizon*; then from any point as A, taken on the line S A, we raiſe a perpendicular from 12 to S A, till it meets with S M in 12, and draw the lines 9, 12, 4, perpendicular to S *a*, and make 12 *a* equal to 12 A; and from the point A as a center, we deſcribe a circle at any diſtance, and divide it into equal parts from 15 degrees to 15 degrees, beginning the diviſion where the line *a* 12 interſects the circle, and draw lines from the point *a* to the diviſions of the circle, to meet with the line 9, 4, at the points 9, 10, 11, 12, 1, 2, 3, 4, &c. and by the ſame points and the point S, we draw ſtrait lines, which we make to meet the *horizontal line* in the points of the hours required, which we mark according to the diurnal motion of the ſun, of which the point M is noon, and D the point of the hour 6. If the line S D drawn perpendicular to S M, meet with the *horizontal line* at the point D, that point ſhall be the hour 6 on the *horizontal line*, which is the ſame point where the *horizontal line* ought to meet with the *horizontal line*.

If we have not the point of mid-day on the *horizontal line*, and we have but D the point of the hour 6; we then draw S D and S M perpendicular to S D; then we do the ſame as we did before to find the points of the hours on the *horizontal line*. The hour lines are to be drawn from C the center of the *dial*, and by the points of the hours which have been found on the *horizontal line*.

4. We ſuppoſe the 6 intervals of hours from Fig. 23. C A to C *f* to *o* be given, we draw all the other hours, by making E *e* parallel to *c* 5, cutting *c* A in the point A C B, in the point B C D, in the point D, &c. and we make A *b*, equal to A B A *d* equal to A D, &c. and from the center C, and through the points *b d c*, &c. we draw the lines of the hours that follow the precedent hours. When we will alſo have other hours following the firſt or laſt found, we muſt repeat the operation in drawing another line as E *e*, parallel to that which is the laſt of the ſix intervals of hours. If the *dial* has no center, we muſt draw another line as S *t* parallel to E *e*, on which we are to find the points of the hours as we have found them on the line E *e*, and in joining the horary points of the two parallel lines E *e* and S *t*, we'll have the hour lines required.

5. We draw the parallels of the twelve ſigns, Fig. 24. by drawing firſt the lines S C and S *a* at right angles to it at the point S; we make the angles *a* S *d*, *a* S *k*, each 20 degrees 30 minutes; and the angles *a* S *f*, *a* S *i*, each of 20 degrees 11 minutes, and the angles *a* S *g*, *a* S *k*, each of 11 degrees 30 minutes: the line S *a* denotes the *equinoctial*, which is the beginning of *Aries* and of *Libra*; the line S K, denotes the beginning of *Taurus* and *Virgo*; S *i* the beginning of *Gemini* and *Leo*; S *k* the beginning of *Cancer*, which is the tropick of the ſame ſign; S *g* the beginning of *Scorpio* and *Piſces*; S *f* the beginning of *Sagittarius* and

and *Aquarius*; S *d* the beginning of *Capricorn*, which is the tropick of the fame fign. If the center of the *dial* be towards the North in regard to the point of the *ftyle*, we make S *c* equal to S C of the *dial*, which is the diftance between the point of the *ftyle* and the center; but if the center be towards the fouth, in refpect of the point of the *ftyle*, we make S *c* upon *c* S prolonged on the other fide of the point S.

Next we muft find the points of the parallels of the figns upon the hour lines; as for example, on the line of mid-day, we muft take the diftance S XII, from the point of the *ftyle* S to the point XII, which is the interfection of the line of mid-day with the *equinoctial*, and fet it from S to 12 upon the line S *a*, and having drawn the line *c* 12, which cuts the lines of the figns in the points *d*, *f*, *g*, *b*, *i*, *k*, then we tranfport the intervals 12 *b*, 12 *i*, 12 *k*, 12 *g*, 12 *f*, 12 *d*, in XII H, XII I, XII K, XII G, XII *f*, XII D, on the one and other fide of the *equinoctial line*, as they are on both fides of the line S *a*. And in the fame manner having found the other points upon each hour-line, and likewife on the halves and quarters, or other lines coming from the center, we draw by all the points which belong to the fame fign, the line of the parallel of the fign, and thus for each of them in particular. But if we have not the interfection of the *equinoctial line* upon the hour-line, on which we would have the points of the figns, in that cafe we may have always the center of the *dial*; but if we have not the center of the *dial*, we may have always the *equinoctial line*; therefore having taken (for example) the third hour, on which we would have the points of the parallels of the figns, and the point R at pleafure; and having marked S 3 on the line S *a* equal to S III, which is the diftance between the point of the *ftyle* S, and the point where the third hour propofed, interfects the *equinoctial line*: on that line S 3 for the bafe, we muft make the triangle S 3 *r* equal to the triangle S III R, which has S III for its bafe; and draw *r* 3 prolonged, which fhall interfect the lines of the figns in points, which are to be transferred to the line of the third hour.

6. The *aftronomical hours* being drawn on the *dial*, Fig. 26. whofe center is C, and the *meridian* C A, and V A the *equinoctial line*; *c* E being divided into two equal parts; to draw the *Italian* and *Babylonian* hours upon an *horizontal* plane, we muft find on the hour-lines the points *b*, *c*, *d*, *e*, *f*, *g*, *b*, &c. of a parallel to the *equator*; which done, the line A 12 parallel to the *equinoctial*, fhall be the line of the 12th *Italian* hour. The ftrait line *b* VII, which paffes by the point of the feventh hour in the morning of the *equinoctial*, and by the point of the firft hour after noon of the parallel, fhall be the line of the 13th *Italian* hour. The ftrait line *c* VIII, which paffes by the point of the eighth hour in the morning on the *equinoctial line*, and by the point of the fecond hour after noon of the parallel, fhall be the 14th *Italian* hour. The ftrait line *d* IX, which paffes by the point of nine in the forenoon, on the *equinoctial*, and by the point of three in the afternoon, on the parallel, fhall be the 15th *Italian* hour, and thus of the reft; there being always fix hours diftance between the hour of the *equinoctial* and that of the parallel.

The *Babylonian hours* are marked after the fame manner, but only that which is done on one fide of the *meridian* for the *Italian* hours, is made on the other fide of the *meridian* for the *Babylonian* hours, and they are counted after another manner; as for example, the ftrait line that paffes by the point of mid-day of the *equator*, and by the point of the fixth hour in the morning of the parallel, is the fixth *Babylonian* hour; that which paffes by the firft hour after noon on the *equinoctial*, and by the point of the feventh hour in the morning on the parallel, fhall be the feventh *Babylonian* hour, and thus following; fo as A 12 parallel to the *equator*, fhall be the 12th *Babylonian* hour for the *horizontal dial*.

7. If we want to draw the *Italian* and *Babylonian hours*, on a plane, which is not *horizontal*, Fig. 28. the *aftronomical* hours being defcribed, and the *horizon* R H, which is one of the hours required, being drawn on the plane of the *dial* with the *equinoctial line*, we muft draw a parallel to the *equator*, *d b* R *e f g*, which paffes by R the interfection of the *horizon* with any hour line. And feeing that the *horizon*, which is the line of the 24th *Italian* hour interfects the parallel in R, at the point of the fecond hour after noon, on the *equinoctial line* at the point of the fixth hour afternoon, the line of the firft *Italian* hour fhall pafs by the point *e* of the parallel, which is the third hour after noon, and by the point of the *equinoctial*; the line of the fecond *Italian* hour fhall pafs by the point *f* of the parallel, which is the fourth hour, and by the point of the eighth hour on the *equinoctial line*, and thus of the reft; for we muft find all the points by which the *Italian* hours are to pafs, fo as the 18 *Italian* hours may pafs always by the point of mid-day of the *equinoctial line*, and by a point of the hour of a parallel, which fhall be fo far from the point of mid-day, as the point R of the fame parallel, which is the interfection of it with the *equinoctial line*.

But if the point R, by which the parallel to the *equator* is defcribed, was the interfection of an hour

hour before noon, we muſt conſider, that *that* parallel ought to meet alſo the *horizon* in a point of an hour, which is ſo far from noon, as is that by which we have deſcribed it; for example, if the point R was the interſection of nine in the morning with the *horizontal line*, the parallel to the *equator*, deſcribed by the point R, ought to meet the *horizontal line* in the point H, which is upon an hour line, ſo far diſtant from noon as is the point R; that is to ſay, that the point H ſhall be the meeting of the third hour afternoon with the *horizontal line*, and the line of the 24th *Italian* hour, which is an occidental portion of the *horizon*, ought to be taken from the point of the third hour of the parallel, with the point of the ſixth hour after noon of the *equator*, and in reckoning as we have done before, we ſhall find that the firſt *Italian* hour, ſhall paſs by the point of the fourth hour on the parallel, and by the point of the ſeventh hour after noon on the *equinoctial*; and that the line of the ſecond *Italian* hour, ſhall paſs by the point of the fifth hour of the parallel, and by the point of the eighth hour of the *equinoctial*, and ſo on; and we draw only thoſe that are viſible, for the others are of no uſe, and ſerve only to count and to place thoſe which are of no uſe.

Theſe rules are for the *Italian* hours, but for the *Babylonian* hours, which have for the twenty-fourth hour the oriental part of the *horizon*, if the parallel, which is deſcribed by the point R of the *horizon*, was the meeting of the *horizon*, with the line of the ninth hour before noon, the firſt *Babylonian* hour ſhall paſs by the point of the tenth hour in the morning of the parallel, and by the point of the ſeventh hour in the morning on the *equinoctial*; the line of the ſecond *Babylonian* hour ſhall paſs by the point of eleven before noon on the parallel, and by the point of eight on the *equinoctial*, and ſo of the reſt; and if the point R of the parallel, was the point of any afternoon hour, we muſt take its correſpondent before noon, to begin to count the *Babylonian* hours, which is the contrary of that, which we have done for the *Italian* hours.

8. It happens, ſometimes, that the parallel, or the *equator*, is wanting on the plane of the *dial*, notwithſtanding which, we may continue the deſcription of the *Italian* and *Babylonian* hours; if the point *h* be the laſt which is found on the parallel, by means of the *equinoctial line*, and the line *h* III be the laſt *Italian* hour, which we can mark by the help of that parallel; that line *h* III, ſhall meet with ſome aſtronomical hour in ſome point, as *m*, if we find the points *l n o* of the parallel which paſſes by *m*, and if they be on the hour before, or after that, on which is the point *m*; for then we continue to draw the lines of the *Italian* or *Babylonian* hours, by the points of the hours of the parallel *m n o*, and by the points of the hours of the *equator*, in following the ſame order as before, and if the *equator* be wanting, we ſhall find the points of another parallel, by the parallel that is given, and then we may join the points of the hours on the two parallels, in following the former order.

9. Theſe four hour lines following one another, Fig. 31. *viz.* A *a*, B *b*, C *c*, D *d*, with the *equinoctial line* E *f* being given, we find the other hours, by drawing from a point *a* taken at pleaſure, in one of the laſt lines A *a*, the line *a* D which cut B *b* in B, and C *c* in *g*; alſo by the ſame point *a*, having drawn *a* C which cuts B *b* in *b*, and A *b* which meets C *c* in *c*, and B *g* which meets D *d* in *d*; we prolong *c b*, *c d*, to the points E *f* in the *equinoctial line*; and the hour lines E *e*, *f f*, drawn by the points E *f*, ſhall be the hour lines required, whereof E *e* ſhall be diſtant from A *a* one hour, and *f f* ſhall be two hours from D *d*; therefore B D being prolonged to *f* in the line *f f*, and *f d* to *b* in the line B *b*, having drawn C *f* which cuts D *d* in *i*, *l i* prolonged ſhall meet the *equinoctial* in M, by which the hour line M *m*, ſhall be between the two hour lines D *d*, and *f f*, and theſe ſeven hour lines being found, we may have all the reſt by the practice of the third article.

There are many caſes where three hour lines are ſufficient with the *equinoctial* and *horizon*; for example, if we have three hour lines, Fig. 31. *a* 2, *b* 3, *c* 4, and the *equinoctial line* 24, and *horizontal line a c*, having drawn *a* 4 which cuts *b* 3 in *d*, and having drawn *d* 2 which cuts *c* 4 in *f*, drawn *c* 2 which cuts *b* 3 in *e*, and *e* 4 which cuts *a* 2 in *h*; a ſtrait line muſt paſs by the three points *f b h*, which ſhall meet the *equinoctial* in the point *g*, which is one point of the hour as far from *b* 3, as is the hour line of ſix: Therefore, if the hour line *b e*, be the fourth hour, *a h* ſhall be the third, and *g i* the ſecond; but in this example, *b e* being the third hour, *g i* ſhall be the twelfth hour. The firſt hour between 12 and 2, is found by drawing *g c* which cuts *a* 2 in *k*, and *k* 4 which cuts the hour line *g i*, which was drawn by the point *g* to the point *i*, and in drawing *i* 2 which cuts *g h* in *n*, the hour line by the point *n* ſhall be the firſt hour.

I. We find the foot of the *ſtyle*, Fig. 32. which has ſerved to draw a *dial*, and determine the height thereof, by ſuppoſing, firſt, the line A B to be the *equinoctial line*; and the diſtance A B on the line, to be the interval of any ſix hours: then having divided A B into two equal parts in the point G, from

from the point G as a center, we deſcribe on the diameter A B, the circle A S B *d f*, and mark the points L and *f*, which divide the ſemicircle into two equal parts: A *f*, *f* D and D B, are each the interval of two hours on the *equinoctial line*; the lines *d* D, *f f*, ought to meet the circumference of the circle at the point S, and the like S E P drawn perpendicular to the *equinoctial line* ſhall be the *ſubſtyle*. If we have C the center of the *dial*, having deſcribed on the diameter C E, the ſemicircle C Z E, and having drawn in it the line E Z equal to E S; Z P being drawn perpendicular to the *ſubſtylar line* E P, and meeting it at the point P, that point ſhall be the foot of the ſtyle, whereof P Z ſhall be the height. But if we have not the center of the *dial*, having drawn *a e* parallel to the *equinoctial*, and from the point *a* draw *a* S parallel to A S, which meets the *ſubſtylar line* in S, from the point *e* as a center, and ſemidiameter S, we'll deſcribe the arch *x*, and draw the ſtrait line *x z*, which ſhall touch the two arches *x* and *z*, and that line *x z* ſhall determine the inclination of the *axis* to the *ſubſtylar-line*, and having drawn E *z* perpendicular to *x z*, from the point E, and from the point *z*, the ſtrait line *z* P perpendicular to the *ſubſtylar line* E P, the point P ſhall be the foot of the ſtyle, whereof P Z ſhall be the height.

II. If we would have the hours ſhewn only by the ſhadow of the point of the ſtyle, we muſt make, and place it after ſuch a manner, as may ſerve without changing it; and though we can give it various forms, the beſt is to make it waved to the end, that the ſhadow thereof may not unite with the hour lines in any place, and that we may always know, that it is only the ſhadow of the point that ſerves to ſhew the hours. But if we would have a portion of the *axis* to ſhew the hours, and that the *axis* be repreſented by an iron rod, the ſtyle we have placed ought to have the point very ſmall, that it may enter into a little hole made in the rod, ſo as the point of the ſtyle, may exactly anſwer to the middle of the thickneſs of the rod; the ſtyle may remain if we would have it to ſupport the *axis*; but if the *axis* be not very long, and if it be ſtrong enough to ſuſtain itſelf alone, being faſtened at one end, we may take away the ſtyle when the *axis* is fixed on the ſurface of the *dial*. We may do the ſame, if we faſten to the end of the ſtyle a point of an iron wire, which there may be very ſmall, and take but half the thickneſs of the rod, ſo as the *dial* being drawn to that point, there remains nothing to be done, but to take it away to place the *axis*, the middle of the thickneſs whereof ought to anſwer to that point; therefore, whether the ſtyle remains to uphold the *axis*, or whether we take it away when the *axis* is fixed in its place, we muſt faſten it to the end of the ſtyle to ſtay it, which ought to anſwer to the center of the *dial*, if it has any.

The rod which ſerves for the *axis*, may be made as marked in the figure, ſo as the hole ſignified by A, Fig. 33. can be made to lodge the point of the ſtyle: and that it may be let in as far as the middle of the thickneſs of the rod, the point B, which anſwers alſo to the middle of the rod, ought to be applied exactly to the center of the *dial:* this rod being thus ſtayed at the point B, and at the point A, we muſt faſten the foot on the plane of the *dial*. But if we would not have a foot to the *axis*, as G, and that we would only fix the rod to the center of the *dial*, we muſt draw various lines, which may paſs by the center of the *dial*, and ſtay the rod on the point of the ſtyle A, ſo that the end may enter in a hole made in the plane of the *dial*, at the place of the center, and be divided by the middle of its thickneſs, by each line that paſſes by the center.

If we make uſe of a thin plate, cut according to the inclination of the *axis* with the *ſubſtylar line*; it muſt be ſet perpendicularly on the plane of the *dial*, in applying one of its ſides to the *ſubſtylar line*, and the other line paſſing by the point of the ſtyle ſhall ſerve for the *axis*.

Thus far we have inſtructed our pupils, who deſign to make ſome progreſs in the *art of Dialing*, in all the general and particular rules belonging to that art; and thereby rendered them capable to draw all the different lines which compoſe a *ſundial*. I propoſe no particular conſtruction on the horizontal and vertical planes, which only gives particular rules for each caſe; and which, in the ordinary way happens very ſeldom; therefore theſe methods are for all ſorts of planes indifferently conſidered. I know very well that there are various caſes where we might find abridgments, but theſe abridgments conſiſt only in certain lines and points, which come to be united in the general practices, which I have given here.

Dials are alſo drawn by *reflection*, in making uſe of a ſmall piece of poliſhed metal, very even and flat; of a round form, and of about an eighth part of an inch in diameter, and having placed and faſtened it in a firm place, we mark the points of light on the plane where we deſign to draw the *dial*, which ſerve inſtead of the points of ſhadow; the middle of the mirror or glaſs, ought to be conſidered as the point of a ſtyle, whereof we find the foot in drawing from the middle of the glaſs, a line perpendicular to the plane of the *dial*; the point where this line meets with the plane of the *dial*, ſhall be the foot of the ſtyle. We may find the *ſubſtylar line*, the *equinoctial line*, the center of the *dial* and *meridian*, by the practices, where we make

no

no uſe of the *horizontal line*, nor of the height of the pole.

Having found the *equinoctial line*, and the point where the *meridian line* interſects it, we draw the hours, following the methods heretofore deſcribed.

If the inclination of the glaſs be never ſo little changed, it will cauſe a conſiderable alteration in the *dial*; therefore this ſort of *dials*, ſeldom laſts many years in good condition; but there always happens ſome alteration to the wall on which they are fixed. But if in the place of the glaſs, we fill ſome ſmall veſſel, either of glaſs or potter's earth, of about an inch in diameter, with water or quick-ſilver, that veſſel being put upon a place marked on ſome *tranſum* of a window, or the like, ſhall give the hours on the *dial*.

Beſides *ſun-dials*, there is a *nocturnal*, or *night-dial*, which ſhews the hours of the night: of this there are two kinds, *lunar* and *ſiderial*.

The Moon-Dial, or Lunar-Dial, is that which ſhews the hours of the night, by means of the light or ſhadow of the moon, projected thereon from an index.

To deſcribe a Moon-Dial, ſuppoſe, *e. g.* a *horizontal moon-dial*; there muſt be drawn firſt a *horizontal ſun-dial*, then two perpendiculars erected to the line of 12 o'clock, and dividing the interval into twelve equal parts, through the ſeveral points of diviſion, there muſt be drawn lines parallel thereto. Now appropriating the firſt line to the day of the new-moon, and the ſecond, to the day when the moon comes an hour later to the *meridian* than the ſun; their interſections with the hour-lines will give points, through which draw a curve line 12 12, for the *meridian line* of the moon. After the like manner are determined the hour-lines 1 1, 2 2, 3 3, &c. which the ſhadow of the moon, projected from the ſtyle of the *dial*, interſects at the reſpective hours. We muſt blot out the hour-lines of the *ſun-dial*, together with the perpendiculars, whereby the *lunar-hours* were drawn, and divide the interval by other parallel lines into 15 equal parts, anſwering to the 15 days between new and full-moon. Laſtly, to theſe lines we muſt write the ſeveral days of the moon's age. Now the moon's age being learned from the *calendar*; the interſection of the line of the moon's age, with the *lunar* hour-lines, will give the hour of the night.

We draw a *portable moon-dial*, by deſcribing a circle on a plane that may be raiſed according to the elevation of the *equator*, and dividing its circumference into 29 equal parts. From the ſame center we deſcribe another moveable circle, which we divide into 24 equal parts, or hours. In the center we erect an index, as for an *equinoctial dial*. This *dial* being daily placed after the manner of an *equinoctial dial*, and the 12 o'clock line brought to the line of the moon's-age: the ſhadow of the index will give the hour.

To find the hour of the night by a *ſun-dial*, we obſerve the hour which the ſhadow of the index points at by moon-light; find the moon's age in the *calendar*, and multiply the number of the days by three-fourths; the product is the number of hours, to be added by the hours ſhewn by the ſhadow, to give the hour required.

There are alſo *ring-dials*, and *quadrantal-dials*.

A Ring-Dial, is a kind of *dial* uſually ſmall and portable, conſiſting of a braſs-ring, or rim, ſeldom exceeding two inches in diameter, and one third of an inch in breadth. In a point of this rim is a hole, through which the ſun-beams being received, make a lucid ſpeck on the concavity of the oppoſite ſemicircle, which gives the hour of the day in the diviſions marked therein; but it only holds good about the time of the *equinox*. To have the *dial* perform throughout the whole year, the hole is made moveable; and the ſigns of the *zodiack*, or the days of the month are marked on the convex ſide of the ring, by means whereof, the *dial* is rectified for the time. To uſe it, put the moveable hole to the day of the month, or the degree of the *zodiack* the ſun is in; then ſuſpending it by the little ring, turn it towards the ſun, till his rays, as before, point out the hour among the diviſions on the inſide.

An *univerſal* or *aſtronomical ring-dial*, is a *ring-dial* which ſerves to find the hour of the day in any part of the earth; whereas the former is confined to a certain latitude. It conſiſts of two rings, or flat circles, from two to ſix inches in diameter; and their breadth, &c. proportionable. The outward ring repreſents the *meridian* of any place you are at; and contains two diviſions of 90 degrees each, diametrically oppoſite to one another; ſerving, the one from the *equator* to the north, the other to the ſouth pole. The inner ring repreſents the *equator*, and turns exactly within the outer, by means of two pivots, in each ring at the hour of 12. Acroſs the two circles, goes a thin riglet or bridge, with a curſor, that ſlides along the middle of the bridge. In the curſor is a little hole for the ſun to ſhine through. The middle of this bridge is conceived as the *axis* of the world, and the extremities as the poles; and on the one ſide are drawn the ſigns of the *zodiack*, and on the other, the days of the month. In the edge of the *meridian* ſlides a piece, to which is fitted a ring to ſuſpend the inſtrument by.

To uſe this *univerſal ring-dial*, we muſt place the line which is on the middle of the ſliding piece, over the degree of latitude of the place (for example 51 degrees for *London)* and put the line which croſſes the hole of the curſor to the degree of the ſign, or day of the month. Then we open the inſtrument, ſo as the two rings be at right angles to each other, and ſuſpend it by the rings, that the *axis* of the *dial*, repreſented by the middle of the bridge, may be parallel to the *axis* of the world. Afterwards we turn the flat ſide of the bridge towards the ſun, ſo as his rays ſtriking through the little hole in the middle of the *curſor*, fall exactly on a line drawn round the middle of the concave ſurface of the inner ring; in which caſe, the bright ſpot ſhews the hour of the day in the ſaid concave ſurface of the ring.

The hour of 12 is not ſhewn by this *dial*, by reaſon the outer circle being then in the plane of the *meridian*, hinders the ſun's rays from falling on the inner circle; nor will this *dial* ſhew the hour when the ſun is in the *equinoctial*, by reaſon his rays, then, fall parallel to the plane of the inner circle.

Quadrantal-Dial, or *horodictical quadrant*, is a pretty commodious inſtrument, thus called from its uſe in telling the hour of the day. Its conſtruction is ſimple and eaſy, and its application ready.

We firſt make a *quadrant*, and from the center of that *quadrant*, whoſe limb is divided into 90 degrees, we deſcribe ſeven concentrick circles at intervals, at pleaſure, and to theſe add the ſigns of the *zodiack*, in the order they are repreſented in the ſcheme. Secondly, applying a ruler to the centre and the limb, we mark upon the ſeveral parallels, the degrees correſponding to the altitude of the ſun when therein, for the given hours; we connect the points belonging to the ſame hour with a curve line, to which we add the number of the hour. We fit a couple of ſights to the *radius* and tie a thread with a plummet to the center of the *quadrant*, and upon the thread a bead to ſlide.

If now the bead be brought to the parallel wherein the ſun is, and the *quadrant* directed to the ſun, till a viſual ray paſſes through the ſight, the bead will ſhew the hour; for the plummet in this ſituation cuts all the parallels in the degrees correſponding to the ſun's altitude: ſince, then, the bead is in the parallel which the ſun then deſcribes, and thro' the degrees of altitude, to which the ſun is elevated every hour, there paſs hour-lines; the bead muſt ſhew the preſent hour.—Some perſons, who are not mighty nice, repreſent the hour-lines by arches of a circle, or even by ſtrait lines; and that without any ſenſible error.

Of DISTILLING, ſee *CHYMISTRY.*

Of DIVING.

DIVING is the art of deſcending under water, to conſiderable depths, and abiding there a competent time; the uſes of which are conſiderable, particularly in fiſhing for pears, corals, ſponges, wrecks of ſhips, *&c.*

There have been various *engines* contrived to render the buſineſs of *diving* ſafe and eaſy; the great point is to furniſh the diver with freſh air, without which he muſt either make but a ſhort ſtay, or periſh. Thoſe who dive for ſponges in the *Mediterranean*, carry down ſponges dipt in oil in their mouths, but conſidering the ſmall quantity of air that can be contained in the pores of the ſponge, and how much that little will be contracted by the preſſure of the incumbent air, ſuch a ſupply cannot ſubſiſt a diver long, ſince a gallon of air is not fit for reſpiration above a minute.

Hence it was neceſſary to contrive a more ſafe *conveyance* of a *diver* to any reaſonable depth, and whereby he may ſtay more time under water: which is the Diving Bell.

That the reader may have a juſt idea of the *diving-bell*, according to the lateſt improvements by Dr. Halley, and Mr. Triewald of *Stockholm*, we have exhibited two figures of it, on the firſt plate of *Mechanic Arts*. The firſt is that of Dr. Halley's form, which was three feet wide at top, five at bottom, and eight feet high, and contained about ſixty three cubic feet, or near eight hogſheads in its concavity.

This was coated with lead, ſo heavy, that it would ſink empty, and the weight was diſtributed about the bottom I K, ſo that it would do down in a perpendicular poſition, and no other. In the top was fixed a ſtrong but clear glaſs D, to let in the light from above; and likewiſe a cock, as at B, to let out the hot air that had been breathed; and below, was fixed a circular ſeat L M, for the divers to ſit on; and laſtly, from the bottom was hung, by three ropes, a ſtage for the divers to ſtand on, to do their buſineſs.

This machine was ſuſpended from the maſt of a ſhip by a ſprit, which was ſufficiently ſecured by

ſtays

ſtays to the maſt-head, and was directed by braces to carry it over-board, clear of the ſide of the ſhip, and to bring it in again.

To ſupply the bell with air under water, two barrels ſuch as C, of about ſixty-three gallons each, were made, and caſed with lead, ſo that they might ſink empty, each having a hole in its loweſt part, to let in the water, as the air in them is condenſed in their deſcent, and to let it out again when they were drawn up full from below. And to a hole in the top of the barrel was fixed a hoſe, or hollow pipe, well prepared with bees-wax and oil, which was long enough to fall below the hole at the bottom, being ſunk with a weight appended, ſo that the air in the upper part of the barrels could not eſcape, unleſs the lower end of theſe pipes were firſt lifted up.

Theſe air barrels were fitted with tackle proper to make them riſe and fall alternately, like two buckets in a well. In their deſcent they were directed by lines faſtened at the under edge of the bell to the man ſtanding on the ſtage to receive them, who, by taking up the ends of the pipes above the ſurface of the water in the bell, gave occaſion for the water in the barrels to force all the air in the upper parts into the bell, while it entered below, and filled the barrels: and as ſoon as one was diſcharged by a ſignal given, it was drawn up, and the other deſcended to be ready for uſe.

As the cold air ruſhed into the bell from the barrel below, it expelled the hot air (which was lighter) through the cock B, at the top of the bell, which was then opened for that purpoſe. By this method air is communicated ſo quick, and in ſuch plenty, that the Doctor tells us, he himſelf was one of the five who was at the bottom in nine or ten fathom water, for above an hour and a half at a time, without any ſort of ill conſequence; and he might continue there ſo long as he pleaſed, for any thing that appeared to the contrary.

In going down, it is neceſſary it ſhould be very gentle at firſt, that the denſe air may be inſpired to keep up, by its ſpring, a ballance to the preſſure of the air in the bell: upon each twelve feet deſcent, the bell is ſtopt, and the water that enters is driven out by letting in three or four barrels of freſh air.

By the glaſs above, ſo much light was tranſmitted, when the ſun ſhone, that he could ſee perfectly well to write and read, and by the return of the air-barrels, he could ſend up orders, written with an iron pen, on ſmall pieces of lead, directing, that they were to be moved from place to place: but in dark weather, when the ſea was rough and troubled, it would be as dark as night, in the bell; but then the Doctor perceived he could keep a candle burning in the bell, as long as he pleaſed, it being found, by experiment, that one candle conſumes much about the ſame quantity of confined air, as one man does, *viz.* about a gallon *per* minute.

The only inconvenience the Doctor complained of, was, that upon firſt going down, they felt a ſmall pain in their ears, as if the end of a quill were forcibly thruſt into the hole of the ear. This may proceed from its being ſome time before the air can get from the mouth, through the ſmall canal of the *euſtachian* tube, which leads to the inner cavity of the ear, where, when it comes, it makes an *equilibrium* with the outward air, preſſing on the tympanum, and thus the pain, for a ſhort time, ceaſes: then deſcending lower, the pain of the ear returns, and is again abated; and ſo on, till you come down to the bottom, where the air is of the ſame denſity continually.

This bell was ſo improved by the Doctor, that he could detach one of his divers to the diſtance of fifty or a hundred yards from it, by a contrivance of a cap or head-piece, ſomewhat like an inverted hand-baſket, as at F, with a glaſs in the fore-part, for him to ſee his way through. This cap was of lead, and made to fit quite cloſe about his ſhoulders; in the top of it was fixed a flexible pipe, communicating with the bell, and by which he had air, when he wanted, by turning a ſtop cock near his head-piece. There was alſo another cock at the end in the bell, to prevent any accident happening from the perſon without. This perſon was always well cloathed with thick flannels, which were warmed upon him, before he left the bell, and would not ſuffer the cold water to penetrate. His cap contained air enough to ſerve him a minute or two: then by raiſing himſelf above the bell, and turning the cock F, he could repleniſh it with freſh air. This pipe he coiled round his arm, which ſerved him as a clue to find his way to the bell again.

This *diving-bell* received its laſt improvement from Mr MARTIN TRIEWALD, F. R. S. and military architect to his *Swediſh* Majeſty. The manner and form whereof is ſhewn in a figure of his own drawing (ibid. N° 2.) A B is the bell, which ſinks with leaden weights D, D, appended at the bottom: the ſubſtance of the bell is copper, and tinned within all over: the bell is illuminated with three ſtrong convex lenſes G, G, G, with copper lids H, H, H, to defend them. The iron ring, or plate E, ſerves the diver to ſtand on, when he is at work, and it is ſuſpended at ſuch a diſtance from the bottom of the bell, by the chains F, F, F, that when the diver ſtands upright, his head is just above the water in the bell, where it is much better than higher up in it, because the air is colder, and consequently more fresh, and fit for respiration: but as there is occasion for the *Diver* to be wholly in the bell, and his head of course in the upper part, Mr. Triewald has contrived that, even there, when he has breathed the hot air as long as he well can, by means of a spiral copper tube *b c*, placed close to the inside of the bell, he may draw the cooler and fresher air from the lowermost parts; to which end, a flexible leather tube, about two feet long, is fixed to the upper end of the tube at *b*; and to the other end of this tube is fixed an ivory mouth-piece for the *Diver* to hold in his mouth, by which to respire the air from below.

Borelli, contrived another machine for diving under water to great depths, called a Diving-Bladder, to be made of brass or copper, and about two feet diameter. This is to contain the *Diver*'s head, and is to be fixed to a goat's skin exactly fitted to the body of the Diver. Within the vesica are pipes, by means of which, a circulation of air is contrived, and the person carries an air-pump by his side, in order to make himself heavier and lighter, as the fishes do by contracting or dilating their air-bladder.

Of D Y I N G.

Dying is the art of giving a lasting colour to silks, cloths, and other things, whereby their beauty is much improved, and their value increased.

The *Art of Dying* is of great antiquity, as it appears from the traces of it in the oldest sacred, as well as profane writers. The honour of the invention is attributed to the *Tyrians*, though what lessens the merit of it, is, that it is said to have owed its rise to chance. The juices of certain fruits, leaves, *&c.* accidentally crushed, are supposed to have furnished the first hint. *Pliny* assures us, that even in his time, the *Gauls* made use of no other *dyes*: it is added, that coloured earths and minerals, washed and soaked with rain, gave the next *dying* materials. But *Purple*, an animal juice, found in a shell-fish called *Murex*, *Conchyliam*. and *Purpura*, seems from history, to have been before any of them, and reserved for the use of Kings and Princes; for private persons were forbidden by law to wear the least scrap of it.

Till the time of *Alexander*, we find no other *dye* in use but purple and scarlet. It was under the successors of that monarch, that the *Greeks* applied themselves to the other colours; and invented, or at least perfected blue, yellow, green, *&c.* For the antient purple it has been long lost.

Among the *Romans*, *Dye-houses*, *Baphia*, were all under the direction of the *Comes sacrarum largitionum*, though they had each their particular *Præpositus*, as at *Alexandria*, *Tyre*, &c. The *Dyers* of *London* make the thirteenth company of of the city, incorporated under *Henry* VI. consisting of a master, wardens, and livery. The *Persian Dyers*, notwithstanding all their *Mahometanism*, have chosen *Jesus* for the patron of their art; insomuch, that among them a *dye-house* is called *Christ's-shop*.

All persons occupying the trade of dying woollen manufactures within the city of *London*, or ten miles round it, shall be subject to the inspection of the company of *dyers* of *London*; and the master, wardens, and court of assistants of the said company may appoint searchers within the said limits; and out of these limits, justices, at their quarter-sessions, may appoint such searchers, who taking to their assistance a constable, or other peace-officer, may, at all seasonable times, enter the shop or work-house of any person using the trade of dying, and search all cloths or other woollen goods to be dyed black or blue; and any person opposing, forfeits 10 *l.*

Every person dying cloths, *&c.* maddered, and not woaded, shall, before delivery, fix a seal of lead to them, with the letter M, on forfeiture for every yard, *&c.* 3 *s.* 4 *d.* Any person within *England*, *Wales*, or *Berwick*, dying black any bays, or other woollen goods, as madder-blacks, not being dyed throughout with woad, indigo, and madder only, or dying any cloths, long ells, *&c.* for woaded blacks, not being woaded throughout, shall forfeit for every long *Bocking*-bays, containing seventy yards, 44 *s.* For every *Colchester* bays, containing thirty-five yards, 22 *s.* and so in proportion for other bays. For every cloth dyed black, not being woaded throughout, containing forty-four yards, 40 *s.* All woollen goods truly maddered black, shall be marked with a red and blue rose; and all woollen goods truly woaded black, with a blue rose; and any person counterfeiting the said marks, or fixing such to any goods falsly dyed, for maddered or woaded blacks, forfeits 4 *l.* for every piece so marked. Any person using logwood in dying blue, shall forfeit 40 *s.* for every piece so dyed, containing forty-four yards.

This

This art depends chiefly on three things, *viz.* 1. Difpofing the furface of the ftuffs to receive and retain the colours, which is performed by wafhing them in different lyes, digefting, beating them, &c. in which human urine putrified, a fharp falt of afhes, divers foaps, and galls of animals, are of principal ufe; by means whereof the vifcous gluten of the filk-worms naturally adhering to their threads, is wafhed and cleanfed from them, and thus they become fitted gradually to imbibe the colours. By thefe alfo the greafy foulnefs adhering to wool and flax is fcoured off.

2. So to grind the colours, as that they may enter the body duly prepared, and preferve their brightnefs undiminifhed.

3. The third confifts in having beautiful colours.

According to Sir W. PETTY's account of what is done in particular trades by the art of dying, 1. There is a whitening of wax, and feveral forts of linen and cotton cloths by the fun, air, and reciprocal effufions of water. 2. Colouring of wood and leather, by lime, falt and liquors, as in ftoves, canes, and marble leathers. 3. Colouring of paper, *viz.* the marbled paper, by diftempering the colours with ox-gall, and applying them upon a ftiff gummed liquor. 4. Colouring, or rather difcolouring, the colours of filks, tiffanies, &c. by brimftone. 5. Colouring of feveral iron and copper-works into black with oil. 6. Colouring of leather into gold-colour, or rather filver leaves into gold by varnifhes, and in other cafes by urine and fulphur. 7. Dying of marble and alabafter, with heat and coloured oils. 8. Colouring filver into the brafs-colour, with brimftone or urine. 9. Colouring the barrels and locks of guns into blue and purple, with the temper of fmall-coal heat. 10. Colouring of glafs (made of fands, flints, &c.) as alfo of cryftals and earthen-ware, with the rufts and folutions of metals. 11. The colouring of live hair, as in *Poland*, horfe and man's hair: as alfo the colouring of furs. 12. Enameling and annealing. 13. Applying colours, as in the printing of books and pictures, and as in making of playing cards, being each of them performed in a different way. 14. Gilding and tinning with mercury, block-tin, fal ammoniac. 15. Colouring of metals, as copper, with calamy, into brafs, and with zink or fpelter into a golden colour, or into a filver one with arfenic; and of iron into a refemblance of copper with *Hungarian* vitriol. 16. Making painters-colours by preparing of earth, chalk, and flates; as in umber, ochre, cullen-earth. &c. as alfo out of calces of lead, as ceruffe and minium; by fublimates of mercury and brimftone, as in vermillion; by tinging whole earths varioufly, as in verdeter, and fome of the lakes; by concrete juices, or fæculæ, as in gambogium, indigo, pinks, fap-green, and lakes; as alfo by rufts, as in verdigreafe, &c. 17. The applying thefe colours by the adhefion of ox-gall, as in the marble paper aforefaid; or by gum-water, as by limning; or by clammy drying oils, fuch as the oils of linfeed, nuts, &c. 18. The watering of tabbies. 19. The colouring of wool, linen, cotton, filk, hair, feathers, horn, leather, and the threads and webs of them with woods, roots, herbs, feeds, leaves, falts, limes, lixiviums, waters, heats, fermentations, macerations, and other great variety of management; an account of all which is a fhort hiftory of *dying*.

The materials *ufed in the* art *of* DYING, are iron and fteel, or what is produced from them, in all true blacks called *Spanifh* blacks, though not in *Flanders* blacks, *viz.* they ufe copperas, fteel-filings, and flippe; they alfo ufe pewter for *Bowdye* fcarlet, *viz.* they diffolve bars of pewter in *aqua fortis*; *litharge* is alfo ufed by fome, though acknowledged by few to add weight to dyed filk. *Antimony* is much ufed to the fame purpofe. *Arfenic* is ufed in *crimfon* upon pretence of giving luftre. *Verdigreafe* is alfo ufed by *linen-dyers* in their *yellow* and *greenifh* colours; though, of itfelf, it ftrikes no deeper colour than that of a pale ftraw.

Of *mineral falts* ufed in *dying*, the chief is *alum*; the true ufe whereof feems to be in regard to the fixation of colours. The next mineral falt is *falt-petre*, not ufed by antient dyers, and but by few of the modern: nor is it yet ufed but to brighten colours, by back-boiling of them, for which *argol* is more commonly ufed: *lime* is much ufed in working *blue-vats*.

Of the *animal family* are ufed *cochineal*, *urine* of labouring men kept till it be ftale and ftinking, *honey*, yolks of *eggs*, and *ox-gall*; the ufe of the urine is to fcour, and help the fermenting and heating of *woad*; and is ufed alfo in *blue-vats* inftead of *lime*: it difchargeth the *yellow*, and therefore is ufed to fpend *weld* withal.

Dyers ufe two forts of water, *viz.* river and well-water; the laft, which is harfh, they ufe in reds and other colours wanting reftringency, and in dying materials of the flacker contextures, as in *calicoe*, *fuftian*, and the feveral fpecies of *cotton-works*; but is not good for blues, and makes yellows and greens look rufty. River-water is more fat and oily, and is therefore ufed in moft cafes, and muft be had in great quantities for wafhing and rinfing their cloths after dying. Water is called by *Dyers* white liquor; but a mixture of one part bran, and five of river-water boiled an hour, and put into leaden cifterns to fettle, is what they call liquor abfolutely.

Gums have been uſed by *dyers* about ſilk, *viz.* gum arabic, tragacanth, maſtic, dragoon's blood. Theſe tend little to the tincture, any more than gum in writing ink, which only gives it a conſiſtence; ſo gum may give the ſilk a gloſſineſs; and, laſtly, to encreaſe the weight.

The three peculiar *ingredients* for *black* are *copperas* filings of *ſteel*, and *ſlipe*: the reſtringent binding materials are *alder-bark*, *pomegranate-peels*, *walnut rinds* and *roots*, *oaken-ſapling bark* and *ſawduſt* of the ſame, *crab-tree-bark*, *galls*, and *ſumach*.

The *ſalts* are alum, ſalt petre, ſal ammoniac, pot-aſhes, and ſtone lime; among which urine may be enumerated as a liquid ſalt.

The *liquors* are well and river-water, urine, *aquavitæ*, vinegar, lemon-juice, *aquafortis*, honey, and molaſſes.

Ingredients of another claſs are bran, wheaten-flour, yolks of eggs, leaven, cummin-ſeed, fenugreek-ſeed, agaric and ſenna.

The *abſterſive*, are fuller's earth, ſoap, linſeed-oil, and ox gall.

The *metals* and *minerals* are pewter, verdigreaſe, antimony, litharge, and arſenic.

The *colourings* are blue, yellow, and red; of which logwood, old fuſtic, indigo, and madder, are the chief.

General obſervations upon Dying.

1. All materials which of themſelves do give colour are either red, yellow, or blue; ſo that out of them, and the primitive fundamental colour white, all that great variety which we ſee in dyed ſtuffs doth ariſe.

2. That few of the colouring materials, as cochineal, ſoot, wood wax, woad, *&c.* are in their outward and firſt appearance of the ſame colour, which by the ſlighteſt diſtempers and ſolutions in the weakeſt menſtrua, they dye upon cloth, ſilk, *&c.*

3 That many of them will not yield their colour without much grinding, ſteeping, boiling and fermenting, or corroſion by powerful menſtrua, as red wood weld, woad, arnotto, *&c.*

4. That many of them will of themſelves give no colouring at all, as copperas or galls, or with much diſadvantage, unleſs the cloth or other ſtuff to be dyed be as it were firſt covered, or incruſtated with ſome other matter, though colourleſs aforehand, as madder, weld, brazil, with alum.

5. That ſome of them, by the help of other colourleſs ingredients, do ſtrike different colours from what they would of themſelves, as cochineal, brazil, *&c.*

6. That ſome colours, as madder, indigo, and woad, by reiterated tinctures, will at laſt become black.

7. That although green be the moſt frequent and moſt common of natural colours, yet there is no ſimple ingredient now uſed alone to dye green with upon any material; ſap green being the neareſt, which is uſed by country people.

8. There is no black thing in uſe which dyes black, though both the coal and ſoot of moſt things burnt or ſcorched be of that colour, and the blacker, by how much the matter before being burnt was whiter, as in ivory black.

9. The tincture of ſome dying ſtuffs will fade even with lying, or with the air, or will ſtain with water only, but very much with urine, vinegar, *&c.*

10. Some of the dying materials are uſed to bind and ſtrengthen a colour; ſome to brighten it; ſome to give luſtre to the ſtuff; ſome to diſcharge and take off the colour, either in whole, or in part; and ſome out of fraud, to make the material dyed, if coſtly, heavier.

11. That ſome dying ingredients, or drugs, by the coarſeneſs of their bodies, make the thread of the dyed ſtuff ſeem coarſer; and ſome, by ſhrinking them ſmaller; and ſome by ſmoothing them, finer.

12. Many of the ſame colours are dyed upon ſeveral ſtuffs with ſeveral materials, as red-wood is uſed in cloth, not in ſilks; arnotto in ſilks, not in cloth, and may be dyed at ſeveral prices.

13. That ſcouring and waſhing of ſtuffs to be dyed, is done with ſpecial materials, as ſometimes with ox-galls, ſometimes with fullers-earth, and ſometimes ſoap; this latter being, in ſome caſes, pernicious, where pot-aſhes will ſtain, or alter the colour.

14. Where great quantities of ſtuffs are to be dyed together, or where they are to be done with any ſpeed, and where the pieces are very long, broad, thick, or otherwiſe, they are to be differently handled, both in reſpect to the veſſels and ingredients.

15. In ſome colours and ſtuffs the tingent liquor muſt be boiling, in other caſes blood-warm, and in ſome it may be cold.

16. Some tingent liquors are fitted for uſe by long keeping, and in ſome the virtues wear away by the keeping.

17. Some colours or ſtuffs are beſt dyed by reiterated dippings in the ſame liquor, ſome by continuing longer, and others a leſſer time therein.

18. In ſome caſes, the matter of the veſſel wherein the liquors are heated, and the tincture prepared, muſt be regarded, as the kettles muſt be pewter for *Bow-dye.*

19. There is little reckoning made how much liquor is uſed in proportion to the dying drugs, it being rather adjuſted to the bulk of the ſtuffs, as the veſſels

vessels are to their breadth; the quantity of dying drugs being proportioned both to the colour, higher or lower, and to the stuffs; as likewise the salts are to the dying drugs.

Concerning the weight that colours give to silk, (in which it is most taken notice of, being sold by weight, and a commodity of great price) it is observed that one pound of raw silk loseth four ounces by washing out the gums, and the natural sordes. That the same scoured silk may be raised to above thirty ounces from the remaining twelve, if it be dyed black with galls, &c.

Next to galls, old fustic encreases the weight about $1\frac{1}{2}$ in 12; madder, about one ounce; weld, half an ounce. The blue vats in deep blues of the fifth stall, give no considerable weight; neither doth logwood, cochineal, nor even copperas, where galls are not; slippe adds much to the weight, and giveth a deeper black than copperas itself.

For *black* in *woollen-manufactures*, it is begun with a strong decoction of woad and indigo, that communicate a deep blue; after which the stuffs being boiled with alum and tartar, or pot-ash, are to be maddered with common madder, then dyed black with Aleppo-galls, copperas, and sumach, and finished by back-boiling in weld. Wools for tapestry are only to be woaded, and then put in black. For scarlet, wool and woollen manufactures are dyed with kermes and cochineal, with which may also be used agaric and arsenic. Crimson-scarlet is dyed with cochineal, mastic, aquafortis, sal ammoniac, sublimate, and spirit of wine. Violet-scarlet, purple, amaranth, and pansy-scarlets, are given with woad, cochineal, indigo, braziletto, brazil, and orchal. Common reds are given with pure madder, without any other ingredient. Crimson-reds, carnations, flame and peach colours, are given, according to their several hues, with cochineal, mastic, without madder or the like. Crimson-red is prepared with *Roman* alum with cochineal. Orange aurora, brick colour, and onion-peel colour, are dyed with woad and madder, mixed according to their several shades. For blues, the dark are dyed with a strong tincture of woad; the brighter with the same liquor, as it weakens in working. Dark browns, minims, and tan colours, are given with woad, weaker in decoction than for black, with alum and pot ashes, after which they are maddered higher than black: for tan-colours, a little cochineal is added. Pearl-colours are given with galls and copperas; some are begun with walnut-tree roots, and finished with the former; though to make them more useful, they generally dip them in a weak tincture of cochineal. Greens are begun with woad, and finished with weld. Pale yellows lemon-colour, and sulphur-colour, are given with weld alone. Olive-colours of all degrees are first put in green, and taken down with soot, more or less, according to the shade that is required. *Feuille-mort*, hair colour, musk, and cinnamon-colour, are dyed with weld and madder. *Nacarat*, or bright orange, is given with weld and goats hair boiled with pot ashes.

DYING *of silks* is begun by boiling them in soap, &c. then scouring and washing them in water, and steeping them in cold alum water. For crimson, they are scoured a second time, before they are put into the cochineal-vat. Red crimson is given with pure cochineal, mastic, adding galls, turmeric, arsenic, and tartar, all mixed in a copper of fair water, almost boiling: with these the silk is to be boiled an hour and an half, after which it is allowed to stand in the liquor till next day. Violet-crimson is given with pure cochineal, arsenic, tartar, and galls; but the galls in less proportion than in the former: when taken out, it is washed and put in a vat of indigo. Cinnamon crimson is begun like the violet, but finished by back boiling, if too bright, with copperas, and if dark, with a dip of indigo. Light blues are given in a back of indigo. Sky blues are begun with orchal, and finished with indigo. For citron-colours, the silk is first alumed, then welded with indigo. Pale yellows, after aluming, are dyed in weld alone. Pale and brown auroras, after aluming, are welded strongly, then taken down with rocou and dissolved with pot-ashes. Flame colour is begun with rocou, then alumed, and afterwards dipped in a vat or two of brazil. Carnation and rose-colours are first alumed, then dipt in brazil. Cinnamon-colour, after aluming, is dipt in brazil, and braziletto. Lead colour is given with fustic, or with weld, braziletto, galls and copperas. Black silks of the coarser sort, are begun by scouring them with soap, as for other colours: after which they are washed out, wrung, and boiled an hour in old galls, where they are suffered to stand a day or two: then they are washed again with fair water, wrung and put into another vat of new galls; afterwards washed again, and wrung, and finished in a vat of black. Fine black silks are only put once into galls of the new and fine sort, that has only boiled an hour: then the silks are washed, wrung out and dipped thrice in black, and afterwards taken down by back-boiling with soap.

The dying of thread is begun by scouring it in a lye of good ashes: afterwards it is wrung, rinsed out in river-water and wrung again. A bright blue is given with braziletto and indigo: bright green is first dyed blue, then back-boiled with braziletto and verdeter, and lastly woaded. A dark green is given like the former, only darkened more before

before woading. Lemon and pale yellow is given with weld mixed with rocou. Orange ifabella, with fuftic, weld, and rocou. Red, both bright and dark, with flame colour, *&c.* are given with brazil, either alone or with a mixture of rocou. Violet, dry rofe, and amaranth, are given with brazil, taken down with indigo. Feulemort and olive-colour are given with galls and copperas, taken down with weld, rocou, or fuftic. Black is given with galls and copperas, taken down and finifhed with braziletto wood.

Thread is dyed likewife of all forts of colours, and begun by fcouring it in lye of good afhes; after which it is wrung rinfed out in river water, and wrung again. Thus prepared the *dyer* gives it what colour he pleafes, with the following drugs, viz. *red colour*, both *bright* and *dark*, *flame colour*, &c. with brazil, either alone, or with a mixture of rolac. *Violet*, *dry rofe*, and *amaranth*, with brazil, taken down with indigo. *Bright blue*, with braziletto and indigo. *Bright green*, is firft dyed blue, then back boiled with braziletto, and verdet, and laftly woaded, *Dark green*, is given like the former, only darkening more before woading. *Lemon* or *pale yellow*, with weld mixed with rolac. *Feulemort* and *olive colour*, with galls and copperas, taken down with weld, rolac, or fuftick. And *black* with galls and copperas taken down and finifhed with braziletto wood.

Hats are dyed with braziletto, galls, copperas, and verdigreafe, diffolved and boiled in a copper capable of receiving, befides the liquor, twelve dozens of *hats* on their blocks or moulds. Here the *hats* are left to boil fome time; after which they are taken out, and left to ftand and cool; then dipped again, and thus alternately, oftner or feldomer as the ftuff is of a nature to take the dye with more or lefs difficulty.

Leather, *fkins*, &c. are alfo *dyed red*, *blue*, *fky colour*, *purple*, *green*, *yellow*, *orange colour*, &c.

The *red colour* is given by wafhing the fkins, and laying them two hours in galls, then wringing them out, dipping them in a liquor made with *liguftrum*, alum, and verdigreafe, in water, and laftly, in a *dye* made of brazil wood made with lye. *Blue* by fteeping the *leather* or *fkins* a day in urine and indigo, then boiling it with alum; otherwife by tempering the indigo with red wine, and wafhing the *fkins* therewith. *Sky colour* is given with indigo fteeped in boiling water, and the next morning warmed and fmeered over the *fkin*. *Purple* by wetting the *fkin* with a folution of roch alum in warm water, and when dry again, rubbing them with the hand with a decoction of logwood in cold water. *Green* by fmeering the *fkin* with fap-green and alum water boiled; and a little more indigo may be added to darken the colour. *Dark green* is given with fteel filings and fal ammoniack fteeped in urine till foft, then fmeered over the fkin; which is to be dried in the fhade. *Yellow* by fmeering the *fkin* over with aloes and linfeed oil diffolved and ftrained; or by infufing it in weld. And *orange colour* is given by fmeering with fuftic berries boiled in alum water; or for a deep orange with turmerick.

Bones, *horn* and *ivory*, are alfo *dyed* of different colours, *viz.* Black by fteeping brafs in aqua fortis till it be turned green, wafhing the *bone*, *horn* or *ivory*, once or twice with this liquor, and then putting it in a decoction of logwood and warm water. Red by boiling it firft in alum water, and afterwards in a decoction of quick lime fteeped in rain water, ftrain it, adding to every pint an ounce of brazil wood, in which the ivory, *&c.* muft boil till it be fufficiently red. *Green* by boiling the bone, *&c.* firft in alum water, then with verdigreafe, fal ammoniack, and white wine vinegar; keeping it hot therein till fufficiently *green.*

To difcover whether a cloth has been duly treated by the *dyer*, and the proper foundations laid, a white fpot, by the *French* called *rofette*, of the bignefs of a fhilling, ought to be left, befides a white ftripe between the cloth and the lift. Further proof is had by boiling the dyed ftuff in water with other ingredients different according to the quality of the *dye* to be proved. If the colour fuftain the *teft*, *i.e.* do not difcharge at all, or very little, fo that the water is not tinctured by it, the *dye* is pronounced good: otherwife falfe.

There are alfo proofs of the *dyes* of filks, *viz.* For red crimfon, the proof is made by boiling the filk with an equal weight of alum. For fcarlet crimfon, it is boiled with foap, almoft of the weight of the filk. For violet crimfon, with alum of equal weight with the filk, or with citron juice about a pint to a pound of filk. Thefe ingredients are to be mixed, and put in fair water, when it begins to boil; after which, the filks are alfo to be put in; and after boiling the whole for half a quarter of an hour, if the *dye* be falfe, the liquor of the red crimfon will be violet, in cafe it have been dyed with orchal, or very red, if with brazil. That of crimfon fcarlet, if rolac have been ufed, will become of an aurora colour, or if brazil has been ufed, red. And that of violet crimfon, if brazil or orchal have been ufed, will be of a colour hordering on red. On the contrary, if the three forts of crimfon be truly dyed, their liquor will difcover very little alteration.

To difcover whether other colours have been dyed with galls, the filk is put in fair boiling water, with pot afhes, or foap, nearly of the weight of the ſilk, after ſome time, it is taken out; upon which if it has been dyed with galls, the colour will be all vaniſhed, and nothing but that of the galls left, which is a ſort of *feulemort*, or wood colour. The *dying* ſilk with galls may alſo be detected by putting it in boiling water, with a gallon of citron juice; being taken out and waſhed in cold water, and then dipped in a black *dye*, if galls have been uſed it will turn black, if not it will be of a brown bread colour.

To diſcover whether black ſilks have been overdyed with galls, ſteel filings, or ſlippe, it is boiled in fair water, with twice its weight of ſoap: if it be laden with galls, it will turn reddiſh, otherwiſe it will keep its colour.

To diſcover whether black cloths have been firſt woaded and maddered, a ſample of it, and at the ſame time a ſample of ſtandard black, kept for that purpoſe by the *dyer*'s company, is to be taken; and then as much *Roman* alum as is equal in weight to both, together with a like weight of pot aſhes, is to be put over the fire in a pan of bran-water; when it begins to boil the two ſamples are to be put in; and after half an hour to be taken out and compared; the piece which has only been woaded will be found blueiſh, with ſomewhat of a dull green; if it hath been both woaded and maddered, it will be of a tan or minim colour; and if it hath been neither woaded nor maddered, its colour will be dunniſh between yellow and fallow. For cloths *dyed* of a minim colour, the proof is to be made after the ſame manner as that of blacks.

To know whether ſcarlet, or crimſon cloth have been *dyed* with pure cochineal, they are to be boiled with an ounce of alum to a pound of cloth. For cloths of other colours, the proof is to be made in the ſame manner as that of blacks and minims.

ELECTRICITY.

ELECTRICITY is that property in certain bodies, whereby, after being rubbed, excited, or heated in ſome particular degree, they acquire a power of *attracting* and *repelling* other remote bodies; and frequently of *emitting* ſparks and ſtreams of *light*.

The antients, having obſerved that *amber*, which they called *electrum*, upon being rubbed, attracts bits of ſtraw, down, and other light bodies, firſt gave this property the name of *Electricity*, which they thought peculiar to amber and a few ſtones mentioned by *Theophraſtus*, *Pliny* and ſome others. But the philoſophers of the laſt, and more particularly of the preſent age, have found that numbers of other bodies poſſeſs this quality; and made ſo many diſcoveries in *Electricity*, that there is ſcarce any other ſubject in *natural philoſophy* that has given occaſion to more experiments.

This quality is of two ſorts, viz. *Vitreous Electricity*, or that which belongs to *glaſs*; and *reſinous Electricity*, or that which belongs to *amber*, *roſin*, *wax*, *gum*, and ſuch like ſubſtances.

The bodies ſuſceptible of *Electricity*, are alſo divided into two claſſes: the one are *electrical* of themſelves, or *electrica per ſe*; that is, they contain that quality in themſelves, and need only be rubbed, &c. to excite it: the others do not contain that virtue in themſelves, or they have ſo little of it, as to be reckoned to have none at all; yet they acquire it by communication, or by emanation derived to them by a body that is electrical *per ſe*: thoſe bodies are ſimply called *non-electrics*, or *non electrica per ſe*.

The *electrics per ſe*, or, as they are otherwiſe called, the *originally electrics*, are, according to MUSCHENBROECK, all ſorts of gems, ſeveral ſtones, all chryſtals and reſinous ſubſtances, ſulphur, red arſenick, ſalts, alum; all ſorts of glaſs, porcellane, dried vegetables; all woods, ropes, threads of lint, paper, the leaves of trees, the harder reſins, pitch, cotton; parts of animals, as their feathers, hair, horns, bones of ivory, whale-bone, the hide, parchment, the ſhells of fiſhes, ſilk, ſtrings made of dried guts, gum, ſealing-wax, feathered or hairy living animals, as cats, dogs, cocks, &c.

The *non-electrics* are ſeveral naked animals, or ſuch as are covered with neither hair nor feathers; metals, ſemi metals, earths and duſt, which, by reaſon of its minuteneſs, will not bear to be rubbed ſeparately; all watry gums, opium, galbanum, ammoniac, aſſa fœtida, camphor; all ſorts of bodies that liquify with a ſmall heat, all moiſt bodies, all fluids which will not bear rubbing, &c.

Electricity, according to the ſame author, conſiſts in ſubtile exhalations, which, in exciting the *electrical body* are put into motion; and which, by flying to and from it, agitate all thoſe light bodies that fall within the ſphere of their attraction.

That theſe exhalations, or ſubtile effluvia, conſtitute *Electricity*, appears from hence. 1. From the touch as theſe bodies are perceived to be ſurrounded with a moſt ſubtile atmoſphere, or covered with a gentle blaſt of wind, that continues to breath every where around them. 2. From that offenſive ſmell, which reſembles phoſphorus, the phlegm of

aqua

aqua regia, or the spirit of vitriol. 3. Being taken into the mouth, they yield an acid and a pungent taste. 4. They seem to adhere to the extremities of the bodies which they surround, and from which they recede, in the form of sparks, and of a subtile lucid flame. 5. This flame is sometimes attended with an explosion, that may be heard at the distance of two hundred paces: besides, the greater flames occasion a continued hissing, or crackling noise in the air. Since, therefore the *electrical effluvia* affect all the human senses, we can no longer doubt of their being a *corporeal fluid*.

Mr. Watson thinks, that *Electricity* is not furnished from the *electric bodies* employed in the experiments, nor from the circumambient air; but that it is the effect of a very subtile and elastic fluid occupying all bodies, in contact with the terraqueous globe; that every where, in its natural state, it is of the same degree of density; that glass and other bodies, which are *electrics per se*, have the power of taking this fluid from one body and conveying it to another, in a quantity sufficient to be obvious to all our senses; that, under certain circumstances, it is possible to render the *Electricity* in some bodies more rare than it naturally is, that by communicating this to other bodies, to give them an additional quantity, and make their *Electricity* more dense; and that these bodies will thus continue, until their natural quantity is restored to each; that is, by those which have lost part of theirs, acquiring what they have lost, and by those to whom more has been communicated, parting with their additional quantity. Both one and the other of these is, from the elasticity of the electric matter, attempted to be done from the nearest *non-electric*; and when the air is moist, this is soon accomplished by the circumambient vapours, which here may be considered as preventing, in a very great degree, our attempts to insulate *non-electric* bodies.

In order to illustrate the phænomena of *Electricity*, we shall give some select experiments.

1. Get a glass tube A B, of about three feet and a half in length, an inch and a half in diameter, and its sides a line thick: rub it with a piece of stuff, paper, or, which is still better, with the hand, provided it be very dry: you will succeed better if your hands be rubbed with chalk, or white lead. Afterwards bring this rubbed tube near any light bodies, as gold leaf laid upon a glass stand C D; then will the gold leaf be attracted and repelled in the manner represented in the plate, Fig. 1.

If you do this in such a manner, that the gold-leaf, for example, be perpendicularly repelled above the tube, and that it meet with no other body, it will sustain itself in the air, always at the same distance from the tube, and may be conveyed in this situation quite round the room; but if it touch any other body, it will come back and adhere to the tube, and then it will be repelled anew as at the first.

2. Again, if the tube be rubbed anew, pretty briskly, it will attract a feather, or other light body, at a considerable distance; and after they have stuck to it for some time, they are again driven off, and it will constantly repel them, till they are touched by some other *non-electrical* body, as a finger or stick: on which they will be again attracted by the tube; and if the finger be held pretty near the tube, the feather will alternately fly from the tube to the finger, and back again; always stretching out its fibres the way that it is going, and that before it comes off from the finger or tube. See plate, No. 2.

Before we proceed to more complicated experiments, it will be proper to observe, that, in order to know that *non-electrics* have received the communicated *Electricity*, they must be insulated: that is, they must not be suspended from, nor supported by any body, but what is an *electric per se*. For if one *non-electric* be touched by another, and this by a third, *&c.* all the *Electricity* received by the first will go to the second, and from this to the third, *&c.* till at last it be lost upon the ground. But, if several *non-electric* bodies, touching one another, are at length terminated by *electric bodies*, in that respect they make but one body, and receive and retain *Electricity* for some time. From hence it may be observed, that *non-electrics* are conductors of *Electricity*. Water conducts it very well, but metals are the most convenient conductors.

3. Let an iron-rod, pointed at one end, be suspended on silk lines, and by means of a glass or rosin-sphere (which can be more regularly and constantly excited than a tube) be electrified, it will be found to have all the properties of the excited tube already mentioned: that end of the iron rod, suspended as already mentioned, which is next the sphere, must point to it at the distance of a quarter of an inch. This apparatus being disposed, as represented, *ibid.* No 3 the globe will be electrified in whirling round against a leather cushion rubbed with whiting, or dry-hand rubbed in the same manner. When the rod, by this means, is strongly electrified, a stream of light, in diverging rays, will be seen to issue from that point of it which is most distant from the sphere; and if any *non-electric* body, as a finger, be placed within a quarter of an inch of the said flame, it will perceive a gentle blast of wind from the end of the iron; that is, the *electrical* fire will issue out from the point in such a manner, as to blow against the finger very sensibly;

bly; and if the finger be ſtill held nearer, the large pencil of rays will be condenſed in ſuch a manner, as to run out from the point upon the finger, in a ſtream, or body of denſe, yellow fire, and ſtrike the finger like a gentle *jet d'eau*. The rod ſuſpended before the glaſs-ſphere, is properly termed the prime conductor in this machine.

4. While the flame continues to appear from the end of the iron-rod, the finger being placed any where upon it, the flame at the end diſappears immediately; and when the finger is taken off, it again inſtantly appears; and ſo by putting the finger off and on ſucceſſively, the electric flame will appear and diſappear alternately. Theſe eruptions of the electrical fire will ſnap very ſenſibly, both to the eye and the ear, upon any part of the rod that the finger is pointed to. See *ibid* No. 3

5. If a chain, or hempen cord, be ſuſpended by ſilken ſtrings all round the room, of any length you pleaſe, and one end thereto be hung, by a loop, acroſs the rod, the electrical fire will inſtantly be tranſmitted through the whole length of the chain, and appear upon every part of the approach of the finger, and be heard to ſnap and ſtrike with as great force as from the rod itſelf.

6. Take two plates of metal, very clean and dry, whoſe ſurfaces are nearly equal; hang one of them horizontally to the electrified rod, and bring under it, upon the other, any thin light body, as ſilver leaf, &c. When the upper plate is made electrical, the ſilver will be attracted by it; and if the under plate is held at a proper diſtance, will be perfectly ſuſpended at right angles to the plates, without touching either of them; but if they are either brought nearer together, or carried farther aſunder, the leaf will ceaſe to be ſuſpended, and will jump up and down between them.

The ſame effect will be produced, if the experiment is reverſed by *electrifying* the bottom plate, and ſuſpending the other over it.

7. The following improvement, upon the *electrical* machine of the *Abbe* NOLLET, already exhibited, was made by Mr. WATSON in 1746. In the periphery of his machine, ſee *ibid.* No. 4. were cut four grooves, correſponding with four globes, which were diſpoſed vertically: one, two, or the whole number of theſe globes might be uſed at pleaſure. They were mounted upon ſpindles, and the leather-cuſhion with which they were rubbed, was ſtuffed with an claſtic ſubſtance, as curled hair, and rubbed over with whiting. One of the globes was lined to a conſiderable thickneſs with a mixture of wax and roſin, but no difference appeared in the power of this globe from the others.

For performing moſt of the following experiments, ſome have imagined a gun-barrel abſolutely neceſſary, as the prime conductor; but Mr. WATSON ſays, that a ſolid piece of metal, of any form, is equally uſeful: having obſerved the ſtroke from a ſword, as violent as that from a gun-barrel

If, to the ſuſpended barrel a ſpunge, thoroughly dry, be hung, it gives no appearance of fire, which ſhews it to be an *electric* ſubſtance; but if when the ſpunge has been immerſed in water, it be ſuſpended to the barrel, and the finger applied near it, the fire iſſues out with conſiderable force and ſnappings; and the drops, which, before the ſpunge was applied, fell very ſlowly, will now fall as faſt: if the room be darkened, theſe drops will appear to be drops of fire, and illuminate the baſon into which they fall,

8. If a phial of water is ſuſpended to the prime conductor by a wire, let down a few inches into water through the cork; and ſome metallic fringes inſerted into the barrel, touch the globe in motion, the electrical power may be ſo accumulated in the phial, that a man graſping it with one hand, and touching the gun-barrel with a finger of the other, will receive a violent ſhock through both his arms, eſpecially at his elbows and wriſts, and acroſs his breaſt.

The commotion ariſing from the diſcharge of accumulated *Electricity* in a phial, may be felt by a great number of men at once. M. LE MONNIER, at *Paris*, is ſaid to have communicated this ſhock through a line of men, and other *non-electrics*, meaſuring nine hundred toiſes, being more than an *Engliſh* mile; and the *Abbe* NOLLET made the experiment upon two hundred perſons ranged in two parallel lines.

9. If the *electrical machine*, and the man who turns the wheel thereof, be mounted on *electrical* cakes, the *electrical* power is ſo far from being increaſed, that, on the contrary, it is ſo much diminiſhed, as to be oftentimes not at all perceptible.

10. A perſon ſtanding on a cake of roſin, holding a chain faſtened to the prime conductor, will be *electriſed*; that is, he will be all over poſſeſſed with *electric* virtue; and, at the ſame time, feel nothing of it, unleſs ſome perſon, ſtanding by, put his finger near to any part, and then the virtue will be emitted in form of fire, and ſnap and become very ſenſible to both parties. See *ibid* Fig 5.

11. A perſon ſtanding on roſin, holding the chain of the conductor, points his finger to the warm ſpirits of wine; and by communicating the *electric* fire thereto, kindles the riſing vapour, and ſo ſets the whole on fire. In this manner any ſort of matter, which, when warmed, will ſend forth an inflammable vapour, will be ſet on fire. See *ibid.* Fig. 6.

The *electrical* commotion, mentioned in *experiment* 8, ariſing from an accumulation of the *electrical* fire, has been made very ſenſible quite acroſs the river *Thames*, by the communication of no other medium than the water of that river, and ſpirit of wine fired at that diſtance.

By comparing the reſpective velocities of *Electricity* and ſound, that of *Electricity*, in any diſtance yet experienced, appears inſtantaneous.

12. If the globe be exhauſted of all its air, and then whirled about, the *Electricity* will be obſerved to act wholly within the globe, where it will appear, in a darkened room, in form of a cloud or flame of reddiſh or purple coloured light, filling the whole capacity of the globe.

13. If a loadſtone, armed with iron, be hung on to the gun-barrel by an iron-wire the *electric* virtue will ruſh out from every part, but more forcibly from the iron than from the ſtone itſelf: for from the ſtone, it ſeems to be emitted in a more lax manner, and diffuſed in a ſort of ſteam, or fiery vapour; whereas from the iron, it iſſues in a more impetuous, denſe, and penetrating ſteam; by which we learn, that the two moſt conſiderable powers of nature, *Electricity* and magnetiſm, do not always interfere, or impede each other's actions.

14. The method of firing gunpowder by the *electric* flame, has ſomething particular in it; as it does not require any inflammable vapour to be previouſly raiſed. The powder may be fired thus: a ſmall cartridge is filled with dry powder, hard rammed, ſo as to bruiſe ſome of the grains: two pointed wires are then thruſt in, one at each end, the points approaching to each other in the middle of the cartridge, till within the diſtance of half an inch: then the cartridge being placed in the circle, when four *electrifed* glaſs jars are diſcharged, the *electric* flame leaping from the point of one wire to the point of the other within the cartridge, among the powder, fires it, and the exploſion of the powder is at the ſame inſtant with the crack of the *electrical* diſcharge

15. As to metals, Mr. FRANKLIN tells us, that he has been able, by *electricity*, to give polarity to needles, and to reverſe it. A ſhock from four large glaſs-jars ſent through a fine ſewing needle, gives it polarity.

16. In conſequence of Mr. *Franklin*'s hypotheſis, of being able, by a proper apparatus to collect the *electricity* from the atmoſphere during a thunder-ſtorm, it has been found, that a pointed bar of iron, forty feet high, being placed upon an *electric* body; and a ſtormy cloud having paſſed over the place where the bar ſtood, thoſe, appointed to obſerve it, attracted from it ſparks of fire, perceiving the ſame kind of commotion, as in the common *electrical* experiments. The like effect followed when a bar of iron ninety-nine feet high was placed upon a cake of roſin two feet ſquare, and two inches thick: theſe were the firſt experiments made, but they have ſince been ſufficiently varied and verified, ſo that it ſeems now certain. 1. That a bar of iron, pointed or not, is *electrifed* during a ſtorm. 2. That a vertical, or horizontal ſituation, is equally fitting for theſe experiments. 3. That even wood is *electriſed*. 4. That, by theſe means, a man may be ſufficiently *electriſed* to ſet fire to ſpirit of wine with his finger, and repeat almoſt all the uſual experiments of *electricity*.

17. Mr. FRANKLIN has contrived a very ingenious and eaſy method of trying experiments of this kind, by means of an *electrical* kite, made of a large thin ſilk handkerchief, extended and faſtened, at the four corners, to two ſlight ſtrips of cedar, of ſufficient length for this purpoſe. This kite being accommodated with a tail, loop, and ſtring, will riſe in the air like thoſe of paper. To the top of the upright ſtick of the croſs, is to be fixed a very ſharp pointed wire, riſing a foot or more above the wood. To the end of the twine, next the hand, is to be tied a ſilk ribband; and, where the twine and ſilk join, a key may be faſtened. The kite is to be raiſed when a thunder guſt appears to be coming on: and as ſoon as the thunder clouds come over the kite, the pointed wire will draw the *electric* fire from them, and the kite, with all the twine, will be *electrifed*; and the looſe filaments of the twine will ſtand out every way, and be attracted by an approaching finger. When the rain has wet the kite and twine, ſo that it cannot conduct the *electric* fire freely, it will ſtream out plentifully from the key on the approach of a man's knuckle. At this key a phial may be charged; and from the *electric* fire, thus obtained, ſpirits may be kindled, and all the other *electrical* experiments be performed, which are done by the help of a glaſs-ſphere or tube; and the ſameneſs of the *electric* matter with that of lightning, may thereby be completely demonſtrated.

From this identity ſome have conceived hopes of depriving the clouds of all their thunder, and thereby rendering thunder ſtorms harmleſs.

18. Mr. STEPHEN GRAY, juſt before he died, hit upon an experiment which ſeemed to indicate, that the attractive power, which regulates the motions of the heavenly bodies, is of the *electric* kind. The experiment was thus: he fixed a large, round, iron-ball upon the middle of a large cake of roſin and wax; and exciting the virtue ſtrongly in the cake, a fine feather, ſuſpended by a thread, and held near the iron-ball, was carried round it, by

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the effluvia, in a circular manner, and performed several revolutions: it moved the same way with the planets, from west to east, and its motion, like theirs, was not quite circular, but a little elliptical.

These being most of the capital experiments hitherto exhibited, in *Electricity*, we shall conclude this head by mentioning some of the *medicinal virtues* lately attributed to this subject of philosophy.

It has been pretended, that odours will pervade *electrified* globes and tubes of glass; and that the medicinal effects of drugs might likewise be transmitted this way; as also, that, if persons were to hold in their hands, or place under their naked feet, odoriferous or purging substances, and were then to be *electrised*, they would be sensible of the effects of these substances; but this seems now to be an imposition on the credulity of the world, no such effects having ever been perceived. However, it does not follow that medicinal advantages are not to be gained from *electricity* itself; so subtile and so elastic a fluid admitted in a large quantity into our bodies, as, from undoubted experience, it greatly heats the flesh and quickens the pulse, may more especially, when assisted with the expectation of success in the patient, in particular cases, be attended with advantages. In effect, we meet with some cures performed in paralytic cases, by the force of *electricity*.

Of EMBROIDERY.

EMBROIDERY is a work with gold, or silver, or silk thread, wrought by the needle upon cloth, stuffs, or muslin, into various figures. In *embroidering* stuffs, the work is performed in a kind of loom, because the more the piece is stretched, the easier it is worked. As to muslin, they spread it upon a pattern ready designed; and sometimes, before it is stretched upon the pattern, it is starched, to make it more easy to handle. *Embroidery* on the loom is less tedious than the other, in which while they work flowers, all the threads of the muslin, both lengthwise and breadthwise, must be continually counted; but on the other hand this last is much richer in points, and susceptible of greater variety. Cloths too much milled are scarce susceptible of this ornament, and in effect we seldom see them *embroidered*. The thinnest muslins are the best for this purpose: and they are *embroidered* to the greatest perfection in *Saxony*: in other parts of *Europe*, however, they *embroider* very prettily, and especially in *France*.

There are several kinds of *embroidery*; as, 1. *Embroidery* on the stamp, where the figures are raised and rounded, having cotton or parchment put under them to support them. 2. Low *embroidery*, where the gold and silver lie low upon the sketch, and are stitched with silk of the same colour. 3. Guimped *embroidery*: this is performed either in gold or silver; they first make a sketch upon the cloth, then put on cut vellum, and afterwards sow on the gold and silver with silk-thread: in this kind of *embroidery* they often put gold and silver cord, tinsel, and spangles. 4. *Embroidery* on both sides; that which appears on both sides of the stuff. 5. Plain *embroidery*, where the figures are flat and even, without cords, spangles, or other ornaments.

Of ENAMELLING.

ENAMELLING is the art of laying *enamel* * upon metals, as gold, silver, copper, &c. and of melting it at the fire, or of making divers curious works in it at a lamp. It signifies also to paint in enamel. *The painting in enamel*, is performed on plates of gold or silver, and, most commonly of copper, enamelled with the white enamel; whereon they paint with colours, which are melted in the fire, where they take a brightness and lustre like that of glass. This painting

* ENAMEL, a kind of coloured glass, used in enamelling and painting in enamel.

Enamels have for their basis a pure crystal-glass or frit, ground up with a fine calx of lead and tin prepared for the purpose, with the addition usually of white salt of tartar. These ingredients fused together, are the matter of all enamels, which are made by adding colours of this or that kind in powder to this matter, and melting or incorporating them together in a furnace.

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ing is the moſt prized of all for its peculiar brightneſs and vivacity, which is very permanent, the force of its colours not being effaced or ſullied with time, as in other painting, and continuing always as freſh as when it came out of the workman's hands. It is uſually in miniature, it being the more difficult the larger it is, by reaſon of certain accidents it is liable to in the operation. Enamelling ſhould only be practiſed on plates of gold, the other metals being leſs pure: copper, for inſtance, ſcales with the application, and yields fumes; and ſilver turns the yellows white. Nor muſt the plate be made flat; for in ſuch caſe, the enamel cracks; to avoid which, they uſually forge them a little round or oval, and not too thick. The plate being well and evenly forged, they uſually begin the operation by laying on a couch of white enamel (as we obſerved above) on both ſides, which prevents the metal from ſwelling and bliſtering; and this firſt lay ſerves for the ground of all the other colours. The plate being thus prepared, they begin at firſt by drawing out exactly the ſubject to be painted with red vitriol, mixed with oil of ſpike, marking all parts of the deſign very lightly with a ſmall pencil. After this, the colours (which are to be before ground with water in a mortar of agate extremely fine, and mixed with oil of ſpike ſomewhat thick) are to be laid on, obſerving the mixtures and colours that agree to the different parts of the ſubject; for which it is neceſſary to underſtand painting in miniature. But here the workman muſt be very cautious of the good or bad qualities of the oil of ſpike he employs to mix his colours with, for it is very ſubject to adulterations.

Great care muſt likewiſe be taken, that the leaſt duſt imaginable come not to your colours while you are either painting or grinding them; for the leaſt ſpeck, when it is worked up with it, and when the work comes to be put into the reverberatory to be red hot, will leave a hole, and ſo deface the work.

When the colours are all laid, the painting muſt be gently dried over a ſlow fire to evaporate the oil, and the colours afterwards melted to incorporate them with the enamel, making the plate red hot in a fire, like what the Enamellers uſe. Afterwards that part of the painting muſt be paſſed over again which the fire hath any thing effaced, ſtrengthening the ſhades and colours, and committing it again to the fire, obſerving the ſame method as before, which is to be repeated till the work is finiſhed.

Moſt *enamelled* works are wrought at the fire of a *lamp*, in which, inſtead of oil, they put melted horſe-greaſe, which they call *caballine oil*. The lamp, which is of copper or white iron, conſiſts of two pieces, in one of which is a kind of oval plate, ſix inches long, and two high, in which they put the oil and the cotton. The other part, called the box, in which the lamp is incloſed, ſerves only to receive the oil which boils over by the force of the fire. This lamp, or where ſeveral artiſts work together, two or three more lamps are placed on a table of proper heighth. Under the table, about the middle of its heighth, is a double pair of organ-bellows, which one of the workmen moves up and down with his foot, to quicken the flame of the lamps, which are by this means excited to an incredible degree of vehemence. Grooves made with a gauge in the upper part of the table, and covered with parchment, convey the wind of the bellows to a pipe of glaſs before each lamp; and that the Enamellers may not be incommoded with the heat of the lamp, every pipe is covered at ſix

For *white enamel*, Neri *De Arte Vitriar.* directs only mangan*e*ſe to be added to the matter which conſtitutes the baſis. For azure, zaffer mixed with calx of braſs. For green, calx of braſs with ſcales of iron, or with crocus martis. For black, zaffer with manganeſe, or with crocus martis; or manganeſs with tartar. For red, manganeſe or calx of copper and red tartar. For purple, manganeſe with calx of braſs. For yellow, tartar and manganeſe. And for violet-coloured enamel, manganeſe with thrice calcined braſs.

In making theſe *enamels*, the following general cautions are neceſſary to be obſerved. 1. That the pots muſt be glazed with white glaſs, and muſt be ſuch as will bear the fire. 2. That the matter of *enamels* muſt be very nicely mixed with the colours. 3. When the *enamel* is good, and the colour well incorporated, it muſt be taken from the fire with a pair of tongs. 4. The general way of making the coloured *enamels* is this; powder, ſift, and grind all the colours very nicely, and firſt mix them with one another, and then with the common matter of *enamels*; then ſet them in pots in a furnace, and when they are well mixed and incorporated, caſt them into water; and when dry, ſet them in a furnace again to melt; and when melted, take a proof of it. If too deep coloured, add more of the common matter of *enamels*; and if too pale, add more of the colours.

Enamels are uſed either in counterfeiting or imitating precious ſtones, in painting in *enamel*, or by enamellers, jewelers, and goldſmiths, in gold, ſilver, and other metals. The two firſt kinds are uſually prepared by the workmen themſelves, who are employed in theſe arts. That uſed by jewelers, &c. is brought to us chiefly from *Venice* or *Holland*, in little cakes of different ſizes, commonly about four inches diameter, having the mark of the maker ſtruck upon it with a punchion. It pays the pound 1 s. 7$\frac{4}{100}$d. on importation, and draws back 1 s. 5 [illegible]d. at the rate of 4 s. *per* pound, a manufacture of this kind is now erected with great approbation in *London*.

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inches diſtance with a little tin plate, fixed into the table by a wooden handle. When the works do not require a long blaſt, they only uſe a glaſs-pipe, into which they blow with their mouth.

It is incredible to what a degree of fineneſs and delicacy the threads of enamel may be drawn at the lamp. Thoſe which are uſed in making falſe tufts of feathers are ſo fine, that they may be wound on the reel like ſilk or thread. The fictitious jets of all colours, uſed in embroideries, are alſo made of enamel; and that with ſo much art, that every ſmall piece hath its hole to paſs the thread through wherewith it is ſewed. Theſe holes are made by blowing them into long pieces, which they afterwards cut with a proper tool.

It is ſeldom that the *Venetian* or *Dutch* enamels are uſed alone; they commonly melt them in an iron-ladle, with an equal part glaſs or cryſtal; and when the two matters are in perfect fuſion, they draw it out into threads of different ſizes, according to the nature of the work. They take it out of the ladle while liquid, with two pieces of broken tobacco-pipes, which they extend from each other at arms length. If the thread is required ſtill longer, then another workman holds one end, and continues to draw it out, while the firſt holds the enamel to the flame. Thoſe threads, when cold, are cut into what lengths the workman thinks fit, but commonly from ten to twelve inches; and as they are all round, if they are required to be flat, they muſt be drawn through a pair of pincers while yet hot. They have alſo another iron-inſtrument in form of pincers, to draw out the enamel by the lamp when it is to be worked or diſpoſed in figures. Laſtly, they have glaſs tubes of various ſizes, ſerving to blow the enamel into various figures, and preſerve the neceſſary vacancies therein; as alſo to ſpare the ſtuff and form the contours. When the Enameller is at work, he ſits before his lamp with his foot on the ſtep that moves on the bellows, and holding in his left hand the work to be enamelled, or the braſs or iron-wires the figures are to be formed on, he directs with his right the enamel thread, which he holds to the flame with a management and patience equally ſurpriſing. There are few things they cannot make or repreſent with enamel; and ſome figures are as well finiſhed, as if done by the moſt ſkilful carvers, and painters.

Of E N G R A V I N G.

ENGRAVING (from lat. *cavare*, to hollow) is the art of cutting metals, and precious ſtones, to repreſent figures, letters, or other matters thereon.

The ancients excelled in the art of *engraving* on precious ſtones, there being divers antique agates, berils, cornelians, and onixes, which ſurpaſs any thing of that kind the moderns have produced. *Pyrgoteles* among the *Greeks*, and *Dioſcorides* under the firſt emperors of *Rome*, are the moſt eminent *engravers* we read of. The former was ſo eſteemed by *Alexander*, that he forbad any body elſe to *engrave* his head; and *Auguſtus*'s head, *engraven* by the latter, was found ſo beautiful, that the ſucceeding emperors choſe it for their ſeal. All the polite arts having been buried under the ruins of the *Roman* empire, the art of *engraving on ſtones* met the ſame fate.

That art was retrieved in *Italy* at the beginning of the fifteenth century, when one *John* of *Florence*, and after him *Dominic* of *Milan*, performed work of this kind no way to be deſpiſed From that time, pieces of that kind became common enough in *Europe*, and particularly in *Germany*, whence great numbers were ſent into other countries; but they came ſhort of the beauty of thoſe of the antients, eſpecially thoſe on precious ſtones; as for thoſe on cryſtal, the *Germans*, and after their example, the *Engliſh* and *French*, have very well ſucceeded.

ENGRAVING properly a branch of ſculpture, is divided into ſeveral other branches, according to the matter whereon it is employed, and according to the manner of performing it.

Theſe branches are denominated *cutting in wood*; *etching*, *mezzotinto*, and, what is properly and originally called, *engraving*.

We are indebted for the invention of *cutting in wood*, as well as that in copper, to *Maſo Finiguerra*, a goldſmith of *Florence*, in the year 1460; and for its perfection to *Albert Durer*, *Martin* of *Antwerp*, and *Mark Antony*. At the ſame time, *Hugo* of *Carpi*, an *Italian* printer, invented a manner of *cutting in wood*; by means whereof, the prints appeared as if printed in *clear-obſcure*: In order to this he made three kinds of ſtamps for the ſame deſign, which were drawn after one another, through the preſs, for the ſame print; they were ſo conducted that one ſerved for the grand lights, the ſecond for the demi-teints, and the third for the out-lines and the deep ſhadows.

The art of *cutting in wood* was certainly carried to a very great pitch about 150 years ago, and might even vye, for beauty and juſtneſs, with that of *engraving* on copper: At preſent it is in a very low

low condition, as having been long neglected; and the application of artiſts wholly employed on copper, as the moſt eaſy and promiſing province: Not that but wooden cuts have the advantage of copper on many accounts; chiefly for figures and devices in books, as being printed at the ſame time, and on the ſame preſs as the letters; whereas for the other, there is required a particular impreſſion.

The *cutters in wood* need no other inſtruments than little ſharp knives, little chiſſels, and gravers of different ſizes, according to the bigneſs or delicacy of their work. The firſt thing they do is to take a block of pear-tree, or box; box is the beſt, they prepare that block, of the ſize and thickneſs intended, and make it very even and ſmooth on the ſide to be cut. On this block, thus prepared, they draw their deſign with a pen or pencil, juſt as it ought to be printed. Thoſe who cannot draw their own deſign, make uſe of a deſign furniſhed them by another, which they faſten upon the block with paſte made of flour and water, with a little vinegar; the ſtrokes or lines turned towards the wood.

When the paper is dry, they waſh it gently over with a ſpunge dipped in water; which done, they take off the paper by little and little, ſtill rubbing it a little firſt with the tip of the finger, till at length there be nothing left on the block but the ſtrokes of ink that form the deſign, which mark out ſo much of the block as is to be left ſtanding: The reſt they cut off, as curiouſly as they can, with the points of their ſharp tools.

This ſort of *engraving* is uſed for various purpoſes; as for initial or figured letters, head and tail pieces of books; and even for ſchemes and other figures, to ſave the expence of *engraving* on copper; and for prints and ſtamps for paper, callicoes, linens, &c.

Etching is a method of *engraving* on copper, in which the lines or ſtrokes, inſtead of being cut with a tool or graver, are eaten in with *aquafortis.*

Etching is done with more eaſe and expedition than *engraving*: it requires fewer inſtruments, and repreſents moſt kind of ſubjects better and more agreeable to nature, as *landſcapes*, *ruins*, *grounds*, and all *ſmall*, *faint*, *looſe*, *remote* objects, buildings, &c.

The method of *etching* is as follows: chooſe a well poliſhed copper-plate, and furniſh yourſelf with a piece of *ground*, tied up in a bit of thin ſilk, kept very clean, to be laid upon the plate when both have been warmed; proper *needles* to hatch with on the ground; a *pencil* or *bruſh*, to wipe away the bits of ground which riſe after hatching; a *poliſher*; two or three *gravers*; a pair of *compaſſes*, to meaſure diſtances and draw circles; a *ruler*, to hatch ſtrait lines; *green wax*, to make the wall round the edges of the plate, to contain the *aquafortis*; an *oil-ſtone*; a bottle of *aquafortis*; ſome *red-lead*, to colour the backſide of the copy; a *ſliſt*, and a *hand-vice*, to hold the plate over the candle.

To make the *ground*; take three ounces of aſphaltum, two ounces of clean roſin, half an ounce of burgundy-pitch, three ounces of black wax, and three ounces of virgin's wax: let all theſe be melted in a clean earthen pipkin over a ſlow fire, ſtirring it all the time with a ſmall ſtick; if it burn to the bottom, it is ſpoiled. After the ingredients are well melted, and it boils up, put it into a pan of fair water; and before it be quite cold, take it out, and roll it into ſmall lumps to be kept from duſt: this *ground* is what others call the *varniſh*.

The next thing is to clean the plate to receive the *ground*: take a piece of liſting, roll it up as big as an egg, tie it very tight, ſo as to make it a rubber, and having dropped a ſmall quantity of ſweet oil, and added a little powder of rotten-ſtone on the plate, rub it with this ball, till it will almoſt ſhew your face. Then wipe it all off with a clean rag, and after that, make it quite dry with another clean rag, and a little fine whiting.

The next thing is to lay on the *varniſh*; to do which aright you muſt take a *hand-vice*, and fix it at the middle of one part of the plate, with a piece of paper between the teeth of the *hand-vice* and the plate, to prevent the marks of the teeth: then laying the plate on a chaffing-diſh, with a ſmall charcoal fire in it, till the plate be ſo hot, that, by ſpitting on the backſide, the wet will fly off: rub the plate with the *ground* tied up in ſilk, till it be covered all over; and after that dawb the plate with a piece of cotton wrapped up in ſilk till the *ground* be quite ſmooth, keeping the plate a little warm all the time. The *varniſh* being thus ſmoothed upon the plate, it muſt be blacked in the following manner: take a thick tallow candle that burns clear, with a ſhort ſnuff, and having driven two nails into the wall, to let it reſt upon, place the plate againſt the wall with the *varniſh* ſide downward and take care not to touch the *ground* with your fingers: then taking the candle, apply the flame to the *varniſh* as cloſe as poſſible, without touching the *varniſh* with the ſnuff of the candle, and guide the flame all over it, till it become perfectly black.

On this *ground* thus blackened, the back of the deſign or draught is laid. This done, the deſign remains to be chalked or transferred upon the plate; which is more eaſily effected than in the common *graving*; for the back of the deſign having been before rubbed over with red chalk, nothing remains but to trace over all the lines and ſtrokes of the draught with a needle or point; which preſſing the paper

paper cloſe down to the *ground*, occaſions the wax therein to lay hold of the chalk, and ſo bring off the marks of the ſeveral lines; ſo as at length to ſhew a copy of the whole deſign in all its correctneſs. The draught thus chalked, the artiſt proceeds to draw the ſeveral lines and contours, with a point, through the *ground* upon the copper. To finiſh his work, he makes uſe of points, of diverſe ſizes, or bigneſs; and preſſes on them ſometimes more ſtrongly, and other times more lightly, according as the ſeveral parts of the figures require more or leſs ſtrength or boldneſs; ſome of the points being as fine as needles, for the tender hair-ſtrokes, and the remoter, fainter objects; and others again as big as bodkins, made oval-wiſe, for the deeper ſhadows, and the figures in the front of the work.

Things thus prepared, a rim, or border of wax, is raiſed round the circumference of the plate, and *aquafortis* poured on; which by the ſaid border is kept from running off at the edges. The *ground* being impenetrable to that corroſive water. The plate is defended from it every where but in the lines or hatches, cut through it with the points; which, lying open, the water paſſes through them to the copper, and eats into the ſame, to the depth required. Which done, it is poured off again. The *aquafortis* having done its part, the *ground* is taken off, and the plate waſhed and dried; after which nothing remains but for the artiſt to examine the work with the *graver* in his hand, to touch it up and heighten it, where the *aquafortis*, &c. has miſſed.

Etching-grounds are either ſoft, or hard: and the *aquafortis*, either white, which is only uſed with the ſoft *ground*, and is applied as above directed; or green, made of vinegar, common ſalt, ſal-ammoniac, and verdigreaſe: This is uſed indifferently with either kind of *ground*: Its application is ſome what different from that of the white. Without making any border, they pour it on the plate, which is placed for that purpoſe a little inclined; and as the water runs off, it is received in a veſſel placed underneath. This they repeat, pouring it again and again, till it has eaten deep enough; and, the *aquafortis*, of which kind ſoever it be, muſt not continue equally long, or be poured equally often, on all the parts of the deſign: the remote parts muſt be eaten more ſlightly, than thoſe nearer to the view. To manage this, they have a compoſition of oil and greaſe, wherewith they cover the parts that are to be bitten no farther: or elſe they lay the compoſition on as a defenſitive at firſt, and take it off again when they think proper. In effect, they are every now and then covering and uncovering this or that part of the deſign, as occaſion requires; the management of the *aquafortis* being one of the principal concerns in the whole art, and that on which the effect of the whole very much depends. The operator is alſo to be very attentive to the *ground*, that it do not fail or give way, in any part to the water; and where it does, to ſtop up the place with the compoſition aforeſaid. Laſtly, it is to be remembered, that a freſh dip of *aquafortis* be never given, without firſt waſhing out the plate in fair water, and drying it at the fire.

MEZZOTINTO is the art of repreſenting figures on copper in imitation of painting in *indian* ink.

The diſcovery of the art of *engraving*, *in taile douce*, on copper, is aſcribed, to *Maſo Finiguerra*, a goldſmith of *Florence*, who uſed to *engrave* on his works, and who, in moulding them in melted ſulphur, perceived that what came out of the mould marked, in its impreſſions the ſame things, which were *engraved* on the piece of work, by the black which the ſulphur had extracted from the lines; he attempted the ſame thing on plates of ſilver with wet paper, in running over it a very ſmooth roller, in which he ſucceeded. This new diſcovery prompted another goldſmith of the ſame city, called *Baccio Baldini*, to try the ſame thing; and the ſucceſs encouraged him to *engrave* ſeveral plates of the invention and deſign of *Sandro Botticello*; and on theſe proofs *Andrew Monteign*, who was then at *Rome*, *engraved* ſeveral of his own works.

The knowledge of this invention having paſſed into *Flanders*, *Martin* of *Antwerp*, who was then a famous painter, *engraved* ſeveral plates of his own invention, and ſent ſeveral prints of them into *Italy*, which were marked thus; *M C*.

Mezzotintos are made in the following manner: take a well poliſhed copper plate, and beginning at one corner, rake or furrow the ſurface all over with a knife or inſtrument made for the purpoſe, firſt one way, and then the other, till the whole is of a regular roughneſs, without the leaſt ſmooth part to be ſeen; in which ſtate, if a paper was to be worked off from it at the copper-plate preſs it would be all over black. When this is done, the plate is rubbed over with charcoal, black chalk, or black lead, and then the deſign is drawn with white chalk, after which the out-lines are traced out, and the plate finiſhed by ſcraping off the roughneſs, ſo as to leave the figure on the plate. The out-lines and deepeſt ſhades are not ſcraped at all, the next ſhades are ſcraped but little, the next more, and ſo on till the ſhades gradually falling off, leave the paper white, in which places the plate is neatly burniſhed.

By an artful diſpoſition of the ſhades, and different parts of a figure on different plates, *mezzo-*

tintos

tintos have been printed in colours, ſo as nearly to repreſent very beautiful paintings.

ENGRAVING properly ſo called, is performed on *ſteel*, *copper*, or *ſtones*.

ENGRAVING *on ſteel* is chiefly employed in cutting ſeals, punches, matrices, and dyes proper for ſtriking coins, medals, and counters. The method of *engraving* with the inſtruments, &c. is the ſame for coins as for medals and counters: All the difference conſiſts in their greater or leſs *relievo*, the *relievo* of coins being much leſs conſiderable than that of medals, and that of counters ſtill leſs than that of coins.

Engravers in ſteel commonly begin with punches, which are in *relievo*, and ſerve for making the *creux* or cavities, of the matrices, and dyes: though ſometimes they begin with the *creux*, or hollowneſs, but then it is only when the intended work is to be cut very ſhallow The firſt thing done, is that of deſigning the figures; the next is the moulding them in wax, of the ſize and depth they are to lie, and from this wax the punch is *engraven*. When the punch is finiſhed they give it a very high temper, that it may the better bear the blows of the hammer with which it was ſtruck to give the impreſſion to the matrix.

The *ſteel* is made hot to ſoften it, that it may the more readily take the impreſſion of the punch; and after ſtriking the punch on it, in this ſtate, they proceed to touch up or finiſh the ſtrokes and lines, where, by reaſon of their fineneſs, or the too great *relievo*, they are any thing defective, with ſteel gravers of different kinds, chiſſels, flatters, &c. being the principal inſtruments uſed in graving on ſteel.

The figure being thus finiſhed, they proceed to engrave the reſt of the medal, as the mouldings of the border, the engrailed ring, letters, &c. with little ſteel punches, well tempered, and very ſharp.

ENGRAVING *on copper*, is employed in repreſenting portraits, hiſtories, landſkips, foliages, figures, buildings, &c. either after paintings, or deſigns, for that purpoſe.

It is performed with the *graver* on a plate of *copper*, which, being well poliſhed, is covered over thinly with virgin-wax, and then ſmoothed, while warmed, with a feather, ſo that the wax be of an equal thickneſs on the plate; and on this the draught or deſign, done in black lead, red chalk, or ungummed ink, is laid with the face of the drawing on the wax: then they rub the backſide, which will cauſe the whole deſign of the drawing to appear on the wax. The deſign, thus transferred, is traced through on the copper, with a point, or needle; then heating the plate, and taking off the wax, the ſtrokes remain to be followed, heightened, &c. according to the tenor of the deſign, with the graver, which muſt be very ſharp, and well pointed.

In the *conduct* of the *graver* conſiſts almoſt all the art, which depends not ſo much upon rules, as upon *practice*, the habitude, diſpoſition, and genius of the artiſt, the principles of *engraving* being the ſame with thoſe of painting; for if an *engraver* be not a perfect maſter of deſign, he can never hope to arrive at a degree of perfection in this art. In conducting the ſtrokes, or cuts, of the *graver*, he muſt obſerve the action of the fingers, and of all their parts, with their out-lines; and remark how they advance towards, or fall back from his ſight, and then, conduct his *graver*, according to the riſings or cavities of the muſcles, or folds, widening the ſtrokes in the light, and contracting them in the ſhades; as alſo at the extremity of the outlines, to which he ought to conduct the cuts of the *graver*, that the figures or objects repreſented, may not appear as if they were gnawn; and lightening his hand that the out-lines may be perfectly ſound, without appearing cut or ſlit; and, although his ſtrokes neceſſarily break off; where a muſcle begins, yet they ought always to have a certain connection with each other, ſo that the firſt ſtroke ſhould often ſerve to make the ſecond, becauſe this will ſhew the freedom of the *graver*.

If hair be the ſubject, let the *engraver* begin his work by making the out-lines of the principal locks, and ſketch them out in a careleſs manner, which may be finiſhed, at leiſure, with finer and thiner ſtrokes to the very extremities.

The *engraver* muſt avoid making very acute angles, eſpecially in repreſenting fleſh, when he croſſes the firſt ſtrokes with the ſecond, becauſe it will form a very diſagreeable piece of tabby-like lattice-work; except in the repreſentation of ſome clouds in tempeſts, the waves of the ſea, and in repreſentations of ſkins of hairy animals, and leaves of trees. So that the medium between ſquare and acute ſeems to be the beſt and moſt agreeable to the eye.

He that would repreſent ſculpture, muſt remember that, as ſtatues, &c. are moſt commonly made of white marble, or ſtone, whoſe colour does not produce ſuch dark ſhades as other matters do, have no black to their eyes, nor hair of the head, and beard flying in the air.

If the *engraver* would preſerve one quality and harmony in his works, he ſhould always ſketch out the principal objects of his piece before any part of them are finiſhed.

The inſtruments neceſſary for this ſort of *engraving* are, beſides a *graver*, a *cuſhion*, or *ſand bag*, made of leather, to lay the plate on, in order to give it the neceſſary turns and motions; a *burniſher*,

 made,

made of iron, or ſteel, round at one end, and uſually flattiſh at the other, to rub out ſlips and failures ſoften the ſtrokes, &c. a *ſcraper*, to pare off the ſurface, on occaſion; and a rubber of a black hat, or *cloth* rolled up, to fill up the ſtrokes that they may appear the more viſible.

In engraving on precious ſtones, they uſe either the diamond, or the emery. The diamond, which is the hardeſt of all ſtones, is only cut by itſelf, or with its own matter.

The firſt thing to be done in this branch of *engraving*, is to cement two rough diamonds to the ends of two ſticks big enough to hold them ſteady in the hand, and to rub or grind them, againſt each other, till they be brought to the form deſired. The duſt, or powder that is rubbed off ſerves afterwards to poliſh them, which is performed with a kind of mill that turns a wheel of ſoft iron. The diamond is fixed in a braſs-diſh and, thus applied to the wheel is covered with diamond duſt, mixt up with oil of olives, and when the diamond is to be cut facet wiſe, they apply firſt one face, then another, to the wheel.

Rubies, ſapphires, and topazes, are cut and formed the ſame way on a copper wheel, and poliſhed with *tripoli* diluted in water. As to agates, amethyſts, emeralds, hyacinths, granates, rubies, and others of the ſofter ſtones, they are cut on a leaden wheel, moiſtned with emery and water, and poliſhed with *tripoli*, on a pewter wheel. *Lapis-lazuli*, opal, &c. are poliſhed on a wooden wheel. To faſhion and engrave vaſes of agate, cryſtal, *lapis-lazuli*, or the like, they make uſe of a kind of lathe, like that uſed by pewterers to hold the veſſels, which are to be wrought with proper tools; that of the *engraver* generally holds the tools, which are turned by a wheel; and the veſſel is held to them to be cut and *engraved*, either in *relievo* or otherwiſe; the tools being moiſtened, from time to time, with diamond duſt and oil; or, at leaſt, emery and water.

To *engrave* figures or devices on any of theſe ſtones, when poliſhed, ſuch as medals, ſeals, &c. they uſe a little iron wheel the ends of whoſe *axis* are received within two pieces of iron, placed upright, as in the turner's lathe; and to be brought cloſer, or ſet further apart, at pleaſure: at one end of the *axis* are fitted the proper tools being kept tight by a ſcrew. Laſtly, the wheel is turned by the foot, and the ſtone applied by the hand to the tool, and is ſhifted and conducted as occaſion requires.

The *tools* are generally of iron, and ſometimes of braſs: their form is various, but it generally bears ſome reſemblance to chiſſels, gouges, &c. Some have ſmall round heads, like buttons, others like ferrels, to take the pieces out, and others flat, &c. when the ſtone has been *engraven*, it is poliſhed on wheels of hair-bruſhes and *tripoli*.

E T H I C S.

ETHICS, or *moral philoſophy*, is the *ſcience of* MANNERS *or* DUTY, which it traces from man's nature and condition, and ſhews to terminate in his happineſs: therefore it is called ETHICS or *moral diſcipline*; and may be properly defined *the knowledge of our* DUTY and FELICITY; or, *the art of being virtuous and happy*.

It is an *art*, becauſe it contains a ſyſtem of rules to promote our happineſs, for whoever practiſes thoſe rules, attains an habitual power or facility of becoming virtuous and happy.

It is alſo a ſcience, becauſe it deduces thoſe rules from the principles and connections of our nature, and proves that the obſervance of them is productive of our happineſs.

Hence it is evident, that men's duty, or his conduct in the ſeveral moral capacities and connections, which he ſuſtains is the object of this philoſophy; and that its office is to direct us in the practice of the great duties to GOD, our neighbour, and ourſelves.

Therefore this treatiſe will be properly divided into four parts.

Firſt, We will treat of the ſovereign good, or final object of all human actions.

Secondly, Of human arts, and their rules.

Thirdly, Of virtues and vices.

Fourthly, Of the various offices of life, in regard to GOD, our neighbour, and ourſelves.

Firſt, Let us be well inform'd what is the ſovereign good.

There is but one *eſſential good*, which is God himſelf, who alone is properly, and of himſelf, good. As *Chriſt* witneſſes it, *Luke* v. 19.

Good by participation is a created good, and this is either a thing or Subſtance, which is good to us; as are the aliments, cloaths, &c. or the modification or affection of a thing, which helps us likewiſe, whether it has a report to the body or to the mind. Hence *good* is commonly diſtributed into the *good of the body*; ſuch as health, ſtrength, beauty, &c. *Good of the mind*; as, ſcience, virtue, &c. and *goods of fortune*; ſuch as houſes, lands, money, &c.

We defire all thefe things, becaufe they are ufeful, or agreeably only, or honeft; whence that famous divifion of *good*, into honeft, agreeable, and ufeful. We call *honeft*, that which is agreeable to order, or rather to the rules of our reafon, as probity, or virtue: *agreeable*, that which pleafes or delights us; *v. g.* fome are pleafed with plays and fpectacles, fome in company, others with ftudying the liberal arts, and the practice of virtue, others with telling their money, *&c.* Laftly, the *utile*, which is that which procures us fome other good, as a bitter potion, which can procure the recovery of health.

Our next enquiry muft be for the *final* object of all human actions; or, the *end* of *things:* we are very fure, that the Creator has appointed an *end* for each created thing in particular.

Therefore all corporeal things, either celeftial or fublunary, even the brutes, which have no faculty to govern themfelves, or reafon, are directed and moved by the omnipotent being towards their end, as an arrow is directed by the archer.

But rational creatures tend toward their end of their own proper will; and chufe the ways which they judge the moft proper to conduct them to their ends: Whence they are invited by the end; neither could they ever be perfuaded to act, without fome end; but move themfelves of their own accord, and with a previous knowledge of their underftanding towards that end, which they know very well to be fuch.

An *end* is defined by *Ariftotle*, *lib.* 2. *phyfic. c.* 3. *id cujus gratia fit aliquid*; i. e. *that in view whereof fomething is done.*

There are two forts of *ends*, *viz.* the *end* which is defired, and the *end* for which fomething is defired. For example, the end defired in the conftruction of a houfe, is a commodious habitation; and the end for which that commodious habitation is defired, is the perfon who is to live in it. Again, there is the *end of the work*, and the *end of the workman.*

The *end of the work*, or operation, is that intended by the work itfelf, as the end of ftudy is the knowledge of truth; becaufe we muft ftudy only to difcover the truth.

The *end of the operator*, or artificer, is that intended by him; as the end of him who learns or teaches philofophy, can be the love of truth, or a vain curiofity, or fomething elfe.

Laftly, the *end* either of the work, or of the workman; one is the firft, which is firft intended; the other the fecond, or that which is placed between two, and the other the laft, to which all the others have a relation. Which laft end is nothing elfe, but God himfelf, from whom all things flow, and to whom they all return.

But though all things tend towards procuring the glory of the Creator, and are all moved by his fpecial favour; the rational creatures are faid, notwithftanding, to have that tendency towards God, as their fovereign good in a more particular manner; as being fole capable of his poffeffion.

This laft *end* is defined by *Cicero*, *lib.* 2. *de finib. bon. & mal.* *That, by which all things are done well, and are related, and itfelf is related to nothing.* In the fame fenfe it is defined in the fchools, *that which is defired for itfelf, and all things defired for it.* This *end* is either the true, proper, and natural end of all things, *i. e.* to which all other things have a natural tendency; or is arbitrary, depending either on the levity, or impetuofity, or affection of the mind; fuch is money with refpect to the avaricious, voluptuoufnefs with refpect to the voluptuous, *&c.*

But however, let it be how it will, it is certain, that the laft, true, proper, and natural *end* of all created beings, is God himfelf.

But that motion whereby all men incline towards God, is often interrupted by them; efpecially when they repofe themfelves in the creatures, and fearch the fovereign good where there is no true and folid good, but only an apparent one to be found. Tho' this cannot be an obftacle to God's being called the proper and natural end of all created beings, but more particularly of men; either becaufe all things and all actions are terminated in God, or becaufe God alone is, laftly, fearched by us, though fometimes we know nothing of it ourfelves; becaufe he can alone appeafe our defires, or gratify them. *Eft enim*, fays *Boetius*, *lib.* 3. *de Confolat Philofoph. prof.* 2. *Omnium fummum bonorum, cunctaque intra fe bona continens, cui fi quid abforet, fummum effe non poffet, quoniam non relinqueretur extrinfecus quod poffet operari.* Therefore in him alone, and not in a created good, confin'd within very narrow limits, we ought to put our whole felicity, which according to the definition of the fame *Boetius*, *is a ftate perfect by the affemblage of all forts of goods.*

Secondly, In fearch after the *human acts*, and enquire how many there are, to be directed by the rules of *Ethicks* towards this end.

We muft fearch, *firft*, what is a human act, and how many. *Secondly*, if all human acts be voluntary. *Thirdly*, if it be free. *Fourthly*, if all human acts be good or bad, and none indifferent. *Fifthly*, which is the ufage of the affections of the foul; and if they be fubject to the rules of the *Ethicks.*

I call, with *Thomas Aquinas*, 1, 2. *queft.* 1. *art.* 1. a human act that which is done by a man, acting like a man; *i. e.* with prudence and reflection: fo that a human act may be diftinguifhed from that called

called the act of a man, and which is done without the least reflection.

Of those *human acts*, some are interiors, gain'd from the will, and are accomplished in it; as the acts of *love* and *hatred*.

Others are *exterior acts*, commanded from the will; but are executed by our corporeal strength, as *walking*, *speaking*, *writing*, &c. and even of these acts several are called transitory; because they pass from the active cause, to a foreign object, as *writing*, *striking*, *building*, &c. Others are called *immanent*; because they produce nothing sensible beyond the active cause, as shaking the head, the motion of the arm, rubbing the eye, &c. But however, those are more properly called *imminent acts*, which remain in the mind, as *love* and *hatred*.

To find the number of the *interior acts*, every one must be attentive to what passes within him.

For *first*, we irresistibly desire *good* in general, or our beatitude, and avoid evil or misery; whence the first act of our will, is the *love of good* in general, or of our felicity, and a hatred for evil or misery. Therefore good in general, or our felicity, if it be considered as it is convenient to us, is very well term'd, the primary object of our will. But if it be considered as it fixes and terminates our desires, it is called the last end. Lastly, if it be considered as rendering us happy by its possession, it is called our felicity.

Secondly, That we may gain the *good* and avoid the *bad*, there are means to be taken; therefore the second act of our will is *consultation*, or an enquiry into the means to conduct us to our end.

Thirdly, After that *consultation*, we chuse one of those means, and thus the third act of our will is *election*; which is not ill defined, the assumption of one means before another, in order to gain our end.

Fourthly, Where through that means we have gained our end, we repose ourselves in it and enjoy it, especially if nothing remains to be desired; whence the last act of our will is *fruition*. But if by misfortune, any body was conducted to a bad end, he would complain and grieve at it, especially if he could not extricate himself from it.

All *human acts*, *i. e.* acted by a man in a human manner, are always *voluntary*, unless violence, or a great fear, or an insuperable ignorance, interferes.

The next thing we are to consider, is, if *all human acts be free*.

We call a free act, that which is done without compulsion, or can be done or omitted, at pleasure. For divines distinguish two sorts of liberty, *viz.* liberty from an *external necessity*, or *coaction*, and liberty from an *intrinsic or natural necessity*.

Divines call *liberty from coaction*, or *liberty of spontaneity*, that, which removes all external violence, *i. e.* proceeding from an external principle against the propensity of the will. By which liberty the will loves good in general, and hates evil in general; and therewith the blessed are said to love God, because they freely, and without constraint, adhere to him by love. Therefore liberty from *coaction* is the same as voluntary or spontaneous; insomuch as it is done by the will without coaction; and therefore all *voluntary acts* are *free from coaction*.

Liberty from necessity, or *liberty of election* and *indifference*, which is also called *free-will* and *simple liberty*, is that which excludes all kinds of necessity, either natural or internal, or external, or of coaction. I call *natural necessity*, *a certain determination or propensity, which our liberty has naturally to pursue, or avoid necessarily, certain things*; *v. g.* to love necessarily, and by election, good in general, and hate evil. I call likewise *necessity of coaction*, or *coaction itself*, a certain *violence offered to some body against his own inclination*; as when any body is put in prison.

Therefore the *coaction differs from a natural necessity*, in that coaction proceeds from an intrinsick principle, against the inclination of the will, and therefore deprives us of our liberty. And the *necessity of natural inclination*, proceeds from the will itself; and therefore does not deprive us of our will, but only of our liberty, taken in a strict sense, which proceeds from election.

That if the necessity of acting or not acting be only hypothetical, and follows the consent or election of the will, it by no means affects our free-will, or *liberty of indifference* and *election*: *v. g.* Suppose I have determined myself to speak, I speak necessarily: but that necessity does not force me to speak, nor hinders me from speaking: whence a free-will remains in me still, since I have still the power of election, which consists in this, that one may act, or abstain from acting as he pleases.

Therefore *liberty of election*, is very well defined an *elective faculty*, *i. e.* a faculty to chuse one thing before another: and as in election, *one is to act or not act*; and the other, *to act this or that*, *in this or that manner*; we distinguish two sorts of liberty of *election* and *indifference*; one to act or not act, call'd *liberty of contradiction*, because *acting* or *not acting* are contradictories; and the other to act this or that, in this or that manner, *v. g.* to love or to hate, to speak or to write, which is called liberty of *contrariety*, or *diversity*; because to *love* and to *hate*, are contrary or opposite; and to *speak* and to *write*, are different.

Free-will, can also be defined a faculty determining itself; or, *a faculty which having all things requisite to act*, *can act*, *or not act*, *or even act the*

 contrary;

contrary: whence it may be inferred, that the liberty of the will does not regard generally the chief end of our actions, or our felicity, becauſe it is impoſſible we ſhould not deſire our felicity. Neither does it tend towards thoſe things which have a neceſſary connection with our ſovereign good, and without which we cannot gain that ſovereign good; ſuch as are *to be*, and *live*, ſince we are neceſſitated to love thoſe things.

From this I'll paſs to *the goodneſs of the human acts*.

Human actions, compared with the *rules of manners*, are called *moral*; and if they be agreeable to thoſe rules, are eſteemed *good*; but if they decline from them, *bad*; ſo that the *morality* is nothing elſe but its *relation to its rule, whereby it is determined morally good or bad.*

The *rules of manners* (at leaſt the primary rules) whereby a human act muſt be meaſur'd, are the *eternal degrees*, or *divine law*, and right reaſon. An human act is to be with theſe rules, as well with regard to the object, and the end, as to the circumſtances; for every body knows that an human act, conſiſts in the object, end and circumſtances.

The object of a human act is that, towards which that act tends, and which can be conſidered either *materially* or *formally*.

It is conſidered *materially*, as far as it is a matter ſubject to certain acts, with regard to which, ſeveral other moral acts, though of a different kind, can be done; as the ſame man can be an object of love or of hatred; of adulation or of reproaches, &c. An object thus conſidered is always good, of an identical goodneſs, it being either God who is perfectly good, or a created thing, which is good by participation; but has neither a moral goodneſs, nor a moral vicioſity; becauſe it is neither agreeable to the rules of manners, nor contrary to them; and conſequently cannot give to the action, either a good or bad ſpecies, in the gender of manners.

The object is conſidered *formally*, when conſidered under ſome form, either phyſical or moral; and then it eſtabliſhes a ſpecies of the act, either phyſical or moral; and as far as it is agreeable or repugnant to phyſical or moral principles, communicates to the action either a phyſical or moral goodneſs, or vitioſity. But it might happen that an object is good *formally*, according to a phyſical ſpecies, and bad *formally* according to a moral ſpecies, and the contrary. For inſtance, if a painter paints in an elegant manner ſome obſcene figures, the object will be good phyſically, and bad morally; ſo that the action will be good *formally*, according to the phyſical ſpecies, and with regard to the execution of the rules of his art of painting; but will be bad *formally*, according to the moral ſpecies, that is to ſay, if compared with the rules of manners.

The end of a *human act*, is that for which the act is done; and can likewiſe be conſidered, either *phyſically*, or *morally*, *v. g.* if any body takes a medicine for the recovery of his health, this end is good *phyſically*; but is neither good nor bad *morally*, but when compared with the *rules of manners*; therefore the end is good *morally*, if any body wiſh for his health, with the intention of making it ſubſervient to God's glory; and bad if he deſires it to gratify his paſſions.

The *formal object* of a human act, is alſo ſometimes called *motive*; *v. g.* God's goodneſs, or the relation he has with our nature, which wants ſeveral things from him, *viz.* his aſſiſtance, and that he may perfect it, is called the *motive*, or reaſon why we love him. Sometimes the *motive* is taken for the end, as when health is ſaid to be the *motive*, which induces ſuch a perſon to take a medicine. Laſtly, *motive* is alſo taken, though very ſeldom, for the efficient cauſe; as the advice which has engaged ſomebody in a good or bad action, is ſaid to be the *motive*, whereby it has been done.

Laſtly, We call *circumſtances of an action*, all the things which accompany the action, as the *place*, the *time*, the *manner*, and the *aſſiſtance*, and all theſe things are included together, with the *object*, *end*, and *effective cauſe*, in the following verſe:

Quis, quid, ubi, quibus auxiliis, cur, quomodo, quando,

We muſt next inform ourſelves of the *rules of moral goodneſs and malice*.

Aquinas, 1, 2 *quæſt*. 71. *art*. 6. has eſtabliſhed two rules of the human acts; one which is the firſt, and remote, *viz.* the *eternal law*, which is the abſolute will of God, or the *order* whereby all things are wiſely diſpoſed; the other *derived*, and nearer, *viz. human reaſon*, which is like a certain participation of that abſolute and divine will.

All law is either *poſitive* or *natural*; that is mutable, and this is not ſubject to change.

The *natural law* is either conſidered in God, or in us: in God, it is called an *eternal law*, or an *eternal order*; and in us, it is either called *right reaſon*, or *natural light*; or retains the name of natural law only.

It is a general received opinion, that the *eternal law* is the ſource of all others, and the firſt rule of the human actions. This eternal law is nothing elſe but an eternal order, eſtabliſhed by the ſovereign wiſdom, and which contains all that we are to do, or to avoid. The *eternal law*, ſays St. *Auguſtin*, *lib.* 22. *contr. fauſt. c.* 27. *is a divine order, or God's will, commanding to preſerve the natural order, and forbidding to diſturb it.* The ſame father explains, *lib.* 1. *de ordi. c.* 10. what the natural order is. *It is an order*, ſays he, *by which every thing is done that*

that God has established: therefore the eternal law is an immutable order. To which is agreeable, all that's done right; and all that's done wrong, disagreeable. Whence the same St. *Augustine*, *lib* 1. *de lib. arbit. c* 6. *To explain to you*, says he, *as much as I am capable, and as concisely as possible, what that notion is of the eternal law, which is imprinted within us, it is that whereby it is just that all things should be in order.* Then lower, expounding in the same book, *c.* 15. which is the first precept of that same law, he says, that *the eternal law commands, to turn our heart from things temporal towards the eternal.* Neither does he believe that men can otherwise sin, than by turning themselves from God towards the creatures, either to fix their affections on them, or to enjoy them: for though we are to make use of things created, we are never to enjoy them. Neither are we to make use of them, but inasmuch as they are conducive towards obtaining the fruition of the sovereign good. *The good*, says the same doctor, *lib.* 15. *de civit. Dei, c.* 7. *num.* 1 *make use of the world to attain to the fruition of God; and the bad, on the contrary, want to make use of God to enjoy the world.*

The *natural law*, which is also called *right reason, natural light*, and *natural order*, is that same eternal law, or a certain participation of the eternal law in a rational creature, whereby she is rendered capable to make the difference betwixt good and evil. According to *Aquinas* 1, 2 *quæst.* 91, *art.* 2. where he quotes the words of the royal prophet, *Psal.* iv. 6. *Offer the sacrifices of righteousness; and put your trust in the Lord.* And if any body was asking which are the deeds of justice, the same royal prophet adds, *There be many that say, who will shew us any good?* Answering that question, he says, *Thou hast made the light of thy countenance to shine upon us*; i. e. the light of a natural reason, whereby we make the difference between *good* and *bad:* which natural law is within us naturally. According to *Cicero*, *lib.* 1. *de legib. Lex est ratio summa insita in naturâ, quâ jubet ea quæ facienda sunt, prohibetque contraria: eadem ratio cum est in hominis mente, confirmata & confecta lex est*

The first principles of that *natural law* consist in the love of God above all things; and of our neighbours, for the sake of God.

First, We should love God with all the faculties of our soul, and above all things; and return him perpetual thanks for the daily favours we receive from him. Therefore the apostle, *Rom.* i. 20. declares *inexcusable those who when they knew God, they glorify'd him not as God, neither were thankful; but became vain in their imaginations, and their foolish heart was darkened.*

Secondly, If we love God as we ought; because *order* requires it, from which the *natural reason* cannot deviate without sin; we must also *love other men*, created by the same being, for his sake; and give to every one of them his own. Therefore, says St. *Peter*, 1 *Epist.* ii. 13. *Submit yourselves to every ordinance of man for the Lord's sake: whether it be to the king, as supreme; or unto governors, as unto them that are sent by him for the punishment of evil doers, and for the praise of them that do well*; and all other men, either our equals or inferiors, we must love as our brethren; not only by doing them no harm, but rather by rendering them all the good offices we can. Therefore we'll bare no false witness, we'll commit no theft, no murder, &c. because those things are contrary to *order*, and consequently to the love of God and our neighbours.

Therefore all the moral duties of men, are contained in these two precepts, or are deduced from them. As *Christ* himself witnesses it, *Matt.* xxii. 37. and following; where a physician and a doctor of the law asking him, which was the greatest commandment in the law, he answers thus: *Thou shalt love the Lord thy God with all thy heart, and with all thy soul, and with all thy mind. And the second is like unto it; thou shalt love thy neighbour as thyself. On these two commandments, hang all the law and the prophets.* Therefore the first precepts of the natural law consist in the love of God above all things, and of our neighbour for the sake of God.

To understand better what has been said, and what is to be said, we must propose in this place some definitions relating to the love of God and of our neighbour.

1 LOVE, is a propensity of our will towards the object which delights us; and that propensity is so great or so strong towards the sovereign good, or our felicity, that we cannot resist it. We are never otherwise induced to love, but by the appearance of the good, or of the delectable, and often of both; without which there could be no love excited within us. For if we pursue riches, honours, and pleasures, it is because we discover some thing in them which flatters our nature. If we love our parents, friends, and relations, we are attracted to it by an inward sense of pleasure, which can be better felt than explained. Therefore in all kinds of love, there is always something agreeable to our nature, which affects us.

If love be considered with regard to its object, it is of two kinds; for, one is the love of God, and the other is the love of creatures; *viz.* either of us, of other men, or of other things, as riches, honours, pleasures, &c. Again, if it be considered with regard to the manner we incline towards the thing we love, one is called *love of desire*, whereby we pine after an absent object; and the other *love of fruition*, whereby we cleave to the object we possess, &c. but we must remember,

ber, all kinds of love for the created things ought to be referred to God, as to the origin or ſource of all ſorts of goods; ſo that God muſt be beloved above all things, and the creatures for his ſake.

2. To love God above all things, is to prefer him to all created beings, or to incline towards him as the ſovereign good, with all the faculties of our ſoul; and to love all other things for his ſake, and as it is agreeable to order.

3. Our love for God, ought to be alone, and properly a *love of complaiſance*, or a love whereby we are pleaſed, or delighted in God as in our ſovereign good. And as that love has no other object but God himſelf, and is diveſted of all human views or conſiderations, it muſt be called *gratuity*, not *mercenary*, which, ſay the antient fathers, *it is required of you that you ſhould ſerve him gratis; not becauſe he gives the temporal things; but becauſe he warrants the eternal.* St. *Auguſtine*, in *Pſalm* xliii. 16, 17. and on *Pſalm* liii. 6. ſays, *God will be ſerved gratis, be loved gratis*, i. e. *of a chaſte love; not be loved becauſe he gives ſomething beſides himſelf, but becauſe he gives himſelf.*

4. The love of our neighbour, is a *love of benevolence*; whereby we wiſh him all the good we deſire for ourſelves. When this love has for its object our parents, or our country, it is called piety; if there is a reciprocal love between us and our neighbour, it is called a love of friendſhip, or it is a true amity.

Hence every perſon, that cannot plead invincible ignorance, may eaſily infer, that he ought not to do to his neighbour, what he would not have done to himſelf; whence it follows, that he is not to rob, nor to kill, *&c.*

The precepts of the *natural right*, are alſo immutable, and no body can be excuſed from obſerving them.

The moral good and evil, or the honeſt and diſhoneſt, are diſtinguiſhed not only by men, but by nature itſelf; becauſe the honeſt is conformable to the good order eſtabliſhed among us by our divine Creator, and the diſhoneſt contrary to it. *Cicero* has confirmed this truth, by ſeveral very ſolid and perſuaſive arguments. *Lib.* 1. *de leg. Nothing certainly is more charming*, ſays he, *than to underſtand clearly, that we are all born to juſtice, not only in man's opinion, but of a natural right.* And a little lower, *Where is the nation that does not love a complaiſant and grateful ſpirit? And where is that people which does not deſpiſe and hate the proud, the vindictive, the cruel, and the ungrateful? Whence it follows, that we are all naturally born juſt, for a mutual communication with one another.*

From this I'll paſs to *Conſcience*, which ſome confound promiſcuouſly with *Syntereſis*; though *Aquinas* diſtinguiſhes the one from the other, and ſays, that *conſcience* is properly the act whereby we apply our knowledge to our actions; and *ſyntereſis*, an habit, which inclines us to give our aſſent to the firſt moral and practical principles. Whence in that ſenſe the habitual knowledge of the firſt moral principles, or intelligence, is *ſynterefis*; and their applications, which is like the concluſion of a practical ſyllogiſm, is *conſcience*; thereby every one knows actually, not only that he exiſts and underſtands, but likewiſe when he acts, or has acted right or wrong; therefore our conſcience approves or reproves all our actions; and though it ſeems to be in ſome meaſure, aſleep, in the obdurate and impious; it, notwithſtanding, never is entirely extinguiſhed, not even in the damned ſouls, according to this paſſage of *Iſaiah* lxvi. 24. *For their worm* (*i. e.* the remorſe of their conſcience) *ſhall not die.*

Therefore *Cicero* ſpeaks thus of the conſcience, *lib. de ſenect. The conſcience of a good life, and the remembrance of a great number of good deeds, is agreeable.*

Thoſe who treat of manners, diſtinguiſh different ſtates of the conſcience. For the conſcience is either true and certain, or probable, or dubious, or erroneous, or falſe.

The *conſcience* is ſaid to be true and certain, when we underſtand clearly and diſtinctly, what is commanded or forbidden; and therefore what we muſt do or omit, *v. g.* every body knows, that we are not to do to others what we would not have done to us: becauſe that law is engraven on our mind.

A *probable conſcience* is that founded on probable arguments. So that if the arguments on both ſides be of an equal ſtrength, the conſcience becomes dubious. Whence a *conſcience* is called dubious, whereby the mind remains uncertain of what it ought to do; and has not a plain ſecurity. There is a great affinity between this and a ſcrupulous conſcience; which though ſhe walks upright, is nevertheleſs retarded, by ſome ſcruple or other.

Scruple, is properly a ſmall ſharp ſtone, which hurts the foot, and hindereth from walking with eaſe. But metaphorically, it is the anxiety of the mind, proceeding from a true and juſt reaſon, or from a vain and ridiculous one. Whence *Cicero*, *orat. pro Sexto*, ſpeaks thus of *Cornelius Chryſogonus: He deſires you would be pleaſed to eradicate from his mind that ſcruple which night and day teazes and pricks him.*

An *erroneous*, or *falſe conſcience*, is that which dictates what is forbidden by the law, or forbids what the law commands.

What is done againſt our conſcience, is always morally bad; and what is done according to the dictates of our conſcience, is not always good.

All

All that is acted againſt the dictates of our conſcience is bad, becauſe it always includes a perverſity of mind, and an inclination to ſin; and he that acts thus, knows that he acts ill.

Likewiſe all that is done according to the dictates of our conſcience, is not always good; becauſe it may be done againſt the order and the law, as it happens when the conſcience errs. As that of thoſe mentioned by Chriſt, to his apoſtles, *John* xvi. 2. *Yea the time comes, that whoſoever kills you, will think that he does God ſervice.*

Therefore the conſcience, generally ſpeaking, cannot be conſidered as a very ſecure rule of our action; but only when it is true and certain, or when it is agreeable to good order and the law; all that is agreeable to it being good, and all that is repugnant to it being bad.

A *conſcience* which errs, excuſes from ſin, when the error proceeds from that ignorance which renders an action unvoluntary; but if it does not proceed from ſuch an ignorance, it cannot excuſe from ſin.

A *probable conſcience*, ſeems ſecure in the practice; as far as the arguments whereby it is ſupported are ſolid, and morally certain, and are not in concurrence with a contrary authority, or reaſon of an equal force.

When the *conſcience* is dubious, we muſt make uſe of the rule preſcribed by St *Paul*, *Epiſt.* 1. *Theſſal.* v. 21. *Prove all things, hold faſt that which is good.* And conſequently if the reaſons are of an equal force on both ſides, we muſt either abſtain from acting, if poſſible, or incline on that ſide, which is more agreeable to the good order, and favours leſs our cupidity: for though that ſide ſhould not appear, perhaps, the more probable, or ſupported with the ſtrongeſt reaſons; it is, notwithſtanding, the moſt ſecure, and fartheſt from danger.

If we follow that rule of St. *Paul*, it will be difficult to determine, if we can, with a ſafe conſcience follow the doctrine of *probability*, in our conduct. That doctrine conſiſts in this, that a probable opinion, provided it be probable, though in concurrence with one more probable and ſincere, can be propoſed a falſe rule of our actions or conduct. Whence it follows,

1. That any probable opinion, can be preferred to one more probable.

2. That when a divine is conſulted, he can anſwer according to a leſs probable opinion, tho' in concurrence with one more probable; and even againſt his own ſentiment, give advice according to the opinion of another, tho' leſs probable; becauſe that opinion leſs probable, is notwithſtanding probable; and conſequently according to that doctrine, very ſecure.

They diſtinguiſh two ſorts of *probability*, *viz.* an *intrinſic probability*, and an *extrinſic probability*. They call *intrinſic probability*, that taken from a probable argument, whereby the mind is inwardly affected. And *extrinſic probability*, that which is ſupported by the ſentiment and authority of ſome eminent divines. Thus talk the Schoolmen: But,

For my part I am of opinion, that this doctrine of *probability* is to be baniſhed from among us, as very prejudicial to the good order of a civil ſociety; and for other reaſons.

The next thing we are to do, is to enquire if the affections of the ſoul are ſubject to the precepts of a moral diſcipline, and what is their uſe.

The Schools diſtinguiſh two ſorts of principles of the human acts, *viz.* thoſe which are *born with us*, and thoſe which are *acquired*: thoſe have been granted to us by nature. *viz.* underſtanding and will; and theſe are acquired by application, and repeated acts. Theſe are good and ill habits, or *virtues* and *vices*: of which I'll treat in this place, as well in general, as in particular; and firſt we muſt know what's *virtue* and what's *vice*.

Three things are to be conſidered in the ſoul, ſays *Ariſtotle*, *lib.* 2. *ethic. c.* 4. *viz.* its thoughts and motions, as, perception, love, &c. afterwards the faculties or natural powers neceſſary to act or ſuffer, as, the *underſtanding* and *will*. Laſtly, the *habits*, either good or bad: that's to ſay, which incline us either to good or evil. The good habits are called virtues, and the bad vices.

I'll ſpeak firſt of the virtues infuſed, which are thoſe infuſed into us by the Almighty without our concurrence; ſuch are the virtues called theological, *viz. faith*, *hope*, and *charity*. To theſe are joined, by a certain tye of affinity, the habitual and ſanctifying grace, the gift of perſeverance, or the grace of perſevering in the practice of virtues, to the latter end of one's life, the gifts of the Holy Ghoſt, &c.

FAITH is a theological virtue, divinely infuſed, whereby a created ſoul conſents or agrees, that all that God has revealed is true, though it be far above our apprehenſion or underſtanding. Whence the *material object of faith* is God; and the formal one, or the manner, wherewith God is conſidered by *faith*, is commonly expreſſed in theſe words, *inaſmuch as God is the firſt truth*; that is to ſay, as he cannot deceive or be deceived, and conſequently he deſerves the conſent of our will, and the ſubjection of our underſtanding, in all thoſe things he propoſes for objects of our faith; whence it appears, that our natural knowledge of God, and even of our own mind, precedes faith: for if we were not to know that God is ſovereignly true, and ſovereignly potent, and that our mind is much limited in its conceptions, we could not eaſily ſubject ourſelves to the myſteries of faith.

HOPE,

Hope, is a theological virtue, which regards the sovereign good, as absent; and with a certain confidence, that it is sometimes to be obtained or possessed. Or, it is a virtue divinely infused, whereby we expect, with a certain confidence, our salvation, or eternal felicity; its *material object*, is also God; and its formal object, is expressed in these terms, inasmuch as God is to be obtained or possessed in time to come: therefore *hope* includes the desire of an absent good; and without that desire there would be no hope.

Charity, is a theological virtue, whereby God is beloved above all things; and for himself, or for his supreme goodness; and all the other things for God. For this is the order of love, that the supreme good should be beloved for himself, and all other things for him. And as that order, when it invites us by its beauty, is nothing else but God himself: Charity is nothing else, likewise, but a supernatural love of the order, whereby God is beloved for himself, because he is sovereignly good, and all other things for him.

The natural and acquired virtues, are those acquired by repeated acts, and these are called either intellectual, or moral.

Those are called intellectual virtues, which promote the knowledge of the mind; and which, consequently, have a greater relation to the understanding; since knowledge, or perception, is the office of the understanding.

Aristotle, *lib.* 6. *Ethic. c.* 2. reckons five of these habitual virtues, *viz. understanding*, *wisdom*, *science*, *prudence*, and *art*.

Several, after *Aristotle*, define Wisdom, *a certain sublime science*, or *a knowledge of sublime things*.

Understanding is *the knowledge of the first principles, or most common actions*, which is not so much a new habit of the mind, as it is the mind itself, naturally considered. For the mind, by the sole dictates of nature, perceives and embraces the common notions, or actions; such as these, *it is impossible to be, and not to be, at one and the same time*. The *whole is greater than a part thereof*, &c.

The name of *wisdom*, is to be taken in two manners, *viz.* either for a collection of all sorts of sciences, or for the knowledge of all things, as well universal as sublime.

Science, is commonly defined, *a true, certain, and evident knowledge of every thing necessary, and immutable, for the true and proper causes for which it is such; or for which it is constantly affirmed or denied that it is such.*

It is first said a *knowledge*, or *cognition*, not actual as they speak, but habitual, *i. e.* the facility of knowing, not the act or motion of him that knows. For the science of a thing remains even in a person while asleep, and not at all thinking of that thing; provided he has before rendered himself perfect in that knowledge, by his assiduous application and study; that he may understand it when he reflects on it.

Secondly, It is a true knowledge, not of all things indifferently, but of a necessary thing, or of a thing which cannot be otherwise. Thus he who knows that the eclipse of the moon, happens from the interposition of the earth between the sun and the moon, knows a thing which cannot be otherwise; for it is impossible that the moon should not suffer an eclipse, by the interposition of so opake a body as is the earth, between her and the sun, from which she borrows her whole light. In which, *science* is distinguished from *prudence* and art, which are employed about things contingent, as well as about those which are necessary.

Science, is, besides, a *cognition or knowledge of a thing by its causes, or the reason why that thing is; or else, for which it is affirmed or denied to be so.* Whereby it is evident, that science is not a bare perception of a thing, or to speak the language of the schools, an apprehension, without affirmation or negation; but a knowledge acquired by ratiocination, and consequently joined with the judgment, or also a collection of several perceptions and judgments. However, *science*, besides the perception of the understanding, which is passive, includes the assent of the will, or the judgment which is active. For we do not only conceive a thing by means of the *sciences*, but affirm, besides, that what we conceive, is such as we conceive it.

Science is also a sure *knowledge*, i. e. firm, permanent, and supported by certain immutable arguments; to distinguish from opinion, which is uncertain.

Lastly, it is an evident knowledge, *i. e.* manifest and perspicuous, or established on clear and evident principles, to distinguish it from *faith*; which is true and certain, but dark. Thus it is true and certain that in the blessed Trinity there is one nature and three persons, but that is obscure, and known by the sole authority of God, who has revealed it, and not by an evident reason.

Prudence, as well as wisdom, is taken in two senses, *viz.* either for *science*, or general knowledge of things, which pertains to life and manners, and this is called a *general prudence*; or for the practical and efficacious knowledge of those things, which on all occasions are to be acted by an honest man, and is called *particular prudence*, or *cardinal virtue*: of which I will speak by and by.

Lastly,

Laftly, *art*, is the *practical knowledge of things which can be accomplifhed by induftry*; which confifts of two parts, the firft and fuperior part of *art*, is the knowledge of the mind; if it be either intelligence only, or *fcience:* the fecond and inferior, is the execution, or work of the artift. Though *Ariftotle, lib.* 6. *Ethic. c.* 4. makes a difference between what is called *effection*, and action, or practice; that *practice is a moral action, in which the intention of the perfon that acts, is confidered comparatively to a moral honefty*; and *effection* is any *operation*, in which the induftry or fkill of *the perfon, who acts, is confidered.* In which fenfe the *effection* is good, while the *action* is bad, as when a perfon robs another of his purfe with great dexterity; and the *action* good, while the *effection* is bad, as it happens in a mother, who to fave her fon from an imminent danger, fuffocates him.

Moral virtues are thofe, which incline our will to a moral good, which the infufed virtues do, as well as the moral ones. Therefore, *virtue*, generally fpeaking, is very well defined by St. *Auguftin, lib. octogint. quæft.* 31. *An habit of the mind, agreeable to nature and reafon*, i. e. inclining to act, what is placed in fo juft a mediocrity, that it neither exceeds the juft limits of reafon and order, nor falls fhort from it.

A *virtue*, or good habit of what kind foever, confifts of two parts, one *fuperior*, which commands and governs, and the other *inferior*, which ferves and obeys.

The fuperior part of *virtue* is that *affection or difpofition of the mind*, which follows every where an honeft temperament, with regard to the perfon that acts, the place, the time, and all the circumftances. For the fame things do not become every one, nor the fame things become the fame perfon at all times.

The inferior part of *virtue* is the facility of acting, which is placed entirely in the impreffions received in the brain, in the determination of the animal fpirits, and in the other difpofitions of the body, and confequently is corporeal.

This inferior part may be confidered, as the *body* of virtue, fince it is this part that operates, or acts, *v. g.* he that has the *virtue of temperance*, this through an inclination to order, moderates the fenfuality of the *tafte* and *touch*; and has acquired to him by a long ufe and often repeated acts, the facility of refraining his appetite. And that facility, which has its feat in the body, is rather an act of virtue, than virtue itfelf. Becaufe without the leaft inclination for a good order, any body may acquire the facility of practifing fome acts of temperance, *viz.* when he refrains his appetite through infirmity, or to avoid ficknefs, or for any other caufe: and likewife, he can have the virtue of temperance, or a conftant love for order in the object of temperance, though he cannot very well practife the acts of temperance.

The next thing, which falls under our confideration, is *the divifion of the moral virtues.*

If *virtue* can be confidered as nothing elfe, but *an habitual love of order*, or *a firm and conftant love of an honeft mediocrity, governed, or directed in any fubject, by right reafon*: there is certainly a general virtue, which for the different reafons, or manners, by which order is preferved in different material objects, can be divided into different kinds; and is in fact, divided into *cardinal virtues*, i. e. thofe, which ought to give motion to, or influence all the actions of our life; and in *adjunct*, or *concomitant*, which flow from the *cardinals*, and are referred to them.

We commonly reckon four *cardinal virtues*, viz. prudence, juftice, fortitude, and temperance. This number is afferted by the authority of feveral living writers: and firft, *Wifd.* viii. 7 *For the wife teacheth fobriety*, i. e. *temperance and prudence, juftice and virtue*, i. e. *fortitude*; *nothing in life being more ufeful to mankind.*

Cicero enumerated thofe four virtues, *lib.* 1. *de officiis.* *All that is honeft*, fays he, *proceeds from fome of thefe four parts; for it is either employed in the confideration of the truth, or in fecuring the good order in a civil fociety, by promoting and countenancing the diftributive juftice, and encouraging probity; or in fupporting magnanimity and courage; or preferving a good order, or a juft fubordination, in which confifts modefty and temperance.*

Thofe virtues, either *cardinal* or *adjunct*, are fo well united together, that none of them can be obtained in a perfect ftate, without the others: For a perfect virtue being a *firm and conftant love of order*, that love includes all virtues, or rather is but one and the fame virtue, which to be perfect, requires a perfect will to purfue what is right and juft in every fubject: For, that man, *v. g.* is not perfectly juft, who wants fortitude, or temperance, or liberality, *i. e.* if he wants the love of order, of the fubject of temperance, or of liberality, or of fortitude; an intemperate judge, for example, can be tempted by pleafure, an avaricious one corrupted by money, and a pufillanimous one frighted by menaces. Likewife, no body can obtain temperance in a perfect ftate, without prudence, and the other virtues.

Therefore one virtue cannot be perfect in a fubject, but in fociety with all the others. I fay that it cannot be perfect without the others, for it can be imperfect without them; fince we commonly diftinguifh after *Ariftotle, lib.* 7. *Ethic. c.* 1. three different

different states of *virtue*, viz. the *imperfect state*, called the *state of continence*; the *middle state*, called the *state of temperance*; and lastly, the *perfect state*, called the *heroical*.

The *imperfect state of virtue* is that, in which one is agitated by the motions of his affections, to which he resists, though with a certain reluctancy; and this state is that of the *beginners*, who are not yet confirmed in virtue. To which state is opposed that of *infirmity*, or *incontinence*, in which he is not yet abandoned to vice, and entirely reprobate, but is conquered by *concupiscence*, though he faintly resists it.

The *middle state of virtue* is that, in which one is so confirmed in *goodness*, that though he be tempted by his *concupiscence*, he notwithstanding resists to it the easier; because he has made a long practice of that resistance; and this is the state of those, who make a progress in virtue. To which is opposed the state of *perversity*, or *malice*, in which he is so used to vice, that he seldom resists it.

Lastly, the *state of perfection of virtue*, or the *heroical*, is that whereby the affections are so well conquered, that they cannot make the least impression on *virtue*; which state is that of the *perfect*. To which is opposed the state of *brutality*, whereby one is brought so much beneath the common condition, even of the weakest, that he in some measure degenerates to that of the *brutes*; which state is commonly called the state of *obduratenefs*, of *blindness*, and of *Pharaoh*. In both states, *viz.* the middle state, and the perfect, but more particularly in the perfect, or heroical, all the other virtues, either cardinal or concomitant, are united together; but not in the imperfect state.

I must at present, speak of each *moral virtue* in particular, their potential and integrant parts.

I will begin by *prudence*, which is *an habit acting in concert with right reason, in those things which are either good or bad, with respect to man*, i. e. an habit whereby we know, not only what must be done or avoided, but likewise, whereby we love to act, and act what is to be acted, and abstain from what is to be avoided, because order requires it.

In the same sense, *prudence* is defined by *Cicero*, *lib.* 2. *de invent. The science of good and bad things, and of both.* And by St. *Augustin. lib.* 1. *de liber. arbi . c.* 13. *the science of things to be desired, and to be avoided.*

We commonly reckon after *Aristotle*, three potential parts, or three offices of prudence, *viz.* to *consult well*, to *judge right*, and to *reduce into practice*, what has been judged or decreed.

Thomas Aquinas, 2 *quæst.* 48. mentions eight integrant parts of prudence, and has taken them in part from *Aristotle*, *lib.* 6. *ethic. c.* 10, 11, and 12. in part from *Tully*, *lib* 2. *de invent.* in part from *Macrobius*, *lib.* 1. *in somn. Scipion. c.* 8. or also from St. *Augustin*, *lib.* 83. *quæst.* 31. where he has transcribed *Cicero* word for word. And those integrant parts are these, *memory*, *intelligence*, *foresight*, *reason*, *docility*, *dexterity* (to which must be added *sagacity*) *circumspection*, and *caution*.

Therefore, to render the *prudence perfect*, is necessary, 1. *Memory*, i. e. the remembrance of things past. 2. *Intelligence*, i. e. the knowledge of things present. 3. *Foresight*, i. e. the presence of things to come. 4. *Reason*, i. e. the facility of collecting what is to be done from the things past, present, and to come. 5. *Docility*, or a good disposition of mind to take and follow the advice and counsels of others. 6. *Sagacity* and *dexterity*, i. e. an easy apprehension, and application of the means conducive to the end; for *sagacity* finds and *dexterity* executes happily. 7. *Circumspection*, or a serious consideration of all the circumstances. 8. *Caution*, or care, or solicitude, to avoid all that could be an obstacle to the undertaking.

The *species* or kinds of *prudence*, are the *prudence* wherewith we govern ourselves, and the *prudence* wherewith we govern others. And this last sort of *prudence* is again divided into other kinds; for it is either *œconomical*, whereby a family is governed; or political, whereby a city or republic is governed: but these *species* do not differ among themselves, with regard to their principles, *viz.* to a mind loving order; but only with regard to the object it considers; and then they differ only with regard to the material object, *viz.* with regard to what is acted in a family, or a city; but not with regard to the formal objects.

The *vices*, opposite to *prudence*, wound it either through excess or defect.

The *vices* which affect *prudence* through excess, are, 1. The *prudence of the flesh*; which is employed in gratifying our sensual appetites. 2. *A too great solicitude for temporal goods*; which proceeds either from an immoderate desire of possessing them, or from an excessive fear of losing them. 3. *Fraud*, or *finesse*, or *deceit*; which is concerting dangerous measures to deceive others. When *deceit* consists only in words, it is called *finesse*; and *fraud*, when it proceeds to facts: though oftner *deceit and fraud* are indifferently taken for one and the same thing.

The *vices* opposite to *prudence*, proceed very often from ignorance; and therefore may be generally styled *want of prudence:* of this there are several kinds, viz. *precipitation*, *inconsideration*, *inconstancy*, and *negligence*.

Precipitation is a vice whereby any one undertakes ſomething without a mature deliberation, and this oppoſite to conſultation.

Inconſideration is a vice, whereby a judgment is given, or pronounced without the leaſt attention to the means; and this oppoſite to a good underſtanding or intelligence.

Inconſtancy is changing one's opinion, on any ſlight or frivolous account.

Negligence is a want of diligence, or care in the execution of our affairs.

The term JUSTICE is often taken in a wide ſenſe, *viz.* for ſanctity, or the aſſemblage of all ſorts of virtues: thus it is uſed in the ſacred ſcriptures, *Matth.* i. 19. *Joſeph* is called *juſt*, i. e. eminent for ſanctity.

The firſt kind of juſtice is commonly called *general juſtice*, or *legal juſtice*; which contains all the law, and all the other virtues: but there is another ſort of juſtice, called *particular* or *ſpecial*, the ſecond among the cardinal virtues; and properly called *diſtributive* juſtice, whereby we give every one his own. This *juſtice* is defined by the emperor *Juſtinian*, a conſtant and perpetual will, to give every one his due, or right.

Right is all that is juſt and equitable; or what is a medium between two vicious extreams: therefore, thoſe who contend or diſpute for ſomething, have recourſe to a judge, as to a diviſor or partitioner, who divides between them what they contend for, according to the rules of equity, and declares what part belongs to every one.

The *ſpecial juſtice*, which is the ſecond among the cardinal virtues, is divided into *commutative*, and *diſtributive*, as into ſpecies.

The *commutative juſtice* is that which keeps or maintains an equality, in commutations of goods, in contracts and covenants.

The *diſtributive juſtice* is that which diſtributes rewards, or recompence, according to the merit and condition of perſons; and when it inflicts any puniſhment, according to the atrocity of the crime, it is called *vindictive*.

Both eſtabliſh a certain equality: but in the *diſtributive juſtice*, is obſerved a *geometrical proportion*; and in the *commutative*, an *arithmetical one*. For when the *diſtributive juſtice* is employed in diſtributing recompences, or inflicting puniſhments, it has not only regard to the merit, recompence, or to the pain, but likewiſe compares the perſons; for there is to be the ſame difference between the pains, or the rewards, as there is between the perſons, or the merits or deſerts; and therefore as much as a captain ſurpaſſes a private ſoldier in rank or dignity, ſo much greater muſt be his recompence, when they have both equally done a brave action.

But the *commutative juſtice* wants a perfect equality, and has no regard to perſons or to any other circumſtances. So that as much as the thing deducted in the commutation, or in the contract, is worth; as much muſt be worth the price given for that thing, without the leaſt regard to the perſons who change, or to the manner they change in; or, which is the ſame, as much one thing exceeds the other, as much muſt the price of that one thing ſurpaſs the price of the other.

There are two integrant parts of *juſtice*, viz. to *abſtain from evil*, and *to do good*; becauſe thoſe parts are requiſite for a perfect act of *juſtice*.

There are eight potential parts of *juſtice*, whereby it performs its operations, as if they were ſo many faculties or organs, *viz. religion*, *piety*, *reſpect*, *truth*, *gratitude*, *correction*, *liberality*, and *amity*, to which they add *affability*. See *Cicero*, *de inventione*.

Religion is that moral virtue, which renders to God the worſhip due to him, in confeſſing his ſupreme power and excellence. That worſhip, is rendered to God, either inwardly, *i. e.* by *devotion* and *meditation*, or outwardly, by adoration, vows, &c.

Piety, according to *Cicero*, is a virtue, whereby we acquit ourſelves of our duties to our prince, to our country, to our parents, and to all our other relations. *Piety* is alſo taken among chriſtians for devotion.

Reſpect is that part of *juſtice*, whereby men reſpect and reverence thoſe, who are above them, either by their age, wiſdom, honour, or dignity.

Truth, or as ſome others call it *veracity*, is a moral virtue, whereby we take care that nothing ſhould be ſaid but what really is, has been, or is to be.

Gratitude is that which contains the remembrance of paſt ſervice, or kindneſſes, and the will of rewarding them.

Correction, according to *Tully*, is a virtue whereby we repel the violence and affronts offered to us, to ours, and all thoſe, who are dear to us, and whereby we puniſh crimes. But it is not licit, but to thoſe only, who are placed above the reſt, to correct the delinquents, or at leaſt reprimand them, to procure, or maintain the public tranquility, and to countenance *juſtice*.

Liberality is defined by *Ariſtotle*, *lib.* 4 *ethic c.* 1. a virtue, which keeps a medium between given and receiving money. It is ſaid to differ from *beneficence*, in that *beneficence* conſiſts in the diſtribution of all ſorts of goods; and *liberality*, only in that of money.

Affability is a virtue, whereby we ſtudy to behave ourſelves in a civil ſociety, with that freedom and complaiſance, which become us; to which are oppoſed, *inſolence*, *haughtineſs*, and *moroſity*.

Ariſtotle defines *amity*, *lib.* 8. *ethic. c.* 2 an open mutual benevolence, founded on ſome good, either profitable, agreeable, or honeſt; but that only which is founded on the honeſt good, deſerves that appellation; becauſe it is a part of juſtice whereby we return love for love.

The vice generally oppoſed to juſtice, is *injuſtice*, and which can offend juſtice in different manners, *viz.* either through *exceſs* or *defect*, though in both it retains the name of *injuſtice*.

Therefore, 1. The *diſtributive juſtice*, can be offended through defect, either in the diſtribution of recompences, or of pains; for if a prince grants more honour, more glory, and greater recompences to a perſon than he really deſerves, he ſins, thro' exceſs; if leſs, through defect. Likewiſe, when greater puniſhments are inflicted on the guilty, than their crime deſerves, the exceſs is in the matter of the *vindictive juſtice*, and is called cruelty: if the puniſhment is much more leſs than the crime, it is a *defect*, or a *too great indulgency*.

2. *Exceſs* and *Defect*, have place in the matter of *commutative juſtice*, v. g. when ſomething is ſold or bought too dear, or when in commutation of goods, ſomething is given or received beſides the principal, juſtice is offended through *exceſs*; if leſs is paid than received, then we deviate from juſtice, through *defect*. Whence juſtice can be offended not only through *defect*, but likewiſe through *exceſs*, with regard to its matter, or as they call it, its material object.

Fortitude is defined by *Ariſtotle*, *lib.* 3 *ethic c.* 9. *A mediocrity or medium, between temerity and fear.* It can alſo be defined, *A virtue between temerity and fear, in the dangers our reaſon commands us to encounter, or in ſupporting with conſtancy, the adverſities.* Therefore, the material ſubject of *fortitude* are the perils we are to encounter, when our reaſon requires it, *v. g.* in a juſt war, undertaken in the defence of religion, of our prince, or of our country: or the adverſities, which are either to be repelled where they aſſail, or ſupported with conſtancy.

Therefore, there are two oppoſite acts in *fortitude*. *viz.* to *encounter*, or admit the peril when it is proper, and *ſupport*, or ſuffer with an heroical conſtancy, the greateſt adverſities; both acts muſt be entirely directed by right reaſon, or the love of order. For we are not to attempt any thing with a too great temerity, nor fear it without reaſon. But a brave man muſt be always in a certain medium between temerity and fear.

Aquinas, 2. 2. *queſt.* 128. *art.* 1. reckons four integrant parts of *fortitude*, which can be called potential, *viz. confidence*, *magnificency*, *patience*, and *perſeverance*. Which *Tully* remembers alſo, *lib.* 2 *de invent.* of theſe, *confidence* and *magnificency*, regard more particularly the *aggreſſion*, and *patience*, and *perſeverance*, the act of ſupporting; though every one of them ſeems to be agreeable to both acts.

Therefore, *confidence* can be defined that part of *fortitude*, whereby the mind imagines, that it can undertake and ſupport the moſt difficult things, where, and when it is proper. But if thoſe thorny and arduous things are not common, and not to be undertaken by ordinary acts, then they become the object of *magnanimity*, which differs both in name and effect from *fortitude*.

Magnificency, according to *Tully*, is the execution of great and pompous things, which if it conſiſts in expences, has a very ſtrict connection with liberality.

Patience, or *conſtancy*, is a virtue whereby our mind is ſuſtained, and ſtrengthened in adverſities.

Perſeverance, is a firm reſolution in what we have once determined, if it be either to attack, defend, or ſupport.

It would be needleſs to rehearſe here, the vices oppoſite to *fortitude*, ſince they are contained in its definition. For temerity is oppoſed to it, through *exceſs*, and fear and cowardice, through *defect*. Thus pride and puſillanimity are oppoſed to magnanimity, ſays *Ariſtotl*, *li*. 4 *ethic. c.* 9. for a man muſt be intrepid, but not mad, as the *Gauls*, who, ſays *Ariſtotle* again, *lib* 3. *ethic. c.* 10. were afraid neither of earthquakes, nor of tempeſts.

I call *temperance*, with *Ariſtotle*, *lib.* 3. *ethic. c.* 13. *a cardinal virtue which moderates the ſenſual appetite, eſpecially in the taſte and touch.*

The ſpecies or kinds of *temperance*, are *abſtinence*, *ſobriety*, *chaſtity*, and *purity*.

Abſtinence is imagined to conſiſt in eating, and ſobriety in drinking: chaſtity is to abſtain from all illicit pleaſures; purity from all impure ſights and touch or feeling: but there are three degrees of chaſtity, *viz.* virginal, conjugal, and of viduity.

Purity is derived from *pudor*, and pudor is a trouble of the mind, occaſioned by any thing which can cauſe ſhame.

There are two integrant parts of *temperance*, viz. *modeſty*, and *honeſty*. *Modeſty* is the flying from all that has the leaſt mark of intemperance, and honeſty is what appears moſt honourable in the acts of temperance. Therefore, *honeſt* and *honourable*, in this place, ſignify the ſame thing; in which ſenſe, *Tully* ſays, *lib.* 1. *de offic* that *what is honourable is honeſt*, and *what is honeſt honourable*.

It is very difficult to tell exactly the number of the *potential parts of temperance*. The firſt is *continence*, which reſiſts the motions of the concupiſcence

scence provoking to intemperance. The second is *humility*, which inclines a man to confess ingenuously his imperfections. The third is *meekness*, which moderates wrath, as clemency does vengeance. The fourth is *modesty*, which keeps in due order the internal and external motions of the mind; and is defined by *Cicero, lib* 2. *de invent. a virtue whereby an honest shame acquires a just and permanent authority.* The fifth is *studiousness*, which confines the desire of knowledge within just limits. The sixth, *urbanity*, which regulates our recreations and diversions. The seventh, *moderation*, which directs us in the care we take of our person.

The *vices* opposite to temperance are either *thro' excess*, or *thro' defect*; but several of them have no name. Therefore, 1. *Intemperance*, whereby one abandons himself beyond measure to the pleasures of the *taste* and *feeling*, is opposed to temperance through excess and through defect; *insensibility*, when the sensual pleasures, ordered even by God himself, for the preservation of human nature, are neglected without reason. 2. *Gluttony*, *drunkenness*, *luxury*, and *impurity*, are opposed through *excess* to *abstinence*, *sobriety*, *chastity*, and *purity*; and through *defect*, the vices which have no name. 3. To *modesty*, and *honesty*, are opposed through *excess immodesty*, *impudence*, and *turpitude*; and through *defect* the vices which have no proper names. 4. *Incontinence* to *continence*. *pride* to *humility*, *wrath* to *meekness*, *curiosity* to *studiousness*, *scurrility* to *urbanity*, and *luxury* to *parsimony*, are repugnant *through excess*. The vices opposed to them, *through defect*, have no name.

From the principle heretofore established, can be deduced certain general rules, whereby all human actions may be directed towards the salutary end proposed to all men.

We will therefore proceed to examine the *duties* of men in general

Those *duties* are either of a man to God, and to himself; or of a man to other men, either with regard to a family, or to a republic. Which different *duties* are all as follow.

It seems that man was formed to God's image, and created for no other reason, and for no other end than to know and love him; and to obtain, through means of a religious worship, the fruition of that divine object, who alone can render him truly happy. Which to facilitate, God himself has infused within him an immortal soul, capable of understanding, of religion, and of an eternal felicity; so that though this visible world were entirely destroyed, that soul will remain, by the condition of its nature, always the same, and uncorruptible; which is more than sufficient to inspire us with the greatest sentiments of gratitude towards that supreme and eternal Being, who has been pleased to distinguish us in so particular and excellent a manner from the rest of his creatures; and to raise our mind from the contemplation of our own excellency, to that of the divine architect, who has made us his master-piece. That contemplation will soon make us understand that we ought to love him, with all the faculties of that soul he has created of so noble and so excellent a nature; and modelize all the actions of our life, according to those salutary rules, which in his great wisdom he has established to render them agreeable to him; and which is not to be considered as a laborious, but rather as an honourable task. For what must we be, whose vows and prayers a supreme and immense Being will have the condescension to hear and excuse? therefore none but those who forget themselves, will also forget so much honour done to them. But however, if we believe the royal prophet *Psalm* xlix. 12. *Nevertheless, man being in honour abides not: he is like the beasts that perish.* Which is the greatest punishment which can be inflicted on those ungrateful men, who are not sensible of the advantages of their condition, to be reduced to that of the brutes, to have no taste but for terrestrial things, to nauseate the celestial, and refuse to be cured of the wound they do not feel.

Therefore we must persuade ourselves, 1. That God is the principal and end of all things: that his power is diffused throughout this vast universe. And his wisdom in the government and disposition of all things, *attains powerfully from end to end, and disposes all things with pleasure*; that all that is done, may be done with a just œconomy and for him, that we all live, move, and rest in him, so that he can never be too much worshipped and beloved by us, and we always love him less than we ought to do.

2. And because the figure of this world passes, and we have but one essential obligation, which is to observe the law of God; we must learn as perfectly as possible, that divine law, make it the subject of our most serious meditations, and not neglect, if possible, even the least article of it.

3 We must not content ourselves with an inward worship, but likewise practise an outward one, consisting in public *vows* and *prayers*, in the company of the faithful, that others may be edified by our example *Coimus in cœtum & congregationem*, says *Tertullian, Apologet. c.* 39. *ut ad Deum quasi manu facta precationibus ambiamus orantes. Hæc vis Deo grata est.*

4. With regard to the *prayer*, whereby we ask something of God, we must seriously consider what and from whom we ask. For we are not to ask of God trifling things, much less those, which are illicit or

unjust;

unjuſt; but aſk only thoſe, which can be acceſſary to our ſalvation, and comfortable to life.

Therefore what it is juſt we ſhould aſk of God, is that which can be advantageous to us and to others, *viz.* a mind ready to execute the divine commandments, and a will inclined to do good to thoſe we live with.

5. We muſt alſo be thankful for all the benefits or favours we have received from him: and the beſt manner to ſhew our gratitude on thoſe occaſions, is to ſhew always the ſame equality of mind, and the ſame tranquility, either in adverſity or proſperity; for God does not love leſs thoſe he is pleaſed to tempt by adverſity, than thoſe he loads with temporal favours.

From the love of God we will paſs to the love of our neighbours: for none is nearer to us than our ſelves.

That a man may love himſelf with that love which is uſeful and juſt, *viz.* with regard to an everlaſting life, *he muſt lay apart all ſuperfluity of malice, and keep himſelf unſpotted from the world*; according to St. *James*, *epiſt.* i. 21, 27. Whence it is neceſſary to take a great care to moderate all the faculties and affections of our ſoul.

And, 1. With regard to our body, it muſt be fed with neceſſary but not ſuperfluous aliments, that we may neither fall under its burthen, nor revolt againſt the ſpirit.

2. We ought not to be idolaters of our body, nor break it by idleneſs; but, on the contrary, ſtrengthen it by exerciſe and labour: for there is nothing more prejudicial to it than to indulge it in luxury and indolence, which not only weakens and corrupts it, but likewiſe proves contagious to the ſoul, and plunges it into all ſorts of irregularities and vices.

Otia ſi tollas, periere Cupidinis arcus,
Contemptæque jacent, & ſine luce faces.

3. We muſt put a guard to our ſenſes; ſince what enters through our ears, or eyes, make often ſo great an impreſſion on our mind, as to excite its affections beyond meaſure, as to be almoſt impoſſible afterwards to conquer them when you pleaſe. Whence *Juvenal*, Satyr 14.

Nil dictu fœdum viſuque hæc limina tangat,
Intra quæ puer eſt.

4. We muſt endeavour to adorn our ſoul with [illegible] knowledge; that with their aſſiſtance it [illegible] facility, govern herſelf, and the [illegible] under her command.

[illegible] to deſcribe every one of the duties [illegible] itſelf, ſince they are different according to the difference of perſons: but however, these general rules may be preſcribed; that there is a certain medium, or ſubordination, to be obſerved, either in the judgment, which every body forms of himſelf; or in his external geſtures or motions; or in his outward apparel; or in his table and equipage. For as *Juvenal* ſays, *Satyr.* 11.

Noſcenda eſt menſura ſui, ſpectandaque rebus
In ſummis minimiſque: etiam cum piſcis emetur,
Ne multum cupias, cum ſit tibi gobio tantum
In loculis.

Therefore we are not to live either with more ſplendour, or with a greater parſimony; but every one muſt have regard to his birth, fortune, and faculties; that there may be a certain ſubordination, in the houſes, equipage, and cloaths.

Auream quiſquis mediocritatem
Diligit, tutus caret obſoleti
Sordibus tecti, caret invidendâ?
Sobrius aula?

Neither are we to envy thoſe who live in a more elegant manner than we do, for every condition has both its advantage and difficulties. Whence the apoſtle St. *Paul* wiſely admoniſhes us, 1 *Cor.* vii. 20. that *every man muſt abide in the ſame calling wherein he was called*; without envying that of another.

Therefore they act with prudence, who ſtudy carefully all that belong to their vocation, follow it, and remain in it. But that kind of life, to love, what becomes us moſt, is the work of heaven, and not a human one. And the difficulty is ſtill greater, when we have made choice of a ſtate of life, when we were too young, yet, to make that choice: Therefore, in an affair of that importance, we are firſt to implore heaven's aſſiſtance, that we may chuſe what is more convenient to us, and more agreeable to God: and afterwards conſult our friends, not every one, but thoſe only we know to have a greater ſhare of judgment, prudence, and diſcretion, and a real friendſhip for us.

This leads us inſenſibly to the conſideration of a *man's duty towards his family*, which *Ariſtotle* has deſcribed in two books, and which is called *Oeconomical Doctrine*, (to which I refer the reader). The firſt conſiſts of ſix chapters, where he ſhews the difference between the *œconomic* and *politic*; and treats of the different parts of a houſe, of the manner of acquiring wealth, of the conjugal duties of huſband and wife, maſters and ſervants: the laſt, which is not divided into chapters, is almoſt entirely hiſtorical, where he deſcribes ſeveral forms of the *œconomic*. He has alſo inſerted in his firſt book of *politics*, ſeveral things relating to the ſame ſubject;

ject; all which are so fully explained in WOOLLASTON's *Nature delineated*; bishop WILKIN's *Religion of Nature*; and, under the *Relative duties*, in the NEW *Whole Duty of Man*, which are in the hands of most readers, that makes it needless to take up your time in repetition of those duties in this place.

FALCONRY.

FALCONRY is the art of taming, managing, feeding, &c. the *falcon*, or other kinds of *hawks* and employing them in the pursuit of taking of birds or game. This by others is called *Hawking*, much used by our anceestors.

The birds employed in this sport are first divided into *long winged* and *short winged* HAWKS.

To the long winged hawks, belong the *falcon*, *baggard falcon*, *ger falcon*, *lanner*, *hobby*, *saker*, *merlin*, and *bawler*; all which are reclaimed, manned, fed, and mewed much after the same manner. Of the *short winged hawks*, properly so called, are the *gos-hawks*, and *sparrow hawks*.

The former are generally brought to the *lure*, and seize their prey with their foot, breaking their neck bone with their beak before they plume, or tear it. The latter are brought to the fist, and kill their game by strength, and force of wing, at random, and proceed immediately to plume them.

The FALCON, or *Faucon*, is a bird of prey of the *hawk kind*, superior to all others for courage, docility, gentleness, and nobleness of nature. The best is that whose head is round, the beak thick and short, the neck long, the shoulders broad, long thighs, short legs, large feet, the feathers of the wings slender, the pounces black, &c.

The *Falcon* is excellent at the river, brook, and even in the field, and flies chiefly at the largest game, as wild goose, kite, crow, heron, crane, pye, shoveller, &c.

The *baggard falcon*, called here, also, *peregrine falcon*, *passenger*, and *traveller*; because no native of this land; is not inferior for strength, courage, hardiness, and perseverance. She is larger, longer, armed with a longer beak and talons, a higher neck, &c. than the common *falcon*. She will lie longer on the wing, and is more deliberate, and advised in her stooping, &c.

The *ger falcon*, or *gyr falcon*, is the largest bird of the *falcon* kind, and of the greatest strength, next an *eagle*. She may also be called a *passenger*, her *ayrie* being in *Prussia*, *Muscovy*, and the mountains of *Norway*.

The *saker*, or *sacre*, is the third in esteem next the *falcon*, and *ger falcon*, but difficult to be managed, being a *passenger*, or *peregrine hawk*, whose *ayrie* has not yet been discovered, but chiefly found in the islands of the *Levant*; she is somewhat longer than the *baggard falcon*; her plume rusty and ragged: the sear of her foot and beak like the *lanner*; her pounces short, and her train the longest of all birds of prey; she is very strong and hardy to all kind of fowl, being a great deal more disposed to the field, than the *brook*, and delighting to prey on great fowl, as the heron, goose, &c. but for the crane she is not so free as the *baggard falcon*; she also excels for the lesser fowl, as pheasants, partridges, &c. and is much less dainty in her diet, as long winged hawks usually are.

The *lanner*, or *laner*, is a hawk common in most countries, especially in *France*; making her *ayrie* on lofty trees in forests, or on high clifts near the sea side. She is less than the *falcon*, gentle, fair plumed, and has shorter talons than any other *falcon*. Such as have the largest and best seasoned heads are esteemed the best. There is none so fit for a young falconer as this, because she is not inclined to surfeits, and seldom melts grease by being over-flown.

There is another sort of *lanners*, whose *ayrie* is in the *Alps*, having their heads white, and flat aloft, large and black eyes, slender nares, short and thick beaks: their tail marbled and russet; breast feathers white and full of russet spots, and the points and extremities of their feathers full of white drops; their sails and trains long, short legged, with a foot less than that of a falcon, marble seared. This hawk never lies upon the wing, after she has flown to a mark; but after once stooping, makes a point, and like the *gos hawk* waits the fowl. She is flown at field or brook, and will maintain long flights, by which means much fowl is killed. To fly them they must be kept very sharp; and because they keep their castings long, they must have hard castings made of tow, and knots of hemp.

The *Merlin* is the smallest of all birds of prey, and bears a resemblance to a *baggard falcon* in plume, as also in the sear of the foot, beak, and talons, and not unlike her in conditions; when well manned, lured, and carefully looked after, she proves an excellent hawk; especially at partridge, thrush, and lark.

The *hobby* is a sort of hawk, that naturally creeps on doves, larks, and other small game. She is a hawk of the lure, and not of the fist, and is an high flyer,

flyer, being in every reſpect like the ſaker, but ſhe is of a much leſs ſize; for ſhe is not only nimble and light of wing, but dares to encounter kites, buzzards, or crows, and will give blow for blow, till ſometimes they ſeize, and come tumbling down to the ground both together. But ſhe is chiefly for the lark. The *hobby*, alſo, makes excellent ſport with nets and ſpaniels, for when the dogs range the fields to ſpring the fowl, and the *hobby* ſoars aloft over them, the poor birds think it ſafer to be cloſe on the ground, and ſo are taken in the nets. This ſport is called *daring*.

The *gos-hawk*, or *goſs-hawk*, q. d. *groſs-hawk*, is a large ſhort winged hawk, of which there are ſeveral ſorts differing in goodneſs, force, and hardineſs, according to the diverſity of their choice in cawking. There are *gyhawks* from moſt countries, but none better than thoſe bred in the north of *Ireland*. To diſtinguiſh the ſtrength of the bird, tie divers of them in ſeveral places of one chamber, or mew; and that hawk that flies and mutes higheſt and fartheſt off, may be concluded to be ſtrongeſt. The *gyhawk* flies at the pheaſant, mallard, wild gooſe, hare, and coney, nay ſhe will venture to ſeize a kid or goat. She is to be kept with care, as being very choice and dainty in eating, &c.

The *ſparrow hawk*, is alſo a kind [illegible] winged hawk, whereof there are ev[illegible] ferent in plumes: ſome ſmall pl[illegible] others of a larger feather [illegible] quail, ſome brown or canvas mail, &c. [illegible] both for winter and ſummer with [illegible] will fly at all kinds of ga[illegible] more than the *falcon*

Terms proper for the ſeveral Actions of *falcons*.

When the bird flutters with her wings, as it ſtriving to get away, either from perch or fiſt, ſhe is ſaid *to bate*.

Crabbing, is when the birds ſtanding too near, they fight with each other.

Cowring, is when the young ones quiver and ſhake their wings in obedience to the elder.

To *feak*, is when the bird wipes her beak after feeding.

To *jack*, is when ſhe ſleeps.

Intermewing, is the interval between exchanging her coat, and turning white again.

Treading, is called *cawking*.

Mantling, is when ſhe ſtretches one of her wings after her legs, and then the other.

Her dung is called *muting*; when ſhe mutes a good way from her, ſhe is ſaid to *ſlice*; when ſhe does it directly down inſtead of yerking backwards, ſhe is ſaid to *ſlime*; and if it be in drops, it is called *dropping*; when ſhe, as it were, ſneezes, it is called *ſniting*.

To *rouze*, is when ſhe raiſes and ſhakes herſelf.

To *warble*, is when after mantling, ſhe croſſes her wings together over her back.

To *bind*, is when ſhe ſeizes.

To *plume*, is when after ſeizing ſhe pulls off the feathers.

Truſſing, is when ſhe raiſes a fowl aloft, and at length deſcends with it to the ground.

Stooping, is when being aloft, ſhe deſcends to ſeize her prey.

To *rake*, is when ſhe flies out too far from the game.

To *check*, is when forſaking her proper game, ſhe flies at pyes, crows, &c. that chance to croſs her.

To *fly on head*, is when miſſing the fowl, ſhe betakes herſelf to the next check.

The *quarry*, is the fowl or game ſhe flies at.

The *pelt*, is the dead body of the fowl killed by the hawk.

To *carry*, is when ſhe flies away with the quarry.

Canceling, is when in ſtooping ſhe turns two or three times on the wing, to recover herſelf ere [illegible]ſeizes.

[illegible], is when ſhe ſeizes the prey, yet does not [illegible]

[illegible]*ming*, is the making a hawk tame and gentle

Manning, is the bringing her to endure company

A *make hawk*, is an old ſtanch one, uſed to fly and ſet example to a young one.

Beſides the above mentioned terms, there are alſo ſeveral others proper to the *art of falconry*, viz. *caſting*, *plumage*, *rangle*, *gleaming*, *enſeaming*, *gurgiting*, *imping*, *tiring*, *ink*, *pill*, or *pelf*.

Caſting, is ſomething given a hawk, to cleanſe and purge her gorge.

Plumage are ſmall feathers given to make her caſt

Rangle, is gravel given her to help bring down her ſtomach.

Gleaming, is her throwing up filth from the gorge after caſting

Enſeaming, is the purging of her greaſe, &c.

A being ſtuffed is called *gurgitting*.

Imping, is the inſerting a feather in her wing, in lieu of a broken one.

Tiring, is the giving her a leg, wing, or pinion of a fowl to pull at.

The *ink*, is the neck of a bird the hawk preys on.

The *pill*, or *pelf*, is what the hawk leaves of her prey.

The

The terms proper for her furniture are,

The *bewits* or the leathers, with bells buttoned on her legs.

The *leafe*, or *leath*, is a leathern thong whereby the falconer holds the hawk; the little ftraps by which the *leafe* is faftened to the legs, are called *jeffes*; and a line or pack-thread faftened to the *leafe*, in difciplining the hawk, a *creance*.

Hood, is a cover for her head to keep her in the dark; a large wide hood, open behind, to be wore at firft, is called a *rafter hood*; and to draw the ftrings, that the hood may be in readinefs to be pulled off, is called unftriking the hood.

Seeling, is the blinding a hawk, juft taken, by running a thread through her eyelids, and thus drawing them over the eyes, to prepare her for being hooded.

A *lure* is a figure or refemblance of a fowl, made of leather and feathers.

The *pearch* is her refting place, when off the falconer's fift.

The *back* is the place where her meat is laid.

The *mew* is the place wherein fhe is fet, while her feathers fall and come again.

The Management and Discipline of the *falcon*, is the next fubject, and the foundation of the *art of falconry*.

When a young *falcon* is firft taken, fhe muft be feeled, and the feeling at length gradually flackened, that fhe may be able to fee what provifions are brought her. Her furniture is to be *jeffes* of leather, mailed *leafhes*, with buttons at the end, and *bewits*; befides a fmall round ftick, hanging in a ftring, to ftroke her frequently withal; which the oftner it is done, the fooner and better will fhe be manned: two bells on her legs, that fhe may be the more readily found, or heard, when fhe ftirs, fcratches, &c and a hood raifed, and boffed over her eyes. Her food to be pigeons, larks, and other live birds, of which fhe is to eat twice or thrice a day, and till fhe be full gorged. When the falconer is about to feed her, he muft hoop and lure, that fhe may know when to expect it; then unhooding her gently, he gives her two or three bits, and putting her hood on again, gives her as much more; but takes care that fhe be clofe feeled, and after three or four days, leffens her diet; at going to bed he fets her on a pearch by him, that he may awake her often in the night, continuing to do fo till fhe grows tame and gentle. When fhe begins to feed eagerly, he gives her fheep's hearts; now he begins to unhood her by day, but it muft be done far from company; feeds her and hoods her again, as before, but takes care not to fright her with any thing when he unhoods her, and if he can, reclaims her without over-watching. The falcon muft be borne continually on the fift, till fhe be thoroughly manned, and induced to feed in company: for two or three days, give her wafhed meat, and then plumage, according as you efteem her foul within; if fhe cafts, hood her again; and give her nothing, till fhe gleams after her cafting: but when fhe has gleamed and caft, give her a little hot meat in company; and towards evening, let her plume a hen's wing, likewife in company; cleanfe the feather of her cafting, if foul and flimy; if fhe clean within, give her gentle cafting; and when fhe is well reclaimed, manned and made eager and fharp fet, venture to feed her on the lure.

Three things are to be confidered *before you lure your falcon*. 1. That fhe be bold and familiar in company, and not afraid of dogs and horfes. 2. Sharp-fet and hungry, having regard to the hour of morning and evening, when you would lure her. 3. Clean within, and the lure well garnifhed with meat on both fides. When you intend to give her the length of a leafe, you muft abfcond yourfelf; fhe muft alfo be unhooded, and have a bit or two given her on the lure, as fhe fits on your fift; that done, take the lure from her, and fo hide it that fhe may not fee it; when fhe is unfeeled, caft the lure fo near her, that fhe may catch it within the length of her leafe; and as foon as fhe has feized it, ufe your voice as falconers do, feeding her upon the lure on the ground.

After you have *lured* your *falcon*, in the evening give her but little meat, and let this luring be fo timely, that you may give her plumage, &c. next morning on your fift; when fhe has caft and gleamed, give her a little beaching of warm water: about noon, tie a creance to her leafe, go into the field, there give her a bit or two upon the lure, and unfeel her; if you find fhe is fharp-fet, and has eagerly feized on the lure, let a man hold her to let her off to the lure; then unwind the creance, and draw it after you a good way, and let him who has the bird, hold his right hand on the taffel of her hood, ready to unhood her as foon as you begin to lure; to which if fhe comes well, ftoop roundly upon it, and haftily feize it, let her caft two or three bits thereon; that done, unfeize, take her off the lure, and deliver her again to the perfon that held her, and going further off the lure, feed her as before; and fo daily further and further off the lure. Afterwards you may lure her in company, but do not fright her; and having ufed her to the lure on foot, do it alfo on horfeback, which may be fooner accomplifhed, by caufing horfemen to be about you, when you lure her on foot; it is alfo fooner done by rewarding her upon the lure on horſeback, among horſemen. And when ſhe is grown bold in this way, let ſome body a foot hold the hawk, and he that is on horſe back muſt call, and caſt the lure about his head, while the holder takes off the hood by the taſſels; and if the ſeize eagerly on the lure, without fear of a man or horſe, then take off the creance, and lure at a greater diſtance. Laſtly, if you would have her love dogs as well as the lure, call dogs when you give her plumage.

If the hawk be intended for ſome particular ſort of game, her lure muſt be a reſemblance of that ſort of game; and the falconer ought to make a frequent practice of feeding, and rewarding her thereon, or on a train of the ſame kind; calling her when feeding, as if ſhe was called to the lure.

A *brancher*, *ſoar-hawk*, or *ramage-hawk*, needs no nurſing: ſhe is to be brought down from her wildneſs, and habituated to another courſe of life; and in purſuance of her own views and intereſts, to be made ſubject to thoſe of her maſter. An *eyeſs*, needs no reclaiming, ſhe is to be carefully nurſed, and brought up in her natural tameneſs.

The perſon, who brings up, tames, and makes, that is, tutors and manages birds of prey, as falcons, hawks, *&c.* is called *falconer*; the emperor of the *Turks* uſually keeps ſix thouſand *falconers* in his ſervice. The king of *France* has a grand *falconer*.

F E N C I N G.

FENCING is a genteel accompliſhment, as it teaches a man to place himſelf in a proper upright poſture, and inſtructs him in the means of ſelf defence. Hence

Fencing is the art of defence, or of uſing the ſword, to wound an enemy, and ſhelter one's ſelf from his attacks

The art of fencing is acquired by practiſing with foils, called in *latin rudes.*

Pyrard aſſures us, that the art of fencing is ſo highly eſteemed in the *Eaſt Indies*, that princes and noblemen teach it. They wear a badge or cognizance on their right arms, called in their language *Eſjara*, which is put on with great ceremony, like the badges of our orders of knighthood, by the kings themſelves.

Fencing is divided into two parts, *ſimple* and *compound.*

Simple, is that performed directly, and nimbly on the ſame line; and is either offenſive, or defenſive.——The principal object of the firſt, is, whatever may be attempted in puſhing or making paſſes from this or that point, to the moſt uncovered part of the enemy.——The ſecond conſiſts in parrying and repelling the thruſts aimed by the enemy.

The *compound*, on the offenſive ſide, includes all the poſſible arts and inventions to deceive the enemy, and make him leave that part we have a deſign on, bare and unguarded, upon finding we cannot come at it by force, nor by the agility of the ſimple play.

The principal means hereof are feints, appeals, claſhings, and intanglings of ſwords, half thruſts, *&c.* and in the defenſive, to puſh in parrying.

Parrying is the action of defending a man's ſelf, or of ſtaving off the ſtrokes offered by another.——Good fencers puſh and parry at the ſame time.——The *Spaniards* parry with the poniard; the *ancients* parried with their bucklers.

Feint is a falſe attack, or a ſhew of making a ſtroke or puſh in one part, with deſign to bring the enemy to guard that part, and leave ſome other part unguarded, where the ſtroke is really intended.

Feints are either ſingle, or double, high, or low, without, or in the whole circle; of one, two, or three meaſures.

The *ſimple feint* is a meer motion of the wriſt, without ſtirring the foot, *&c.*

Guard is an action or poſture proper to ſcreen the body from the attacks of an enemy's ſword.

There are four general *guards* of the ſword: to underſtand which, it will be neceſſary to imagine a circle drawn on an upright wall, and divided into four cardinal points, *viz.* top, bottom, right, and left.

Now when the point of the ſword is directed to the bottom point of the circle, and conſequently the head of the ſword tilted up to the top point, with the body inclining forwards; this is called *prime*, or the *firſt guard.*——The *ſecond guard*, which ſome improperly call the *third*, is when the point of the ſword is directed to the right, or ſecond point of the ſame circle, a quadrant diſtant from the firſt; with the fort of the ſword turned to the right, and the body raiſed proportionably.——*Tierce*, or the *third guard*, is performed by directing the ſword's point to the uppermoſt point of the ſame

ſame circle, diametrically oppoſite to that of *prime*; in which caſe the body, arm, and ſword, are in their natural diſpoſition, being the mean between the extremes of their motion.——*Quart*, or the *fourth guard*, is, when the point of the ſword is directed to the fourth point of the circle, deſcending to the right, as far as one fourth of the *tierce*, with the external ſide of the arm, and the flat of the ſword turned towards the ground; and the body out of the line to the right, and the fort of the ſword towards the line to the left.——There is alſo *quint*, or a kind of *fifth guard*, being the return of the point of the ſword on the right, after tranſverſing the circle, to the point of the *prime*, whence it had departed; and yet, with a different diſpoſition of the body, arm, and ſword.

These guards are alſo called *figures* and *poſtures*; and the common center of all their motions, is to be in the ſhoulder.

In all theſe kinds of guards there are high *advanced*, high *retired*, and high *intermediate* guards, when diſpoſed before the upper part of the body, either with the arm quite extended, quite withdrawn, or in a mean ſtate.——*Mean advanced* guard, or ſimply *mean guard*, is when the ſword is diſpoſed before the middle part of the body.——*Low advanced*, *retired*, or *intermediate guards*, are thoſe where the arm and ſword are advanced, withdrawn, or between the two extremes, before the lower part of the body.

Some will have *prime* the principal guard; others *quint*; others, with better reaſon, *tierce*, becauſe it conſiſts of right lines, which are eaſier defended than oblique ones; ſuch as thoſe of *prime*, *ſecond*, *quart*, and *quint*.

F I S H I N G.

FISHING is the art of catching fiſh with nets, ſpears, lines, rods, hooks &c. either in *ſalt-water*, or in *freſh water*, *rivers* or *ponds*.

We will begin with the *ſalt water fiſhery*, and confine our pen to thoſe ſubjects as ſhall ſeem moſt intereſting and entertaining, ſuch as

ANCHOVY FISHERY. *Anchovies* are fiſhed on the coaſt of *Provence*, in the months of *May*, *June*, and *July*, at which ſeaſon ſhoals of this fiſh regularly come into the *Mediterranean* through the *Streights* of *Gibraltar*. They are likewiſe found in plenty in the river of *Genoa*, on the coaſt of *Sicily*, and on that of the iſland of *Gorgone*, oppoſite to *Leghorn*; theſe laſt are reckoned the beſt. It is remarkable, that *anchovies* are ſeldom fiſhed but in the night-time. If a fire be kindled on the poop of the veſſels uſed for this fiſhing, the *anchovies* will come in greater numbers into the nets; but then it is aſſerted, that the *anchovies* taken thus by fire, are neither ſo good, nor ſo firm, and will not keep ſo well as thoſe which are taken without fire. When the fiſhery is over, they pull off the heads of all the *anchovies*, gut them, and afterwards range them in barrels of different weights, the largeſt of which do not weigh above 25 or 26 pounds, and they put a good deal of ſalt in them. Some alſo pickle them in ſmall earthen pots made on purpoſe, of two or three pounds weight, more or leſs, which they cover with plaſter, to keep them the better.

The COD-FISHERY. There are two kinds of *cod-fiſh*, the one *green* or *white-cod*, and the other *dried* or *cured-cod*, tho' it is all the ſame fiſh differently prepared; the former being ſometimes ſalted and barrelled, then taken out for uſe; and the latter having laid ſome competent time in ſalt, is dried in the ſun or ſmoke. We ſhall therefore ſpeak of each of theſe apart, and firſt of

The GREEN COD-FISHERY. The chief fiſheries for *green cod* are in the bay of *Canada*: on the great bank of *Newfoundland*, and on the iſle of *St. Peter*, and the iſle of *Sable*: to which places veſſels reſort from divers parts both of *Europe* and *America*. They are from 100 to 150 tuns burden, and will catch between 30 and 40 thouſand cod each. The moſt eſſential part of the fiſhery, is to have a maſter who knows how to cut up the cod, one who is ſkilled to take the head off properly, and above all, a good ſalter, on which the preſerving them, and conſequently the ſucceſs of the voyage, depends. The beſt ſeaſon is from the beginning of *February* to the end of *April*; the fiſh, which in the winter retire to the deepeſt water, coming then on the banks, and fattening extremely. What is caught from *March* to *June* keeps well, but thoſe taken in *July*, *Auguſt*, and *September*, when it is warm on the banks, are apt to ſpoil ſoon. Every fiſher takes but one at a time: the moſt expert will take from 350 to 400 in a day, but that is the moſt: the weight of the fiſh and the great coldneſs on the bank fatiguing very much. As ſoon as the cods are taken, the head is taken off; they are opened, gutted and ſalted, and the ſalter ſtows them in the bottom of the hold, head to tail, in beds a fathom or two ſquare; laying layers of ſalt and fiſh alternately, but never mixing fiſh caught on different days. When they have lain thus three or four days to [illegible] off the water, they are replaced in another part of the ſhip, and ſalted again; where they [illegible] the veſſel is loaded. Sometimes they are [illegible] thick pieces, and put up in barrels for the [illegible] of carriage.

The Dry Cod-Fishery. The principal fiſhery [illegible] is from *Cape* [illegible] to the *Bay des Ex*[illegible], along the coaſt of *Placentia*, in which compaſs there are divers commodious ports for the fiſh to be dried in. These though of the ſame kind with the freſh cod, are much ſmaller, and therefore fitter to keep, as the ſalt penetrates more eaſily into them. The fiſhery of both is much alike, only this latter is moſt expenſive, as it takes up more time, and employs more hands, and yet ſcarce half ſo much ſalt is ſpent in this as in the other. The bait is herrings, of which great quantities are taken on the coaſt of *Placentia*. When ſeveral veſſels meet and intend to fiſh in the ſame port, he whoſe ſhalloop firſt touches ground, becomes intitled to the quality and privileges of admiral: he has the choice of his ſtation, and the refuſal of all the wood on the coaſt at his arrival.

As faſt as the maſters arrive, they unrig all their veſſels leaving nothing but the ſhrouds to ſuſtain the maſts, and in the mean time the mates provide a tent on ſhore, covered with branches of trees, and ſails over them, with a ſcaffold of great trunks of pines, twelve, fifteen, ſixteen, and often twenty feet high, commonly from forty to ſixty feet long, and about one third as much in breadth.

While the ſcaffold is preparing, the crew are a fiſhing, and as faſt as they catch they bring their fiſh aſhore; open and ſalt them upon moveable benches; but the main ſalting is performed on the ſcaffold. When the fiſh have taken ſalt, they waſh and hang them to drain on rails; when drained, they are laid on kinds of ſtages, which are ſmall pieces of wood laid acroſs, and covered with branches of trees, having the leaves ſtripped off, for the paſſage of the air. On theſe ſtages, they are diſpoſed, a fiſh thick, head againſt tail, with the back uppermoſt, and are turned carefully, four times every twenty-four hours. When they begin to dry, they are laid in heaps ten or twelve thick, in order to retain their warmth; and every day the heaps are enlarged, till they become double their firſt bulk; then two heaps are joined together, which they turn every day as before; laſtly, they are ſalted again, beginning with thoſe firſt ſalted, and being laid in huge piles, they remain in that ſituation, till they are carried on board the ſhips, where they are laid on the branches of trees diſpoſed for that purpoſe, upon the ballaſt, and round the ſhip, with mats to prevent their contracting any moiſture.

There are four kinds of commodities drawn from cod, *viz.* the *zounds*, the *tongues*, the *roes*, and the *oil* extracted from the liver. The firſt is ſalted at the fiſhery, together with the fiſh, and put up in barrels from 6 to 700 pound. The *tongues* are done in like manner, and brought in barrels from 4 to 500 pounds. The *roes* are alſo ſalted in barrels, and ſerve to caſt into the ſea to draw fiſh together, and particularly *pilchards*. The oil comes in barrels, from 400 to 520 pounds, and is uſed in dreſſing leather. The *Scots* catch a ſmall kind of cod on the coaſts of *Buchan*, and all along the *Murray Firth* on both ſides; as alſo in the *Firth of Forth*, *Clyde*, *&c.* which is much eſteemed. They ſalt and dry them in the ſun upon rocks, and ſometimes in the chimney. They alſo cure *ſkait*, and other ſmaller fiſh in the ſame manner, but moſt of theſe are for home conſumption.

The Coral-Fishery. Red coral is found in the *Mediterranean*, on the ſhores of *Provence*, from *Cape de la Couronne* to that of *St. Tropez*; about the iſles of *Majorca* and *Minorca*; on the ſouth of *Sicily*; on the coaſts of *Africa*; and, laſtly, in the *Ethiopic* ocean, about *Cape Negro*. The divers ſay, that the little branches are found only in the caverns whoſe ſituation is parallel to the earth's ſurface, and open to the ſouth. The manner of fiſhing being nearly the ſame wherever coral is found, it will ſuffice to inſtance the method uſed at the baſtion of *France*, under the direction of the company eſtabliſhed at *Marſeilles* for that fiſhery. Seven or eight men go in a boat commanded by the patron or proprietor, and when the net is thrown by the caſter, the reſt work the veſſel, and help to draw the net in. The net is compoſed of two rafters of wood tied croſs-wiſe, with leads fixed to them: to theſe they faſten a quantity of hemp twiſted looſely round, and intermingled with ſome large netting. This inſtrument is let down where they think there is coral, and pulled up again when the coral is ſtrongly entangled in the hemp and netting. For this purpoſe, ſix boats are ſometimes required; and if in hauling in, the rope happens to break, the fiſhermen run the hazard of being loſt. Before the fiſhers go to ſea, they agree for the price of the coral, which is ſometimes more, ſometimes leſs a pound; and they engage, on pain of corporal puniſhment, that neither they nor their crew ſhall embezzle any, but deliver the whole to the proprietors. When the fiſhery is ended, which amounts one year with another to twenty five quintals for each boat, it is divided into thirteen parts, of which the proprietor hath four, the caſter two, and the other ſix men one each,

each, the thirteenth belongs to the company for payment of the boat furnished them. See Diving.

The Herring-Fishery. *Herrings* are chiefly found in the *North-sea.* They are a fish of passage, and commonly go in shoals, being very fond of following fire or light, and in their passage they resemble a kind of lightning. About the beginning of *June*, an incredible shoal of herrings, probably much larger than the land of *Great-Britain* and *Ireland*, come from the north on the surface of the sea; their approach is known by the hovering of the sea fowl in expectation of prey, and by the smoothness of the water; but where they breed, or what particular place they come from, cannot be easily discovered. As this great shoal passes between the shores of *Greenland* and the *North-Cape*, it is probably confined, and as it reaches the extremities of *Great-Britain*, is necessarily divided into two parts. For we find one part of the herrings, steering west, or south-west, and leaving the islands of *Shetland* and *Orkney* to the left, pass on towards *Ireland*, where being interrupted a second time, some keeping the shore of *Britain*, pass away south down *St. George's Channel*; while the other part edging off to the south west, coast the western ocean, till they reach the south shore of *Ireland*, and then steering south-east, join the rest in *St. George's Channel.* The other part of the first division made in the north, parting a little to the east and south-east, pass by *Shetland*, and then make the point of *Buchan-ness*, and the coast of *Aberdeen*, filling as they go, all the bays, firths, creeks, &c. with their innumerable multitudes. Hence they proceed forward, pass by *Dunbar*, and rounding the high shores of *St. Abbe's Head*, and *Berwick*, are seen again off *Scarborough*; and even then not diminishing in bulk, till they come to *Yarmouth-Roads*, and from thence to the mouth of the *Thames*; after which, passing down the *British Channel*, they seem to be lost in the western ocean.

The vast advantage of this fishery to our nation is very obvious, when we consider that tho' herrings are found upon the shores of *North America*, they are never seen there in such quantities as with us; and that they are not to be met with in considerable numbers in any of the southern kingdoms of *Europe*, as *Spain*, *Portugal*, or the south parts of *France* on the side of the ocean, or in the *Mediterranean*, or on the coast of *Africa*.

There are two seasons for fishing herring, the first from *June* to the end of *August*, and the second in *Autumn*, when the fogs become very favourable for this kind of fishing.

The *Dutch* begin their *herring-fishing* on the 24th of *June*, and employ no less than two thousand vessels therein called busses, being between forty-five and sixty tons burthen, and carrying three or four small cannon. They never stir out of port without a convoy, unless there be enough together to make about eighteen or twenty cannon among them, in which case they are allowed to go in company. Before they go out, they make a verbal agreement, which has the same force, as if it were in writing.

The regulations of the admiralty of *Holland* are partly followed by the *French*, and other nations, and partly improved and augmented with new ones: as, that no fisher shall cast his net within a hundred fathoms of another boat: that while the nets are cast, a light shall be kept on the hind part of the vessel: that when a boat is by any accident obliged to leave off fishing, the light shall be cast into the sea: that when the greater part of a fleet leaves off fishing, and casts anchor, the rest shall do the same, &c.

By the late act of parliament in *Great Britain*, the regulations are, that every vessel intitled to the bounty, must carry twelve *Winchester* bushels of salt in new barrels, for every last of fish such vessel is capable of holding; and as many more new barrels as such vessels can carry; and two fleets of tanned nets, that is, a vessel of seventy tons shall carry one fleet of fifty nets, each net to be thirty yards full upon its rope, and seven fathoms deep; and so in proportion for greater or smaller vessels; and be provided with one other fleet of fifty like nets, on board a tender, or left on shore in a proper place for the use of the said vessel, &c.

There is nothing particular in the manner of this fishing. The nets wherein the fish are drawn, should regularly have their meshes an inch square to let all the lesser fry go through.

The curing and preparing herring. The commerce of *herring*, both *white* or *pickled*, and *red*, is very considerable. The *white Dutch herrings* are the most esteemed, being distinguished into four sorts, according to their sizes; and the best are those that are fat, fleshy, firm, and white, salted the same day they are taken, with good salt and well barrelled. The *British herrings* are little inferior, if not equal to the *Dutch*, for in spite of all their endeavours to conceal the secret, their method of curing, lasting, or casking the herrings, has been discovered, and is as follows.

After they have hawled in their nets, which they drag in the sterns of their vessels backwards and forwards in traversing the coast, they throw them upon the ship's deck, which is cleared of every thing for that purpose: the crew is separated into sundry divisions, and each division has a peculiar task: one part opens and guts the herrings, leaving the melts and roes: another cures and salts them, by by lining or rubbing their inſide with ſalt: the next packs them, and between each row and diviſion they ſprinkle handfuls of ſalt: laſtly, the cooper puts the finiſhing hand to all by heading the caſks very tight, and ſtowing them in the hold. It is cuſtomary with us to waſh the herring in freſh water, and ſteep them twelve or fifteen hours, in a ſtrong brine, before we proceed to barrel them.

Red Herrings muſt be twenty four hours in the brine, in as much as they are to take all their ſalt there, and when they are taken out, they are ſpitted, that is, ſtrung by the head on little wooden ſpits, and then hung in a chimney made for that purpoſe. After which, a fire of bruſh-wood, which yields a deal of ſmoke, but no flame, being made under them, they remain there till ſufficiently ſmoked and dried, and are afterwards barrelled up for keeping.

The Mackrel-Fishery. The *Mackrels* are found in large ſhoals in the ocean, but eſpecially on the *French* and *Engliſh* coaſts. They enter the *Engliſh Channel* in *April*, and proceeding as the ſummer advances; about *June*, they are on the coaſts of *Cornwall*, *Suſſex*, *Normandy*, *Picardy*, *&c.* where the fiſhery is moſt conſiderable.

They are taken either with a line or nets: the latter is preferable, and is uſually performed in the night-time. They are pickled two ways, firſt by opening and gutting them, and cramming their bellies, as hard as poſſible, with ſalt, by means of a ſtick, and then laying them in rows at the bottom of the veſſel, ſtrewing ſalt between each layer. The ſecond way is putting them directly into tubs full of brine, made of ſalt and freſh water, and leaving them to ſteep till they have taken ſalt enough to keep. After this, they are barrelled up and preſſed cloſe down.

The Pilchard-Fishery. The chief pilchard fiſheries are along the coaſts of *Dalmatia*, on the coaſt of *Bretagne*, and along the coaſts of *Cornwall* and *Devonſhire*. That of *Dalmatia* is very plentiful: that on the coaſts of *Bretagne* employs annually about 300 ſhips. The *pilchards* caught on our coaſts, tho' bigger, are not ſo much valued as thoſe on the coaſts of *France*, owing principally to their not being ſo thoroughly cured. They naturally follow the light, which contributes much to the facility of the fiſhery: the ſeaſon is from *June* to *September*. On the coaſts of *France* they make uſe of the roes of the cod-fiſh, as a bait, which, thrown into the ſea, makes them riſe from the bottom, and run into the nets.

On our coaſts there are perſons poſted aſhore, who ſeeing by the colour of the water where the ſhoals are, make ſigns to the boats to go among them to caſt their nets. When taken, they are brought on ſhore to a warehouſe, where they are laid up in broad piles, ſupported with backs and ſides, and as they are piled, they ſalt them with bay ſalt, in which lying to ſoak twenty or thirty days, they run out a deal of blood, with dirty pickle and bittern: then they waſh them clean in ſea-water, and when dry, barrel and preſs them hard down to ſqueeze out the oil, which iſſues out at a hole in the bottom of the caſk. The *Corniſh* men obſerve of the pilchard, that it is the leaſt fiſh in ſize, moſt in number, and greateſt for gain, of any they take out of the ſea.

The Salmon-Fishery. The chief *ſalmon-fiſheries* in *Europe* are in *England*, *Scotland*, and *Ireland*, in the rivers, and on ſea coaſts adjoining to the river mouths. Thoſe moſt diſtinguiſhed for *ſalmon* in *Scotland*, are the river *Tweed*, the *Clyde*, the *Tay*, the *Dee*, the *Don*, the *Spey*, the *Neſs*, the *Bewley*, *&c.* in moſt of which it is very common about the height of ſummer, eſpecially if the weather happen to be very hot, to catch four or five ſcore of ſalmon at a draught. The chief rivers in *England* for *ſalmon* are the *Tyne*, the *Wear*, the *Trent*, the *Severn*, and the *Thames*. The fiſhing uſually begins about *January*, and in *Scotland*, they are obliged to give over about the 15th of *Auguſt*, becauſe, as it is then ſuppoſed the fiſh come up to ſpawn, it would be quite depopulating the rivers to continue fiſhing any longer. It is performed with nets, and ſometimes with a kind of locks or wears made on purpoſe, which in certain places have iron or wooden grates ſo diſpoſed, in an angle, that being impelled by any force in a contrary direction to the courſe of the river, they may give way and open a little at the point of contact, and immediately ſhut again, cloſing the angle. The *ſalmon*, therefore, coming up into the rivers, are admitted into theſe grates, which open, and ſuffer them to paſs thro', but ſhut again, and prevent their return. *Salmon* are alſo caught with a ſpear, which they dart into him when they ſee him ſwimming near the ſurface of the water. It is cuſtomary likewiſe to catch them with a candle and lanthorn, or wiſp of ſtraw ſet on fire; for the fiſh naturally following the light, are ſtruck with the ſpear, or taken in a net ſpread for that purpoſe, and lifted with a ſudden jerk from the bottom.

The curing Salmon. When the *ſalmon* are taken, they open them along the back, take out the guts and gills, and cut out the greateſt part of the bones, endeavouring to make the inſide as ſmooth as poſſible, then ſalt the fiſh in large tubs for the purpoſe, where they lie a conſiderable time ſoaking in brine, and about *October*, they are packed cloſe up in barrels, and ſent to *London*, or exported up the *Mediterranean*. They have alſo in *Scotland*, a great deal

deal of ſalmon ſalted in the common way, which after ſoaking in brine a competent time, is well preſſed, and then dried in ſmoak: this is called *kipper*, and is chiefly made for home conſumption, and if properly cured and prepared, is reckoned very delicious.

The STURGEON-FISHERY. The greateſt *ſturgeon-fiſhery* is in the mouth of the *Volga*, on the *Caſpian-ſea*, where the *Muſcovites* employ a great number of hands, and catch them in a kind of incloſure formed by huge ſtakes, repreſenting the letter Z, repeated ſeveral times. Theſe fiſheries are open on the ſide next the ſea, and cloſe on the other, by which means the fiſh aſcending in its ſeaſon up the river, is embarraſſed in theſe narrow angular retreats, and ſo is eaſily killed with a harping iron.

Sturgeons, when freſh, eat deliciouſly, and in order to make them keep, they are ſalted or pickled in large pieces, and put up in cags from thirty to fifty pounds. But the great object of this fiſhery is the *roe*, of which the *Muſcovites* are extremely fond, and of which is made the *cavear* or *kavia*, ſo much eſteemed by the *Italians*.

The WHALE-FISHERY. *Whales* are chiefly caught in the *North-ſea*: the largeſt ſort are found about *Greenland*, or *Spitzbergen*.

The *whale-fiſhery* begins in *May*, and continues all *June* and *July*; but whether the ſhips have good or bad ſucceſs, they muſt come away and get clear of the ice by the end of *Auguſt*.

The manner of taking *whales* at preſent is as follows. As ſoon as the fiſhermen hear the *whale* blow, they cry out, *fall! fall!* and every ſhip gets out its long-boat, in each of which there are ſix or ſeven men: they row till they come pretty near the whale, then the harpooner ſtrikes it with his harpoon. This requires great dexterity, for through the bone of his head there is no ſtriking, but near his ſpout there is a ſoft piece of fleſh, into which the iron ſinks with eaſe. As ſoon as he is ſtruck, they take care to give him rope enough, otherwiſe, when he goes down, as he frequently does, he would inevitably ſink the boat: this rope he draws with ſuch violence, that, if it were not well watered, it would by its friction againſt the ſides of the boat, be ſoon ſet on fire.

The line faſtened to the harpoon is ſix or ſeven fathoms long, and is called the *fore-runner*: it is made of the fineſt and ſofteſt hemp, that it may ſlip the eaſier: to this they join a heap of lines of 90 or 100 fathoms each, and when there are not enough in one long boat, they borrow from another.

The man at the helm obſerves which way the rope goes, and ſteers the boat accordingly, that it may run exactly out before. When the whale is ſtruck, the other long-boats row before, and obſerve, which way the line ſtands, and ſometimes pull it; if they feel it ſtiff, it is a ſign the *whale* ſtill pulls in ſtrength; but if it hangs looſe, and the boat lies equally high before and behind upon the water, they pull it in gently; but take care to coil it ſo, that the *whale* may have it again eaſily if he recovers ſtrength: they take care, however, not to give him too much line, becauſe he ſometimes entangles it about a rock, and pulls out the harpoon. The fat *whales* do not ſink as ſoon as dead, but the lean one's do, and come up ſome days afterwards. The whale being laſhed along-ſide, they lay it on one ſide, and put two ropes, one at the head, and the other in the place of the tail, which together with the fins is ſtruck off, as ſoon as he is taken, to keep thoſe extremities above water. On the off ſide of the *whale* are two boats to receive the pieces of fat, utenſils, and men, that might otherwiſe fall into the water on that ſide.

Theſe precautions being taken, three or four men with irons at their feet, to prevent ſlipping, get on the whale, and begin to cut out pieces of about three feet thick, and eight long, which are hauled up at the capſtane or windlaſs. When the fat is all got off, they cut off the whiſkers of the upper jaw with an ax. Before they cut, they are all laſhed to keep them firm, which alſo facilitates the cutting, and prevents them from falling into the ſea: when on board, five or ſix of them are bundled together, and properly ſtowed, and after all is got off, the carcaſs is turned adrift, and devoured by the bears, who are very fond of it.

In proportion as the large pieces of fat are cut off, the reſt of the crew are employed in ſlicing them ſmaller, and picking out all the lean. When this is prepared, they ſtow it under the deck, where it lie till the fat of all the *whales* is on board; then cutting it ſtill ſmaller, they put it up in tubs in the hold, cramming them very full and cloſe. The fat is to be boiled and melted down into train oil.

Beſides theſe *fiſheries*, there are ſeveral others both on the coaſts of *Great Britain* and in the *North-ſeas*, which although not much the ſubject of merchandize, nevertheleſs employ great numbers both of ſhips and men; as, 1. The *oyſter-fiſhing* at *Colcheſter*, *Feverſham*, the iſle of *Wight*, in the *Swales* of the *Medway*, and in all the creeks between *Southampton* and *Chicheſter*, from whence they are carried to be fed in pits.

2. The *lobſter-fiſhing* all along the *British Channel*, the *Firth* of *Edinburgh*, on the coaſt of *Northumberland*, and on the coaſt of *Norway*; from whence great quantities are brought to *London*. And laſtly, the fiſhing of the *pot-fiſh*, *fin fiſh*, *ſea-unicorn*

unicorn, *ſea-horſe*, and the *ſeal*, or *dog-fiſh*; all which are found in the ſame ſeas with the *whales*, and yield blubber in a certain degree.

The Pearl-Fishery. *Pearl* is a hard, white, ſhining body, is uſually roundiſh, found in a teſtaceous fiſh reſembling an oyſter: and though eſteemed in the number of gems, and highly valued in all ages, proceeds only from a diſtemper in the creature that produces it.

The fiſh in which *pearls* are uſually produced, is the *Eaſt Indian pearl oyſter*, as it is commonly, though not very properly, called. it has a very large and broad ſhell, of the bivalve kind, ſometimes meaſuring twelve or fourteen inches over, but thoſe of eight inches are more frequent: it is not very deep; on the outſide it is of a duſky brown, and within of a very beautiful white, with tinges of ſeveral other colours, as expoſed in different directions to the light.

Beſides this ſhell, there are many others that are found to produce pearls; as the *common oyſter*, the *muſcle*, the *pinna marina*, and ſeveral *others*; the pearls of which are often very good, but thoſe of the true *Indian-berberi*, or *pearl-oyſter*, are in general ſuperior to all.

The ſmall or ſeed-pearls, alſo called *ounce pearls*, from their being ſold by the ounce, and not by tale, are vaſtly the moſt numerous and common. The fineſt, and what is called the true ſhape of the pearl, is a perfect round. Their colour ought to be a pure white, and that not a dead and lifeleſs, but a clear and brilliant one; they muſt be perfectly free from any foulneſs, ſpot, or ſtain, and their ſurfaces muſt be naturally ſmooth and gloſſy; for they bring a natural poliſh with them, which art is not able to improve.

All *pearls* are formed of the matter of the ſhell, and conſiſts of a number of coats ſpread with perfect regularity one over another, in the manner of the ſeveral coats of an onion, or like the ſeveral ſtrata of the ſtones found in the bladders or ſtomachs of animals, only much thinner.

This valuable article of commerce is not the product of any peculiar part of the world. The eaſt *Indies* and *America* produce the pearl ſhell-fiſh in abundance, and it is found with good pearls in many parts of *Europe*. The coaſts of the iſland *Ceylon* afford pearls ſuperior to thoſe of all the *Eaſt* in the beauty of their colour, but there are no very large ones found there. The *Perſian Gulph* abounds with the *pearl-fiſh*, and *fiſheries* are eſtabliſhed on the coaſts of the ſeveral iſlands in it. In *America*, there are fiſheries in the gulph of *Mexico*, and along the coaſt of *Terra Firma*, all which yield conſiderable advantage. The *European* pearls are principally found on the coaſts of *Scotland*, and the neighbouring parts.

There are two ſeaſons for *fiſhing pearls*, in the *Eaſt Indies*; the firſt in *March* and *April*, the ſecond in *Auguſt* and *September*; the more rain falls in the year, the more plentiful are the fiſheries. In the opening of the ſeaſon, there appear, ſometimes, two hundred and fifty barks on the banks. In the larger barks are two divers; in the ſmaller, one. Each bark puts off from ſhore e'er ſun-riſe, by a land-breeze, which never fails; and returns again by a ſea-breeze, which ſucceeds at about noon. As ſoon as the barks are arrived, and have caſt anchor, each diver binds a ſtone ſix inches thick, and a foot long under his body; which is to ſerve him as a ballaſt, and prevent his being driven away by the motion of the water; and to enable him to walk more ſteadily a-croſs the waves. Beſides this they tye another very heavy ſtone to one foot, whereby they are ſunk to the bottom of the ſea in a moment. And as the oyſters are uſually ſtrongly faſten'd to the rocks, they arm their fingers with leathern mittens, to prevent their being wounded in ſcraping them violently off; and ſome men carry an iron rake for the purpoſe. Laſtly, each diver carries down with him a large net, in manner of a ſack, ty'd to his neck by a long cord, the other end whereof is faſtened to the ſide of the bark. The ſack is intended for the reception of the oyſters gathered from the rock, and the cord to pull up the diver when the bag is full, or he wants air. In this equipage he precipitates himſelf, ſometimes above ſixty feet under water. As he has no time to loſe there, he is no ſooner arriv d at the bottom, than he begins to run from ſide to ſide, ſometimes on a ſand, ſometimes on a clayey earth, and ſometimes among the points of rocks; tearing off the oyſters he meets withal, and cramming them into his budget. At whatever depth the divers be, the light is ſo great, that they eaſily ſee whatever paſſes in the ſea, with the ſame clearneſs as on land.

The beſt divers keep under water for half an hour, the reſt do not ſtay leſs than a quarter. During which time, they hold their breath without the uſe of oils, or any other liquors; when they find themſelves ſtraitened, they pull the rope to which the bag is faſtened, and hold faſt by it with both hands; when the people in the bark taking the ſignal, heave them up into the air, and unload them of their fiſh. Some of the divers need a moment's reſpite to recover breath; others jump in again inſtantly, continuing this violent exerciſe, without intermiſſion, for many hours. See Diving.

On the ſhore they unload their barks, and lay their oyſters in an infinite number of little pits, dug four or five feet ſquare in the ſand; raiſing heaps of ſand over them to the height of a man, which, at a diſtance, look like an army ranged in battle.

In

In this condition, they are left till the rain, wind, and sun, have obliged them to open, which soon kills them. Upon this the flesh rots and dries, and the *pearls*, thus disengaged, tumble into the pit, upon taking the oysters out.

The season for *fishing* in the *West Indies*, is usually from *October* to *March*. In this time there set out from *Carthagena* ten or twelve barks, under the convoy of a man of war, called *Larmadilla*, each bark has two or three slaves for divers. Among the barks there is one called *Capitana*; to which all the rest are obliged to bring at night what they have caught in the day, to prevent frauds. The divers continue sometimes under water above a quarter of an hour. The rest is the same as in the *East India fishery*.

The *fishing* in fresh water is commonly performed by *Angling*. For this purpose, there must be provided rods, lines, hooks, floats, both natural and artificial *flies* *, *&c.*

The Fishing-Rod is a long taper rod or wand, to which the line is fastened for *angling*. Of these there are several sorts; as, 1. The troller, or trolling-rod, which has a ring at the end, for the line to go through, when it runs off a reel. 2. The whipper, or whipping-rod, which is weak in the middle, and top-heavy, but very slender. 3. The dopper, which is a strong rod, and very light. 4. The snapper, or snap-rod, which is a strong rod, peculiarly used for the pike. 5. The bottom-rod, which is the same as the dapper, only somewhat more pliable. 6. The sniggling or poking-stick, which has a bow'd stick at the end, a strong line and needle baited with a lob-worm: this is only used for eels in their holes.

To make a *line*, after the best manner, the hairs ought to be very round, of an equal bigness, and twisted even: afterwards lay them in water for a quarter of an hour, to find which hairs do shrink; then twist them over again: some mix silk in the twisting, which is never so good as a line of all hairs, or all silk. The best colour for lines is, the sorrel, white, and grey; the two last for clear waters, and the first for muddy rivers. In the making your line, leave a bow at both ends, the one to put it to and take it from the rod, the other to hang your lowest link upon, to which your hook is fastened.

The *hook* ought to be long in the shank, somewhat round in its circumference, the point standing even and strait; and let the bending be in the shank. Strong, but small silk, is to be used in the setting on of the hook; and the hair laid on the inside of it.

The *floats* are made divers ways: some use the *Muscovy* duck quils, which are the best for still waters; but for strong streams, take good sound cork, without flaws or holes, and bore it through with a hot iron; then put into it a quill of a fit proportion; then pare your cork into a pyramidical form, of what bigness you think fit; after this grind it smooth.

To *plumb* your *ground*, you must carry with you a musket-ball, with a hole made through it, or any other sort of plummet, tying this to a strong twist, hang it on your hook, and so you will find the depth of the water. And that you may not incommode your tackle, it will be very requisite to make several partitions in pieces of parchment sewed together, by which each utensil may have a place by itself; not forgetting to carry a little whetstone with you to sharpen your hooks, if you find them blunt and dull; and having several bags of divers sizes for your hooks, corks, silk, thread, lead, flies, *&c.* Likewise linen and woollen bags for all sorts of baits; and a small pole with a loop at the end thereof, to which you may fasten a small net to land great fish withal.

There are many different sorts of *natural flies*, but some better beloved by some sort of fish; which is easily distinguished, when coming in the morning to the river-side, you beat the bushes with your rod, and take up what variety you may of all sorts of flies, and try them all, by which means you will

* To make the *palmer fly*, the angler must arm his line on the inside of the hook; then with a pair of scissars cut so much of the brown of a mallard's feathers, as he shall think sufficient to make the wings; then lay the outermost part of the feather next the hook, and the point of the feather towards the shank of the hook; and afterwards whip it three or four times about the hook, with the same silk he armed it with, then he makes his silk fast; which done, he takes a plover's top, or the hackle of the neck of a cock, of which he takes one side of the feather; then takes the hackle, silk, or gold or silver thread, and makes all these fast at the bend of the hook, working them up to the wings; every turn shifting his fingers, and making a stop, that the gold may fall right, which is to be made fast; and the hackle worked up to the same place, and also made fast: then he takes the hook betwixt his finger and thumb, in the left hand, and with a needle or pin parts the wings in two: then with the arming silk he twists it about, as it falls cross between the wings, and with his thumb must turn the points of the feathers towards the bend of the hook, working it three or four times about the shank, and afterwards fastening it. If he makes the ground of hog's wool, sandy, black, or white, or of bear's wool, or of a red bullock, he must work these grounds on a waxed silk, and must arm and set on the wings as above mentioned. The body of the *May-fly*, must be wrought with some of these grounds; which will be very well, when ribb'd with black hair. He must make the *oak-fly*, with orange tawney, and black for the body; and the brown of the mallard's feather for the wings.

quickly know which are in the greatest esteem among them.

Though there are reckoned no less than twelve sorts of the *artificial fly*, it is much better to find the fly proper for every season, and that which the fish at that time most eagerly covet, and make one as like it as possible you may, in colour, shape, and proportion; and for your better imitation, lay the natural fly before you. *See the* note *on* p. 490.

The best Rules for *artificial fly-fishing*, are,

1. To fish in a river somewhat disturbed with rain; or in a cloudy day, when the waters are moved by a gentle breeze; the south wind is best; and if the winds blow high, yet not so but that you may conveniently guard your tackle, the fish will rise in plain deeps; but if the wind be small, the best angling is in the swift streams.

2. Keep as far from the water-side as may be; fish down with the stream, with the sun at your back, not suffering your line to touch the water, but only your fly.

3. In clear rivers, ever angle with a small fly, with slender wings; but in muddy places use larger.

4. When after rain the water becomes brownish, use a red or orange fly; in a clear day, at night, a colour'd fly; a dark fly for dark waters, &c.

5. Let the line be twice as long as the rod, unless the river be encumbered with wood.

6. For every sort of fly have several of the same differing in colour, to suit with the different complexions of several waters and weathers.

7. Have a nimble eye, and active hand, to strike presently with the rising of the fish; or else he will be apt to spew out the hook.

8. Let your fly fall first into the water; for if your line fall first it scares the fish, and therefore you must draw again and cast.

9. In slow rivers, or still places, cast the fly cross over the river; and let it sink a little in the water, and draw it gently back with the current.

Lastly, *Salmon flies*, should be made with their wings standing one behind the other, whether two or four. That fish delights in the gaudiest colours that can be; chiefly in the wings, which must be long as well as the tail.

In *angling* the following *rules* are to be observed. 1. To place yourself so that your shadow do not at any time lie upon the water if shallow. 2. To angle in a pond near the ford where the cattle go to drink, and in rivers, in such places as the fish you intend to angle for, usually frequent; as for *breams*, in the deepest water; for *eels*, under banks; for *chub*, in deep shaded holes; for *pearch*, in scowrs; for *roach*, in the same places; for *trouts*, in quick streams.

The best times for angling are from *April* to *October*: for in cold stormy weather, or bleak easterly winds, the fish will not bite. The time of the day, in the warm months, is in the morning, about nine o'clock, and in the afternoon, between three and four.

In order to attract the fish to the place intended for angling, it will be proper once in four or five days to cast in some corn boiled soft, garbage, worms chopt to pieces, or grains steeped in blood, and dried; and if you fish in a stream, it will be best to cast in the grains above the hook.

The best way of *angling* with the *fly*, is down the river; and in order to make them bite freely, be sure to use such baits as you know they are naturally inclined to, and in such manner as they are accustomed to receive them.

If you fish for *carp*, you are to arm yourself with patience, for they are very subtile: they always chuse to lye in the deepest places; they seldom bite in cold weather, and in hot, a man cannot be too early, or too late for them; when they do bite, there is no fear of the hold. The baits are, the red-worm, in *March*; the cadew, in *June*; and the grashopper, in *July*, *August*, and *September*. Proper pastes may also be prepared for them; as honey and sugar, wrought together, and thrown in pieces into the water, some hours before you begin to angle. Honey, and white crumbs of bread mix'd together, do also make a good paste.

If for *dace*, and *dare*, which resemble much one another, in kind, size, goodness, feeding, cunning, &c. The *dace*, or *dare*, will bite at any fly, but especially the *stone cadice fly*, or *May fly*, the latter end of *April*, and the beginning, or most part in *May*, is a most excellent bait, floating on the top of the water, which they rarely refuse in a warm day; but when you fish under water for them, it is best to be within a handful, or something more of the ground. To catch *dace* in water, the bait is a white worm, with a read head, as big as the top of a man's little finger, gather'd after the plough, in heaths, or sandy grounds.

The *silver eel* may be caught with divers baits; particularly powder'd beef, garden worms, or lobs, minnows, hens guts, fish, garbage, &c. But as they hide themselves in the mud, without stirring out for six months, and in the summer, take no delight to be abroad in the day, the most proper time to take them is in the night; by fastening a line to the bank-side, with a laying hook in the water, or a line plumbed with a float, to discover where the line lies in the morning. The roach does here very well for a bait, the needle being laid in his mouth.

There is another way of taking *eels*, called *sniggling*, perform'd in the day-time, by taking a strong line and needle, baited with a lob, or garden worm, and

and reſorting to ſuch holes and places, as *eels* uſed to abſcond in, near mills, wears, or flood-gates, where the bait being gently put into the hole, by the help of a cleft ſtick, fixt at the end of our rod, the *eel* will certainly bite.

Bobbing for eels, is done by taking very large lobs, ſcouring them well, and with a needle, run ſome ſtrong twiſted ſilk through them from end to end; taking ſo many as may be wrapped a dozen times round a board: then they muſt be tied faſt with the two ends of the ſilk, that they may hang in ſo many links. This done, they are to be faſtened all to a cord, and about an handful and a half above the worms, a plummet is fixed, three quarters of a pound weight; and the cord made faſt to a ſtrong pole. *Fiſhing* with theſe in muddy water, the *eels* will bite haſtily at the bait; when you think they have ſwallow'd it, gently drawn up the line, and bring them aſhore.

Others uſe an *eel* ſpear, with three or four forks, or jagged teeth, which they ſtrike at random into the mud.

In *April*, *May*, *June*, and *July*, you may fiſh for *flounders* all day long, either in a ſwift ſtream, or in the ſtill deep, with red-worms, waſps, and gentles.

If you fiſh for *gudgeon*, which is a ſmall fiſh of a delicious taſte, and ſpawns three or four times in the ſummer ſeaſon, feeding in ſtreams, and on gravel: bait with a ſmall red-worm, fiſhing near the ground. The *gudgeon* may either be fiſhed for with a float, the hook being on the ground; or by hand with a running line on the ground, without cork, or float. He will bite well at waſps, gentles, and cod-baits. When you angle for *gudgeons*, ſtir up the ſand or gravel with a long pole, which will make them gather to the place, and bite the faſter.

The *pearch*, or *perch*, ſpawns but in *February* or *March*, and ſeldom grows longer than two foot. He bites beſt when the ſpring is far ſpent. The proper baits are the *minnow*, and *ſmall frog*; but a worm called a *brandling* is beſt; though the *minnow* yields the beſt ſport, which is to be alive and ſtuck on the hook through the upper lip, or back-fin, and kept ſwimming about mid-water, or ſomewhat lower: for which purpoſe, you muſt have an indifferent large cork, with a quill on your line. When you fiſh with a frog, you muſt faſten the hook through the ſkin of his leg, towards the upper part thereof. You may alſo bait with lob-worms well ſcour'd, bobs, oak worms, gentles, colewort worms, minnows, dors, waſps, and cad-baits. When the fiſh bites, as he is none of the leathern-mouth'd kind, he muſt have time to pouch his bait. The beſt place to fiſh for him, is, in the turning of the water eddy, in a good gravel bottom. He bites well all the day long, in cool cloudy weather; but chiefly from eight in the morning till ten, and from three in the afternoon till about ſix; but will not bite at all the ſeaſons of the year, eſpecially in winter, for then he is very abſtemious; yet if it be warm, he will bite then in the middle of the day; for in winter, all fiſh bite beſt about the heat of the day.

There are two ways of *fiſhing* for the *pike*; by the *ledger-bait*, and the *walking-bait*.

The *ledger-bait*, is that fixed in one certain place, and which the *angler* may leave behind him. And this muſt be a living bait, either *fiſh* or *frog*. Of fiſh, the beſt are the dace, roach, or perch; for frogs, the yelloweſt are the beſt.

To apply it; if a fiſh, ſtick the hook through his upper lip; then faſtening it to a ſtrong line, ten or twelve yards long, tie the other end of the line, either to ſome ſtake in the ground, or to ſome bough of a tree, near the pike's uſual haunt, or where you think it is like he may come. Then wind your line on a forked ſtick (big enough to keep the bait from drawing it under water) all about half a yard, or ſomewhat more, and your ſtick having a ſmall cleft at the end, faſten your line therein; but ſo, that when the *pike* comes, he may eaſily draw it forth, and have line enough to go to his hold and pouch. If the bait be a frog; the arming wire is to be put in his mouth, and out at his gills, and one of the legs to be ſtitched or tied over the upper joint of the wire.

The *walking-bait*, is that which the fiſher caſts in, and conducts with a rod, &c. This is perform'd by a trole, with a winch to wind it up withal. At the top of the rod is to be placed a ring for the line to run through. The line for two yards and a quarter next the hook, to be of ſilk double, and armed with wires, the length of ſeven inches: on the ſhank of the hook is to be faſtened a ſmooth piece of lead, ſo as to ſink the fiſh bait, which is to be a *gudgeon* with his head downwards. Thus diſpoſe the bait to be caſt up and down, and if you feel the fiſh at the hook, give him length enough to run away with the bait, and pouch it; then ſtrike him with a ſmart jerk.

To fiſh with a dead bait, uſe a minnow, yellow frog, dace, or roach, anointed with gum of ivy, diſſolved in oil of ſpike; and caſt it where the *pike* frequents. After it has lain a little while at the bottom, draw it to the top, and ſoup the ſtream, and you'll ſoon perceive a *pike*, in earneſt purſuit thereof. This fiſh bites beſt about three in the afternoon, in clear water, with a gentle gale, from the middle of ſummer, to the end of autumn; but in winter all day long; and in the ſpring he bites beſt early in the morning, and late at night.

To angle for *roaches* in *April*, the cads, or worms, are proper baits; and ſmall white ſnails, or flies; which baits muſt be under water, for *roaches* will not bite at the top. Others uſe a *May-fly* in that ſeaſon with good ſucceſs. In autumn you may fiſh for them with paſte, only made of the crumbs of fine white bread, moulded with a little water, and the labour of your hands, into a tough paſte, coloured, not very deep, with red lead, with which you may mix a little fine cotton, or lint, and a little butter; theſe laſt will make it hold on, and not waſh off your hook, with which you muſt fiſh with moſt circumſpection, or you loſe your bait. In winter *gentles* are the beſt bait. Sprouted malt, the young brood of waſps, and bees dipped in blood, and the thick blood of ſheep, half dried, are *noſtrums* in this ſort of *fiſhing*.

The ſeaſon for catching *tench*, is in *June*, *July*, and *Auguſt*, very early and late, or even all night, in the ſtill part of rivers. His bait is a large red worm, at which he bites very eagerly, if firſt dipt in tar, He alſo delights in all ſorts of paſtes, made up of ſtrong ſcented oils, or with tar: or a paſte of brown bread and honey; nor does he refuſe the cad-worm, lob-worm, flag-worm, green gentles, cad bait, or ſoft boil'd bread grain.

The *trout* is uſually caught with a worm, minnow, or fly, natural or artificial. There are ſeveral ſorts of worms, which are baits for the angler; the earth-worm, the dung-worm, the maggot, or gentle; but for the *trout*, the lob-worm, and brandling are the beſt; or the ſquirrel-tail, having a red head, ſtreak'd down the back, and a broad tail. The brandling is commonly found in an old dunghil, cow-dung, hogs-dung, or tanners-bark.

Whatever worms you fiſh withal, they are the better for keeping; which muſt be in an earthen pot with moſs, to be changed often in ſummer, that is, once in three or four days, and in twice as long time in winter.

When you fiſh for a *trout* by hand, on the ground, take a lob-worm, and run your hook through him, a little above the middle, and out again a little below it; then draw your worm above the arming of your hook, making your firſt entrance at the tail-end, that the point of the hook may come out at the head. When you fiſh with a minnow, take the whiteſt and middle ſize, ſlip the hook through his mouth, and the point and beard out of the tail, ſo as it may lie almoſt ſtraight on the hook; then try againſt the ſtream whether it will turn. In defect of a minnow, a ſmall loach may ſerve the turn; or for want of either, an artificial one may be made of cloth, to the life, which is found every whit as good a bait as the natural one.

We'll finiſh this treatiſe with ſome obſervations on *fiſh ponds*, and on the feeding, breeding, and preſerving of fiſh.

Fiſh-ponds are no ſmall improvement of watry and boggy lands, many of which are fit for no other uſe.

In making of a pond, its head ſhould be at the loweſt part of the ground, that the trench of the flood-gate or ſluice, having a good fall, may not be too long in emptying. The beſt way of making the head ſecure, is to drive in two or three rows of ſtakes above ſix feet long, at about four feet diſtance from each other, the whole length of the pond head, whereof the firſt row ſhould be rammed at leaſt about four feet deep. If the bottom is falſe, the foundation may be laid with quick-lime, which, ſlacking, will make it as hard as a ſtone. Some lay a layer of lime, and another of earth dug out of the pond, among the piles and ſtakes; and when theſe are well covered, drive in others, as they ſee occaſion, ramming in the earth as before, till the pond-head be of the height deſigned.

The dam ſhould be made ſloping on each ſide, leaving a waſte to carry off the overabundance of water in times of floods or rains; and as to the depth of the pond, the deepeſt part need not exceed ſix feet, riſing gradually in ſhoals towards the ſides, for the fiſh to ſun themſelves, and lay their ſpawn.

Gravelly and ſandy bottoms, eſpecially the latter, are beſt for breeding; and a fat ſoil with a white fat water, as the waſhings of hills, commons, ſtreets, ſinks, &c. is beſt for fattening all ſorts of fiſh.

For ſtoring a pond, *carp* is to be preferred for its goodneſs, quick growth, and great increaſe; as breeding five or ſix times a year. A pond of an acre, if it be a feeding and not a breeding one, will every year feed two hundred carps of three years old, three hundred of two years old, and four hundred of a year old. Carps delight in ponds that have marl or clay-bottoms, with plenty of weeds and graſs, whereupon they feed in hot months.

Your pond ſhould be drained every three or four years, and your fiſh ſorted. If it is a breeding one, the ſmaller ones are to be taken out, to ſtore other ponds with; leaving a good ſtock of females, at leaſt eight or nine years old, as they never breed before that age. In feeding ponds, it is beſt to keep them pretty near of a ſize.

When fiſh are fed in large pools or ponds, either malt boiled, or freſh grains, is the beſt food; thus carps may be raiſed and fed like capons, and tenches will feed as well. The care of feeding them is beſt committed to a gardener, or the butler, who ſhould be always at hand. In a ſtew, any ſort of grain boiled, eſpecially peas, and malt coarſe ground; alſo the grains after brewing, whilſt freſh and ſweet: but one buſhel of malt not brewed, will go as far as two of grains.

Of

Of FORTIFICATION.

FORTIFICATION is *military architecture*, or the art of fortifying or strengthening a place, by raising works around it for defence against a powerful enemy.

Some authors go back to the beginning of the world for the author, or origin, of *military architecture*, or *fortification*. According to them, God himself was the first engineer; and paradise, or the garden of *Eden*, the first fortress. *Cain* improved on the hint, in building the first city, *Gen.* iv. 17. after him came *Nimrod*, *Gen.* x. 10. then *Semiramis*, as *Polyænus* relates, *Stratagem. lib.* 8. *c.* 27. the *Canaanites*, *Numb.* xiii. 19. *Deut.* i. 28. *David*, 2 *Kings* v. 9. *Solomon*, 2 *Chron.* iii. 5. *Rehoboam* his son, 2 *Chron.* viii. 5. and other kings of *Judah* and *Israel*; and at length the *Greeks* and *Romans*, *Vitruv. lib.* 10. *c. ult.* and *lib.* 1. *c.* 5.

Such is the series of those who *fortified* places; to which might be added *Pharaoh*, the persecutor of the *Israelites*, who built the cities of *Pithom*, and *Raamses*, *Exod* i. 11.

But how ancient soever the surrounding of cities with walls, towers, &c. may be, the name *fortification*, and the art now understood thereby, are of no very old standing. They had their rise since the invention of cannons; the terrible effects whereof rendered it necessary to change the structure of the antient walls, and add so many things thereto, that those changes were thought enough to constitute a new art, which was called *fortification*, by the strength it afforded those in cities, to defend themselves against an enemy.

The first authors, who have wrote on *fortification*, considered as a particular formed art, are *Ramelli* and *Cutaneo*, *Italians*; after them *Errard*, engineer to *Henry the Great*, king of *France*; *Stevinus*, engineer to the prince of *Orange*; *Marolois*, the chevalier *de Ville*, *Lorini*, *Coehorn*, the count *de Pagan*, and the marshal *de Vauban*: Which last two noble authors contributed greatly to the perfection of the art.

FORTIFICATIONS are either *durable* or *temporary*.

Durable fortifications are the walls, &c. of cities, frontier towns, &c.

Temporary fortifications are those erected for the security of a camp, for seizing and maintaining a post or pass, and on such like emergent occasions.

Again: the *durable* kind are divided into *regular* and *irregular*.

The *regular fortification*, has the bastions all equal; built in a regular polygon: whose sides and angles are generally about a musket-shot from each other. In this sort of *fortification* the parts being all equal, have the advantage of being equally defensible, so that there are no weak places.

The *irregular fortification* is that wherein the bastions are unequal and unlike; or the sides and angles not all equal and equidistant. In this sort of *fortification* the defence and strength being unequal, there is a necessity for reducing the irregular figure, as near as may be, to a regular one. And as the irregularity of a figure depends on the quantity of angles and sides; the irregularity of a *fortification* arises either from the angles being too small, or the sides being too long or too short. Consequently an irregular figure being proposed to be fortified, all the angles, with the quantity of the sides, must be found, to be able to judge how it is to be *fortified*.

Fortifications are represented either by designs on paper, or by models of wood, plaister, or pasteboard. There are four sorts of delineations, *viz.* the *design*, *ichnography*, *orthography*, and *scenography*.

The DESIGN is the first draught of a *fortification*, by simple lines, to know the length thereof.

The ICHNOGRAPHY denotes the plan, or representation of the length and breadth of a fortress: the distinct parts of which are marked out, either upon the ground itself, or upon paper.

The ORTHOGRAPHY is the profile, or representation of a *fortification*, or a draught so conducted, as that the length, breadth, height, and thickness of the several parts are expressed: such as they would appear, if it were perspective.

The SCENOGRAPHY is the representation of a *fortification*, on a perspective plan, or a description thereof in all its dimensions, such as it appears to the eye.

Before we proceed we must give some general rules to be necessarily observed in the *fortification* of places. 1. The manner of *fortifying* must be accommodated to that of attacking; so that no one manner can be assured will always hold, unless it be assured the manner of besieging be incapable of being altered; and to judge of the perfection of a *fortification*, the method of besieging at the time when it was built, must be considered. 2 All the parts of a *fortification*, should be able to resist the most

moſt forcible machines uſed in beſieging. 3. A *fortification* ſhould be ſo contrived, that it may be defended with as few men as poſſible. 4. That the defendants may be in the better condition, they muſt not be expoſed to the enemies guns and mortars; but the aggreſſors be expoſed to theirs.

Hence, 5, all the parts of *a fortification* ſhould be ſo diſpoſed, as that they may defend each other; in order to this, every part therein is to be flanked, *i. e.* capable of being ſeen and defended from ſome other, ſo that there be no place where an enemy can lodge himſelf either unſeen, or under ſhelter. 6. All the campaign around muſt lay open to the defendants, ſo that no hills or eminences muſt be allowed; behind which the enemy might ſhelter himſelf from the guns of the *fortification*, or from which he might annoy them with his own. The fortreſs, then, is to command all the place round about; conſequently the outworks muſt be lower than the body of the place. 7. No line of defence to be above point blank muſket-ſhot, which is about one hundred and twenty fathom. 8. The acuter the angle at the centre, the ſtronger is the place; as conſiſting of more ſides, and conſequently more defenſible.

Mr. *Vauban*, as well as count *Pagan*, admits of three ſorts of *fortifications*, viz. the great, where the exterior polygon has always two hundred fathoms; the middle, which has always one hundred and eighty; the ſmall which has but one hundred and ſixty fathoms.

All *fortifications* conſiſt of *lines* and *angles*, which have various names according to their different offices.

The *angles*, Fig. 1. are the *angle of the centre*, the *angle of the polygon*, the *angle of the baſtion*, the *angle of the courtine*, the *angle of defence*, the *flanking angle*, the *flanked angle*, and the *angle of the epaule*.

The *lines* are thoſe of the *exterior polygon*, of the *interior polygon*, of the *perpendicular*, of the *line of defence*, of the *complement*, of the *great ſemi-diameter*, of the *little ſemi-diameter*, of the *capital*, of the *face*, of the *demi-gorge*, of the *flank*, and of the *courtine*.

Of theſe *lines* and *angles*, are formed *baſtions* and *courtines*, and ſometimes *demi-baſtions*, according the ſituation of the ground; *cavaliers*, *ramparts*, *fauſſe-braye*, *ditches*, *counterſcarps*, *covert-ways*, *half moons*, *ravelins*, *horn-works*, *crown-works*, *out-works*, *eſplanades*, *redoubts*, and *tenailles*,

A Bastion, in the modern ſignification, is a huge maſſive of earth, uſually faced with ſods, ſometimes with brick, rarely with ſtone, ſtanding out from a rampart, whereof it is a principal part, and anſwers to what in the antient *fortifications* is called *bul-wark*.

A *baſtion* conſiſts of two faces, and two flanks: the faces are the lines B C, and C S; including the angle of the *baſtion*. The flanks are the line B A S D, Fig. 1. in the plate Fortification.

The union of the two faces makes the outmoſt or ſaliant angle, called alſo the *angle of the baſtion*, B C S. fig. 1. The union of the two faces to the two flanks, makes the ſide angles, called the *ſhoulders*, or *epaules of the baſtion*. And the union of the two other ends of the flanks to the two *courtines*, the *angles* of the flanks of the *baſtion*

The foundation of the *baſtion*, i. e. of a work conſiſting of flanks and faces, is, that great rule in *fortification*, viz. that every part of a work muſt be ſeen and defended from ſome other part; mere *angles* therefore are not ſufficient, but flanks and faces are indiſpenſably requiſite. If the *baſtions* E F G, and H I K, Fig. 8. conſiſted of faces alone, the angles G and H could not be defended from the lines F G, or I H; but if the *baſtion* conſiſts of flanks and faces, as A B C S D, all the points may be defended from the flanks, there being none, *v. g.* in the face B C, but what may be defended from the oppoſite angle E L, nor any in the courtine A E, but what may be defended from the adjacent flanks B A, and E L; nor any in one flank B A, but may be defended from the other E L.

For the proportion of the faces, they are not to be leſs than twenty-four rhine-land perches, nor more than thirty.

The flanks of the baſtion, the longer they are, the better; provided they ſtand at the ſame angle, under the line of defence. If the angle of the baſtion be leſs than ſixty degrees, it will be too ſmall to give room for guns; and beſides ſo acute as to be eaſily beaten down by the enemies guns: Therefore a triangle can never be fortified, in regard ſome, or all the angles will be either ſixty degrees, or leſs than ſixty.

Degree, in this place, is a diviſion of a circle, including a three hundred and ſixtieth part thereof. Every circle, great and ſmall, is ſuppoſed to be divided into 360 parts, called *degrees*; the *degree* is ſubdivided into 60 leſſer parts, called *minutes*; the minute into 60 others, called *ſeconds*, the ſecond into 60 *thirds*, &c.

Baſtions are of divers kinds, *ſolid*, *void*, *flat*, *cut*, &c. The ſolid baſtions are thoſe that are filled up entirely, and have the earth equal to the height of the rampart, without any void ſpace towards the center. Void or hollow baſtions, are thoſe ſurrounded with a rampart, and a parapet only ranging round their flanks and faces, ſo as to have a void ſpace towards the center; where the ground is ſo low, that if the rampart be taken, no retrenchment can be made in the center, but what will lie under the fire of the beſieged. A flat baſtion, is a baſtion built on a right line in the middle of a courtine, when it is too long to be defended by the baſtion at its extremes. A cut baſtion, is that, whoſe point is cut off, and in lieu thereof, has a re-entring angle, or an angle inwards, with two points outwards; ſometimes alſo called a baſtion with a tenaille; uſed either when without ſuch a contrivance, the angle would be too acute, or when water or other impediment hinders the carrying on the baſtion to its full extent.

There are, likewiſe, compoſed, regular, irregular, deformed, demi, and double baſtions. A compoſed baſtion, is when the two ſides of the interior polygon are very unequal, which makes the gorges alſo unequal. A regular baſtion, is that which has its due proportion of faces, flanks, and gorges; the faces being of an equal length, the flanks the ſame, and the two angles of the ſhoulder equal. An irregular baſtion is where this proportion and equality is not obſerved. A deformed baſtion is where the irregularity of the lines and angles makes the baſtion out of ſhape, as when it wants one of its demi-gorges, one ſide of the interior polygon being too ſhort. A demi-baſtion, is that which has but one face and one flank, called alſo an epaulement; to fortify the angle of a place that is too acute, they cut off the point, and make two demi baſtions, which form a tenaille, or a re-entring angle. Their chief uſe is before a horn-work, or crown-work. A double baſtion, is that which on the plain of the great baſtion, has another baſtion built higher, ſomewhat after the manner of a cavalier; leaving twelve or eighteen feet between the parapet of the lower, and the foot of the higher.

Every baſtion hath its capitals, gorges, and diſtances. The capital of a baſtion, is a line drawn from the angle of the polygon, to the point of the baſtion. Thoſe capitals are from thirty-five, to forty fathom long, from the point of the baſtion, to the point where the two demi-gorges meet. The gorge of a baſtion is what remains of the ſides of the polygon of a place, after retrenching the courtines: In which it makes an angle in the center of the baſtion; ſuch is A H D, Fig. 1. The demi-gorge, or half-gorge, is the entrance into the baſtion; not taken directly from angle to angle, where the baſtion joins to the courtine, from the angle of the flank to the center of the baſtion, or angle the two courtines would make, were they thus protracted to meet in the baſtion. The diſtance of the *baſtions* is the ſides of the exterior polygon.

The COURTINE, *curtain*, or *curtin* (the next piece of *fortification* which falls under our conſideration) is that part of a wall or rampart, which is between two baſtions; or which joins the flanks thereof: *q q*, Fig. 8. The courtine is uſually bordered with a parapet five foot high; behind which the ſoldiers ſtand, to fire upon the covert-way, and into the moat. Beſiegers ſeldom carry on their attacks againſt the courtine, becauſe it is the beſt flanked of any part.

The courtine has its angle and complement. The angle of the courtine, or of the flank, is that made by or contained between the courtine and the flank. The complement of the courtine, is that part of the interior ſide thereof, which makes the demi-gorge.

The CAVALIER is a mount, or elevation of earth, either round or oblong, having a platform on the top, bordered with a parapet, to cover the cannon placed on it, and cut with embrazures to fire through; ſerving to overlook and command all around the place. *Cavaliers* are raiſed in ſieges on the baſtions and courtines of ramparts, in order to fire on the eminences around, and oblige the enemy to get farther off, as well as to ſcour the trenches. But the gorge of the baſtion, is the place where *cavaliers* are moſt properly erected; thoſe raiſed on the courtine, being rather called platforms.

A PLATFORM, is an elevation of earth, on which cannon is placed to fire on the enemy. Such are the mounts on the middle of the courtine; and there is always one on the ramparts where the cannon are mounted. The platform is made by heaping up of earth on the rampart; or by an arrangement of madriers,* riſing inſenſibly for the cannon to roll on; either in a caſemate, or on an attack in the outworks.

The RAMPART, is a maſſy bank, or elevation of earth, raiſed about the body of a place, to cover it from the great ſhot. Upon the rampart the ſoldiers continually keep guard, and pieces of artillery are planted for the defence of the place.

To ſhelter the guard from the enemies ſhot, the outſide of the rampart is built higher than the inſide, *i. e.* a parapet is raiſed upon it with a plat-

* Long and broad planks for ſupporting earth.

form. The rampart is built with a *talus* *, or slope, both on the inner and outer side. The rampart is sometimes lined, *i. e. fortified* with a stone wall within side; otherwise it has a *berme* †. It is encompassed with a moat or ditch, out of which the earth that forms the rampart is dug. The height of the rampart should not exceed three fathoms, this being sufficient to cover the houses from the battery of the cannon; neither ought its thickness to be above ten or twelve, unless more earth be taken out of the ditch, than can be otherwise bestowed. The ramparts of half-moons are the better for being low, that the small fire of the defendants, may the better reach the bottom of the ditch: but yet they must be so high, as not to be commanded by the covert-way.

Fausse-braye, is an elevation of earth, two or three fathoms broad, round the foot of the rampart on the outside, defended by a parapet, which parts it from the berme, and the edge of the ditch: its use is for the defence of the ditch.

The Ditch, called *fosse* and *moat*, is a trench dug round the rampart, or wall of a *fortified* place, between the scarp and counterscarp, *b b b*, Fig. 8. Some ditches are dry, others full of water; each whereof have their advantages. The *ditch* should be of such a breadth, as that the tallest tree may not reach over it, *i. e.* from 15 to 20 fathoms.

The Counterscarp is properly the outward, or exterior talus of the ditch; though at present is understood, under that name, the *covert-way*, with its parapet.

But they are mistaken, for the *covert-way* is a space of ground, level with the adjoining country on the edge of the ditch, ranging quite round the half-moons, and other works without-side the ditch *b b*, Fig 8. It it otherwise called corridor, and has a parapet together with its banquette and glacis, which form the height of the parapet. One of the greatest difficulties in a siege is to make a lodgment on the *covert-way*; because, usually, the besieged pallisade it along the middle, and under mine it on all sides. This is also, sometimes called the counterscarp; because it is on the edge of the scarp.

A Banquette, is a little foot-bank, or elevation of earth, forming a path which runs along the inside of a parapet; by which the musqueteers get up, to discover the counterscrap, or to fire on the enemies in the moat, or in the covert-way. The banquette is generally a foot and a half high, and almost three feet broad; having two or three steps to mount it by. Where the parapet is very high, they make a double banquette, one over another.

A parapet or breast-work, is a defence or skreen, on the extream of a rampart, or other work, serving to cover the soldiers, and the cannon from the enemies fire. Parapets are raised on all works, where it is necessary to cover the men from the enemies fire, both within and without the place, and even the approaches. The parapet royal, or that of the rampart, is to be of earth, cannon-proof, from eighteen to twenty feet thick, six feet high towards the place, and four or five towards the rampart. This difference of height, makes a glacis, or slope, for the musqueteers to fire down into the ditch, or at least the counterscarp. The parapet of the wall is sometimes of stone. The parapet of the trenches is either made of the earth dug up, or of gabions, fascines, sacks of earth, or the like.

Glacis is a sloping bank, which reaches from the parapet of the counterscrap, or covert-way, to the level side of the field, *a a a c*, Fig 8. The glacis, otherwise *esplanade*, is about six feet high, and loses itself by an insensible diminution in the space of ten fathoms.

The Half-Moon, is an out-work consisting of two faces, forming together a saliant angle, whose gorge is turned like an half-moon. Half-moons are sometimes raised before the courtine, when the ditch is wider than it ought to be: in which case it is much the same with the ravelin, only that the gorge of an half-moon is made bending in like a bow, or crescent, and is chiefly used to cover the point of the bastion; whereas ravelins are always placed before the courtine.

Ravelin is a detached work, composed only of two faces, which make a saliant angle, without any flanks; and raised before the courtine on the counterscarp of the place. A ravelin is a triangular work, resembling the point of a bastion, with the flanks cut off, *i i i*, Fig. 8. Its use before

* There is an exterior talus, and an interior one. The exterior talus for work, is its slope on the side towards the country; which is always made as little as possible, to prevent the enemies scalado; unless the earth be bad, and then it is absolutely necessary to allow a considerable talus for its parapet. The interior talus of a work, is its slope on the inside towards the place.

† A small space of ground, four or five feet wide, left without the rampart, between its foot and the side of the moat, to receive the earth that rolls down from the rampart, and prevent its falling into, and filling up the moat. This is also called *liziere, relais, retraite, pas de souris, foreland*, &c. Sometimes for more security, the berme is pallisaded.

a coura courtine is, to cover the opposite flanks of the two next bastions. It it used also to cover a bridge or a gate, and is always placed without the moat. What the engineers calls a ravelin, the soldiers generally call a half-moon. There are also double ravelins, which serve to defend each other. They are said to be double when they are joined by a courtine.

To cover and defend a courtine, bastion, or other places suspected to be weaker than the rest, as also to possess a height, there is a sort of outwork erected, and advancing towards the field called horn-work, which consists of two demi-bastions, as L M N and O P Q, Fig. 9 joined by the courtine N O. Its sides or flanks are usually parallel, though sometimes they approach or contract towards the place, forming what they call a *swallow's tail*; when the flanks are too long, they sometimes make epaulements to flank them. The parts of the horn-work, next the country, is to be defended by a parapet.

Two horn-works joined together make a crown-work, which is an out work running into the field; designed to keep off the enemy, gain some hill, or advantageous post, and cover the out-works of the place, *II*, Fig. 8. The crown-work consists of two demi bastions at the extremes, and an entire bastion in the middle with courtines.

All those works made without side the ditch, or *fosse*, to cover and defend it are called out-works which serve to cover the body of the place, and to keep the enemy at a distance, and to prevent their taking advantage of the cavities and elevations, usually found in the places about the counterscarp.

There is a kind of work indented in form of the teeth of a saw, with saliant, and re-entring angles, to the end that one part may flank or defend another, called Redens, *redans*, or *redant*. It is also called *saw-work*, and *indented work*, and is frequently used in the *fortifying* of walls, where it is not necessary to be at the expence of building bastions; as when they stand on the side of a river, a marsh, the sea, &c. The parapet of the *corridor* is frequently redented, or carried on in the way of *redens*.

There is also a kind of out-work, consisting of two parallel sides, with a front wherein is a re-entering angle, called Tenaille, which is of two kinds, *viz*, *simple* and *double*. The *simple*, or *single tenaille*, is a large out work, as D A B C E. consisting of two faces or sides, A B, and C B, including a re-entering angle B, Fig. 9, and Fig 8, *d*. *Double*, or *flanked tenaille*, is a large out-work, consisting of two *simple tenailles*, or three saliants, and two re-entring angles, F G H, and H I K, Fig. 8, *e*. The great defects of *tenailles* are, that they take up too much room, and on that account are advantageous to the enemy; that the angle B, is undefended; the height of the parapet hindering the seeing down into it, so that the enemy can lodge there under covert: and that the sides A D and C E, are not sufficiently flanked For these reasons, *tenailles* are now excluded out of *fortifications* by the best engineers, and never made, but where there wants time to form a horn-work. The *tenaille* of the place, is the front of the place, comprehended between the points of two neighbouring bastions; including the courtine, the two flanks raised on the courtine, and the two sides of the bastions which face one another; so that the *tenaille* is the same with what is otherwise called the face of the fortress. The *tenaille* of the ditch, is a low work raised before the courtine in the middle of the *fosse*, or ditch. It is of three sorts, the first is composed of a courtine, two flanks, and two faces: the rampart of the courtine, including the parapet and talus, is but five fathoms thick; but the rampart of the flanks and faces, seven, *e* Fig. 8. The second, which M. *Vauban* says he found to be of very good defence, is composed only of two faces, made on the lines of defence, whose ramparts and faces are parallel. The third sort only differs from the second in this, that its rampart is parallel to the courtine of the place. All three sorts are good defences for the ditch, and lie so low, that they cannot be hurt by the besiegers cannon, till they are masters of the covert-way, and have planted their artillery there.

There have been invented various methods of *fortifying*; the principal, and those which chiefly obtain through *Europe*, are those of *Vauban*, *Blondel*, *Pagan*, *Coehorn*, and *Scheiter*, from which all the rest are easily conceived.

The figure, or perimeter (*i. e.* the *ambit*, or extent that binds a figure, or body) of a *fortress*, or *fortified* place, is called Polygon, which is a figure whose perimeter consists of more than four sides, and angles. If the sides and angles be equal, the figure is called a *regular polygon*. *Polygons* are distinguished according to the number of their sides. Those of five sides, are called *pentagons*; those of six, *hexagons*; those of seven, *heptagons*; those of eight, *octagons*, &c. The *polygon* of a place is distinguished into exterior, and interior *polygon*. The exterior *polygon* is a right line drawn from the *vertex*, or point of a bastion, to the *vertex*, or point of the next adjacent bastion. The interior *polygon* is a right line drawn from the center of one bastion, to the center of another.

We will begin by making a draught of a regular *pentagon*, according to M. *Vauban's* method of his middle

middle *fortification*, which has always 180 fathoms Therefore, to divide the circumference, we will take 76 (o b (1 and make a circle of it, which we will divide into five equal parts, each whereof will have 90, (?, we will divide the sides into two parts, and draw from the center, as well through the angles of the figure, as through the points found in the middle of the sides, right lines. We will give from the same middle, on the lines drawn towards the center, to the square the eighth part, to the pentagon the seventh, and to all the others, the sixth part of the exterior side; which, makes the perpendicular A I, Fig. 2. afterwards we will draw through that point of the double angle of the neighbouring gorges, the lines of defence A P, O B.

To form the flank, the faces, and the courtine, we will put on the lines of defence, the faces of the angles A B, &c. which are at all the polygons; at the first rank, 27 (*o*, at the second 25; and at the third 23, (as A *a* B *b*) we will take, besides, the distance between the two extremes of the faces, as *a b*, placing first one leg of the compasses in *a*, and directing the other towards the line of defence, where we will make the point P, and afterwards rest the compasses in *b*; and directing it, likewise, from the point *a* towards *o*, we draw *a o b* and P together, to make up the flanks, and *o* P to make up the courtine.

To form the *orillon*, as well as the *brisures*, and the hollow tower, we divide the flanks found into three equal parts, and put on the superior parts semi-circles, which touch the lines of defence, and that is what makes the *orillon*. Besides which, we draw lines from the points A, B; for example from the points *u*, *o*, *r*, P, &c. towards the capital, as *r*, *s*, *w*, *t*, &c. O *o*, P *p*, &c. of three verges in length. We afterwards take the distance, *u o*, or *r* P, and make of *u* and of *o*, aswell as of P and *r*, outward intersections, which will give the center for the arch *t o s p*, which is called the hollow tower.

To make the *tenaille of the fausse-braye*, we put the angles of the shoulder, or *epaule*, three verges from *a* and *b*, on the lines of defence, in *c* and *e*, dividing what remains, by the intersection of the lines of defence, as C *c*, and *e i*, into two parts in *d* and *f*, thus *c d* and *e f*, make the faces of the *tenaille* in the ditch or *fosse*. We draw from *d*, the line *d g*, so that it be perpendicular, or make a right angle, with the line of defence *g f*. Likewise, we draw *f b*, to be perpendicular on the line *d b*, thus those lines will be the flanks, and *g b* will give the courtine

The *ichnography* of the *pentagon*, on the draught, is made by means of this table. which may be used in all works, either regular, or irregular.

	Feet.
The base of the rampart ——	66
The base of the parapet, ——	21
The banquette of the parapet, —	3
The other banquette, ——	1 ½
The ditch, —— ——	120
The covert-way, —— ——	36
The gorge of the place of arms,	60

Its face six verges, six verges and a half, to seven.

The glacis ten to twelve verges.

The use of this table is as follows:

We take 66 feet for the *base of the rampart*, and draw them parallel, inwards, with the faces, hollow towers, inferior brisures, and the courtines. But if we would have solid bastions, we make no lines to the hollow towers, nor to the faces, but join the lower ones with the brisures by a right line, or by demi-circles. To make the line, round the hollow tower, parallel, we must put the 66 feet of the brisure, still more inwards, and take the distance of the hollow tower to that place, with which the parallel is drawn from the same center.

We take, besides, for the parapet, 21 feet, and draw, likewise, with the line of the draught, parallels inwards, to the faces, orillons, hollow towers, inferior brisures, and to the courtines, before the ichnography of the parapet. To that line we draw another parallel three feet more inwards, and still more inwards, another of a foot and a half broad.

The *ditch* is drawn parallel to the faces, 120 feet broad, its lines cutting one another before the courtine, and it is made round at the point of the bastion, that it may be of an equal breadth every where. If the ditch is marshy, it must be full of small herbs, if dry, of small points; and, if to be filled with water, of something, which can represent water.

For the *covert way*, we trace round the ditch, outwards, a parallel, 36 feet long. Of the re-entring angles of those lines, *a b* and *c*, we put on each side (in *b c* and *d c*) five verges outwards, for the gorges of the places of arms; we make of those points, with the breadth of six verges, intersections, in *f* and *g*; and join the lines *b f*, and *c f d g*, and *e g*, together; closing, lastly, on both sides, the angles *b i k*, and *m n o*, and drawing afterwards the line *p b i k f m n o q*, as the interior line of the glacis.

For the *traverses*, we continue the faces of the places of arms, *viz.* of *c d e f*, downwards as far as the ditch; and afterwards make parallels outwards of the places of arms, 18 feet broad. Lastly we draw on both sides, inwards, banquettes of two feet broad, so that the space in the middle be 14 feet

feet broad; and that is what is called *traverses*. Further, we draw parallels with the interior line of the glacis, inside, towards the covert-way, with the breadth of eight feet for a large banquette, in the middle thereof we place pallisadoes; we afterwards draw, besides, still more inwards, an ordinary banquette of a foot and a half. Lastly, we draw an exterior line, of the breadth of 10 to 12 *verges*, and join them together with transversing lines.

We draw parallels to the faces and flanks of the *tenaille* of the *fausse-braye*, inwards, five *verges* broad, and join them together before the *courtine*, by a parallel from two and a half to three *verges* in breadth, which makes the base of the *rampart*. The parapet to the faces, is equal to that of the great rampart, or thereabouts, but that of the courtine is but eight feet broad.

To put a *half-moon*, or *ravelin* before the courtine, we take the distance of the angle of the flank, and of the courtine, as far as the angle of the *epaule*, or shoulder, over against it, and draw from thence an arch which intersects the line drawn through the middle of the polygon; there is found the point of the half-moon; then draw from thence the lines on each side towards the angles of the *epaule*, as far as the ditch. If we want to make flanks, we put a rule to the interior line of the glacis, and mark the points where it intersects the faces of the half-moon, or ravelin: from hence we make lines fall perpendicularly on those of the ditch; these are the flanks of the ravelin.

For the base of the rampart, it is made parallel to the flank and faces, five verges in breadth; the parapet is every where equal to that of the great rampart; the ditch is parallel to the faces, and six yards broad.

To make a *horn work before the curtain*, we put the point of the capital of the ravelin, on the line which comes out through the middle of the polygon, 44 verges outwards, (as C G, Fig. 5.) we make of the point G, on each side, an arch of 30 yards, and intersect those two arches of the *epaule*, with 70 yards in H and *f*, and draw H *f*. Afterwards we will put, from the middle of that line in G, 10 yards inside towards H, and draw from E and *f* lines of defence cross-wise, on which we will put the faces 18 yards long; forming the flanks with their orillons and hollow towers, in the same manner we have done it to the body of the place, except that four yards must always be taken from the flank for the orillon, and the rest remains for the covert-flank, with the hollow tower.

The *orillon* is a small rounding of earth, lined with a wall, raised on the shoulders of those bastions which have casemates; to cover the cannon in retired flank, and prevent their being dismounted by the enemy. There are other sorts of *orillons* properly called *epaulements*.

From E *f* we draw the wings towards the angles of the shoulder, as far as the ditch; and thus the design of the *horn-work* is made in the same manner as that of the body of the place, except that the measures are different, *viz.* the base of the rampart has four yards, that of the parapet 18 feet, and the breadth of the ditch five yards.

To make a *horn-work* before the bastion, we put the point of the bastion lengthened 44 yards, outwards, as far as B, Fig. 6; draw through B, the line C D, which intersects the lengthened diameter into right angles. We make B C, B D 30 yards each, and form on that the *horn-work*, with its faces, flanks and courtines. We place the angle of the shoulder of the body of the place on the faces six yards and a half in *o* and *p*, and draw towards those points the wings of our *horn-work*, which compleats the design. But these sorts of works are seldom used.

We make a *crown-work*, Fig. 7 before the courtine, by placing the point of the ravelin (or in case there was none in the place where that point should be) 50 yards outwards towards B. Making of that point on each side, an angle of the line A, Fig. 7. each whereof is to have from 64 to 70 degrees, as C B A, and D B A; we put on those lines B C and B D twice 25 yards in E C, and *f* D. From E and *f*, we draw perpendiculars of nine yards each, as E G, *f* H; and draw thereby, from E and *f*, the lines of defence cross-ways; on which we place the faces, of 15 yards in length, and form the flanks, as in the *horn-work*; and thus the courtines form themselves. We put the angle of the shoulder of the body of the place five yards on the faces, and draw towards those points the wings of the crown-work as far as the ditch. If we should want to place a ravelin before the courtine of the *horn-work*, or crown-work, the process is the same as demonstrated in the body of the place; the base of the rampart has three yards, that of the parapet 15 feet: and the ditch three yards and a half.

When we design to make the great *lunettes* * of

* The *lunette* is an enveloped counter-guard, or elevation of earth, made in the middle of the *fosse*, before the courtine, about five fathoms in breadth. *Lunettes* are usually made in ditches full of water, and serve to the same purpose as *fausse-brayes*, to dispute the passage of the ditch. The *lunette* consists of two faces, which form a re-entring angle and its *terreplain* being only twelve feet wide, is a little raised above the level of the water, having a parapet three fathoms thick.

M. *Vauban*, having made the draught of the ravelin, which ought to be done previously to any thing else, we continue its faces on both sides, from A (Fig. 9. A) into B and C, placing afterwards the lines B D, and E C, of the ditch of the ravelin outwards, which must be from 22 to 25 yards long. On the lines B D, and C E, we make the angles D B *f*, and E C G, of 60 degrees; and thus the *lunettes* will be made. The profile of the rampart, and of the ditch, is the same as to the *horn work*.

If we will make small *Lunettes*, as well as *Counter-guards*, of the re-entring angles A B. Fig. 9. B. which the *fosse* of the ravelin, and the great ditch make; we must put on each side, outwards, in C D, and E F, 10 yards for the demi-gorges of the lunettes, and make the intersections in G and H, 12 or 13 yards broad, placing the compasses on the points found of the demi gorges; and thus C G, D G, E H, F H, will give the faces of the lunettes.

For the design of the *counter-guards*, we put of the ditch, five yards outwards, and draw from the ditch to the lengthened diameters. thro those points, lines parallel to the ditch; as I K, and L M. For the ichnography thereof, we give to the rampart the thickness of three and a half or four yards; to the parapet, without the banquettes, eighteen feet; for the breadth of the ditch from four to four yards and a half.

The *profile* must be drawn in this manner. After we have made a long right line, as A R, Fig. 3. and A B, which represents the ground or the horizon; we put first upon it, according to Fig. 1 ... the *profile* of the rampart of the body of the place. *a*, is the first point of the base, behind which we put immediately on the same line, for,

	Feet.
The *talus* of the interior Wall,	1
The *cordon* which is on the wall,	1
The *talus* of the terreplain,	3
The breadth of the *terreplain* of the rampart,	30
The breadth of the first banquette,	$1\frac{1}{2}$
The breadth of the second banquette,	3
The interior *talus* of the parapet,	1
Its superior breadth, —— ——	18
The exterior *talus* of the parapet,	2
The *cordon* above, at the exterior lining,	2
The *talus* of the exterior lining,	3
Base of the rampart, or sum, —	66

We afterwards erect perpendiculars on the first and last points, and place upon them the following one after another; for,

	Feet
[illegible] the interior lining,	12
[illegible] terreplain, ——	6
That of the first banquette, ——	$1\frac{1}{2}$
That of the second banquette,	$1\frac{1}{2}$
The exterior height of the parapet,	[illegible]
The interior height ——	$4\frac{1}{2}$
Sum, —— ——	26

From the points which are on the horizontal line, we draw lines upwards to be parallel to the perpendiculars already drawn, and from the points of the perpendiculars, we draw other lines, to be parallels to the horizontal. In that manner the intersections give us a retz, in which we can easily trace the lines of the *profile* *a* [illegible] *c d e f g h i k l m n o p*, in drawing only, according to the figure, from one point of intersection to the other. The horizontal line is marked with small points; but for those of the retz, or net, they are easily blotted out afterwards.

The *profile* of the ravelin is made in the same manner; it is but of earth, except the ditch, which must be lined

The measures of the rampart, are the following ones, marked on the horizontal line, Fig. 3. For,

	Feet.
The interior *talus*, ——	6
The *terreplain*, ——	$25\frac{1}{2}$
The breadth of the first banquette,	$1\frac{1}{2}$
The breadth of the second banquette,	3
The interior *talus* of the parapet,	1
The superior breadth of the parapet	15
The exterior *talus* of the parapet and rampart together, —— ——	8
The base of the rampart. *a o*, Sum	60

On the *Perpendiculars*, for

The height of the rampart,	13
That of the first banquette,	$1\frac{1}{2}$
That of the second banquette,	$1\frac{1}{2}$
The exterior height of the parapet,	1
Its interior height, —— ——	$4\frac{1}{2}$
Sum, —— ——	$21\frac{1}{2}$

In the same manner is made the design of the ramparts of the outworks, the measure thereof can be ordinarily this, Fig. 3.

On the *horizontal line*, for

The exterior *talus*, ——	6
The *terreplain*, —— ——	$15\frac{1}{2}$
The first *banquette*, —— ——	$1\frac{1}{2}$
The second *banquette*, ——	3
The interior *talus* of the *parapet*,	1
The superior height, ——	15
The exterior *talus* of the rampart with the parapet, —— ——	6
Base of the rampart, Sum, ——	48

On

On the *perpendiculars*, for

The height of the rampart,	8
That of the first banquette,	$1\frac{1}{2}$
Of the second, —— ——	$1\frac{1}{2}$
The exterior height of the parapet,	$1\frac{1}{2}$
Its interior height, —— ——	4
Sum —— ——	$16\frac{1}{2}$

As for the *profile* of the ditches, it is made in this manner; where the ramparts are only made of earth, without being lined, a *berme* is left at the bottom, six feet broad, as *o q*, Fig. 3. But when the rampart is lined, the ditch is joined immediately to the rampart; the superior breadth of the ditch having been marked on the horizontal line, we place likewise on both sides of the ditch inwards, the breadth for the *talus*; and lower from thence, perpendiculars, on which we put the depth of the ditch. Afterwards we make the ditch with its two *talus*'s, and inferior breadth. The measures of the *ditch* are the following ones,

To the *ditch* of the body of the place,	Feet.
The superior height, —— ——	114
The base of the interior and exterior *talus*,	3
The inferior breadth, ——	108
The depth, —— ——	18

To the *ditch* of the ravelin.	Feet
The superior breadth, ——	72
The base of the interior and exterior *talus*,	2
The depth, —— ——	12
The inferior breadth, —— ——	68

To the *ditches* of the other out-works.	
The superior breadth, ——	54
The base of the interior and exterior *talus*,	$1\frac{1}{2}$
The depth, —— ——	8
The inferior breadth, ——	51

Lastly, the *covert-way* with its parapet, is made thus: We put on the horizontal line 27 feet for the *covert-way*, and one foot and a half for the first banquette as usual; for the second eight feet, on which are placed pallisadoes, almost in the middle. All the rest is made in the manner of the other parapets; putting at the end 144 feet, on the horizontal line, for the breadth of the parapet, and drawing a right line from the inferior height, as far as there.

The pieces of the profiles may be all joined one to another, as plainly seen in Fig. 3.

We must now trace a FORTRESS in the field. The best instrument he can use for that purpose is a circle, or demicircle, divided into 360 degrees, each whereof also should be subdivided into four or six parts. Commonly this design is made outwards to the polygons; but is far better, if it be possible, to make it of the center. I'll shew both methods in the regular pentagon.

M *Vauban*'s new method is most esteemed, as best answering the end proposed in the *fortifications* of places; and founded on the seven following excellent maxims; *viz.* 1. The defence of the flank must be such, that both the cannon and musquetry may be used at one and the same time. 2. The flank ought to be so well covered, as to be not entirely ruined by the enemy. 3. The ditches, horizontally raised. 4. The bastions are to be so contrived, that those who defend them may be sheltered against the bombs. 5. Some places and passages are to be contrived for the sallies. 6. The greater the number of ditches, the better. 7. The counterscarp must be well covered.

To reduce the first of these maxims into practice, M. *Vauban* makes his flanks in such a manner, that the line of defence may have 70 yards.

To cover well the flank, which is M. *Vauban*'s second maxim, he places a good ravelin before the courtine, and contrives the flank so, that two pieces of cannon, at least, may be hidden behind the orillon.

To raise the ditch, which is the third maxim, M. *Vauban* will have made, under the flank of the *tenaille* of the *fausse-braye*, arches, under which cannons may be planted on carriages used for ship's cannons. The embrasures are shut, and never opened, but when the enemy wants to cross the ditch under the face. There are also arches made for three pieces of cannon, over-against the ditch of the ravelin.

M. *Vauban* has found three means to shelter, as much as possible (according to his fourth maxim) the bastions against the bombs; of traverses, of the separation of the tenaille of the fausse-braye, from the body of the place, by a ditch, and of vaults under the ramparts.

To order securely places and passages for the sallies, which is M. *Vauban*'s fifth maxim, he intersects in several places the glacis of the counterscarp with narrow passages, garnished with three strong gates, *enfiled*, or enfiladed, with works; as *n c*, Fig. 9.

To oblige the enemy to cross several ditches, M. *Vauban*, according to his sixth maxim, makes a great many out-works; and even uses dry ditches round the glacis of the counterscarp: as plainly seen in Fig. 9.

To cover well the counterscarp, which is the seventh maxim, the same excellent engineer has found three expedients: first, he makes the covert-

covert-way, so as to be always higher at the points than at the re-entering angles. Secondly, he makes the parapet of the counterscarp very high. Lastly, he uses traverses near the places of arms. Fig. 4.

The method how to make the angle of the bastion, or flanked angle, the best manner is to make the perpendicular to the polygon from 15 to 20 yards.

M. *Blondel* makes the *flanking angle* obtuse; the Count *de Pagan*, and *Rusenstein* make it right; but most of the other engineers make it more or less acute. M. *Vauban* causes his orillon to make with the line of defence, an angle somewhat acute; the re-entring flank, an angle a little obtuse; and that of the tenaille of the fausse-bray, a right angle.

The *line of defence*, is that which represents the course or flight of the bullet, of any sort of fire-arms, more especially of a musket-ball, from the place where the musketeer must stand to scour, and defend the face of the bastion: there is a line of defence *fichant*, and a line of defence *razant*.

The line of defence *fichant*, is drawn from the angle of the courtine, to that of the opposite bastion; without touching the face of the bastion: This must never exceed 800 feet, which is reckoned the distance at which a musket-ball will do execution.

The line of defence *razant*, is that drawn from the point of the bastion along the face, till it comes to the courtine; and shews how much of the courtine will scour or clear the face.

M. *Vauban* puts his first flank on a line of defence of 70 yards, and that of the fausse braye on a line of defence of 57 yards.

As the Face is always attacked, and it is a very great advantage for the enemy to attack a line of a large front, the faces should always be small; the faces of 25 or 27 yards, as those of M. *Vauban*, are always in a condition to make a tolerable good counter-battery; especially when provided with a risen fausse-braye.

The Flanks must be made large enough, and strong enough. A simple *flank* can never be large enough, therefore a low one must be made near it, at a reasonable distance from the high flank, and even to part it from it by a ditch.

It is also very proper, that the flank should not be every where of the same height; but it must be higher at the angles of the shoulder, always going in diminishing towards the courtine.

From these we'll pass to the out works; beginning with the *ravelins*, which must be made so strong that the cannon may be played upon it boldly.

The Horn-works, or Crown-works, are very proper to fortify a suburb; which, otherwise, the besieged are forced to abandon, and destroy, when the place is attacked; for those works are not so good as redoubts of stone, to occupy and inclose a height; for they require a vast number of men to be well defended.

Before an engineer has entirely finished the body of the place, he must take a particular care to make a very good Couterscarp, since it is of a very great use for the defence of a fortress. To make a very good *counterscarp*, the *covert-way* must be very large; room must be left to put up pallisadoes, at the places which are attacked; the points of the *counterscarp* ought to be covered with bonnets; they must be mined; there must be caponieres at the angles, to shelter the soldiers; places of arms well covered; a good conveniency to make sallies; it should be easily separated into several parts; and it would be very proper to make it in such a manner, that some pieces of cannon may be easily planted upon it. A counterscarp, with all these advantages, would not cost so much as a few out-works; though it could be capable so to fatigue an enemy, that but very little strength would be left him for the attack of the body of the place: because the *counterscarp* has this advantage over all the other works, that it cannot be ruinated by the cannon of the enemy. Whence the three best engineers, *Vauban*, *Rimpler*, and *Coehorn*, have used all their best endeavours to strengthen this part of the *fortification*.

A Rampart, all entirely of earth, without countermines, or arches, is good for nothing.

A Parapet must be of earth, but very hard and tight, interwoven with twigs; it should have embrasures, also interwoven with twigs: but that interwoving ought not to be all of a piece, for fear some mischance should happen to the parapet by fire, or some ebraulement.

Where the water is from seven to eight feet above the horizon, there will be beautiful ditches, if they be made ten yards broad, and eight yards only near the body of the place, but towards the covert-way, they should remain dry, at two yards in breadth: as it may be seen Fig. 9.

There are besides these great works, some small ones, auxiliary to the construction, as the *caponieres*, *bonnets*, *small ditches of separation*, the *blochus's*, and the *traverses*.

The Caponieres is a covered lodgment, sunk four or five feet into the ground, encampassed with a little parapet about two feet high, serving to support several planks covered with earth. The *caponiere* is large enough to contain fifteen or twenty soldiers; and is usually placed in the glacis, on the extremity

extremity of the counterscarp, and in dry moats, having little embratures or holes for the soldiers to fire through.

The BONNET is a kind of little ravelin, without a ditch, having a parapet three feet high; antiently placed before the point of the saliant angles of the glacis; being pallisadoed round: of late also used before the angles of bastions, and the points of ravelins, and fausse brayes; in Fig. 8 *m*. The *bonnet* has two faces, from ten to fifteen, or more rods long: the parapet is made of earth, from thirty to thirty-six feet thick, and from nine to twelve feet high: it is environed with a double row of pallisadoes, ten or twelve paces distant from each other; hath a parapet three feet high, and is like a little advanced *corps de guard*.

For an example of the fundamental rules above-described, there will be found in the plate of FORTIFICATION Fig. 9. A. a design to *fortify* in the manner of M. *Vauban*; with a new ordnance of a *fausse-bray* before the face, and a particular manner of covering the ravelin.

A CITADEL is also a fortress, composed of all the works above-mentioned; but as they are ordered in a particular manner, we'll join here the general rules, and particularly of that ordinance, and reduce them into practice.

A *citadel* (Fig. 8.) is a fort, or place *fortified* with four, five, or six bastions, built sometimes in the most eminent part of a city, and sometimes only near the city. In the first case the *citadel* serves to defend the city against the enemies; in the latter it serves to command it, and to keep the inhabitants in their obedience: for which purpose the city is left *unfortified* on the part towards the *citadel*; but the *citadel* is *fortified* towards the city. The most usual form of a *citadel* is that of a pentagon, a square being too weak, and a hexagon too big.

The general rules for *citadels* are these: 1. The most exalted place must be chosen for a *citadel*: 2. If the city be provided with a navigable river, the *citadel* must be situated at the influxion: 3. The river disembouging into the sea, it is best to place the *citadel* at the mouth of the river: 4. In case the *citadel* could not be built on the most eminent place of the city, the eminence must be so near the *citadel*, that it may be joined to it by a line of communication, and be separated from the city: 5. The *citadel* ought to be so well fortified towards the country, that the enemy may find more difficulty to attack it on the outside, than he would have to attack it on the inside after the taking of the city: 6. There must be a large esplanade between the citadel and the city: 7. It must have two gates, one towards the city, and the other towards the country.

To trace such a *citadel*, there must be made first, an exact ichnography of the city and of all its *fortifications*; after which is drawn on a paper one part of the design of the *citadel*, whose interior polygon must have no less than 80, nor more than 90 yards. We take it afterwards, cut it all around, and put it on the ichnography of the city, turning it from side to side till we find it well placed: then we mark that design with small points, and make the whole plan, but with colours different from those of the city, that we may easily know what must be demolished of the fortress. Care must be taken besides, that the two last lines of the *fortification* of the city near the *citadel*, may not be opposite to it, but easily ensiled by it.

From this we'll pass to the *irregular fortification*, which is practised especially in three cases: 1. When a *fortification* is to be made in a place, which does not allow a regularity in the design. 2. When a city irregularly built, must be fortified. And 3. When old *fortifications* are to be corrected.

In the first case the *fortification* of the exterior polygon inside, is the most commodious. In the second it is best to fortify the interior polygon outwards. In the third case the body of the place must be left as it is, according to M. *Vauban*'s custom.

Places on rivers are also fortified in a particular manner, and in this case an engineer must mind not to make too many works, nor too few. Simple lines in form of tenailles without flanks, as it is seen at *Dresden*, are not sufficient, though it be not necessary to build whole bastions on the river's side; therefore it is best to make ordinary bastions, whose polygons and faces ought to be larger, and the flanks smaller than usual; which is done in proportion to the breadth and depth of the river.

If there be a bridge over the river, a small *fortification* must be placed beyond, and before it; and the best for that purpose is half a regular hexagon, whose polygon must have from 50 to 70 yards. In case there should be an island in the river, before the city, the bridge must be carried upon it, and the *fortification* adjusted before the bridge, that it may be fired from the island, by means of batteries made on purpose.

The small flanks of such *Fortification*, of a city on a river, can very well be double; and in that manner it suffices, that one could put three cannons abreast, taking a particular care to place those cannons in vaults under the rampart, which razes the river horizontally.

If the river runs through the city, the *fortification* must be ordered in such a manner, that a bastion may touch each side of the river with its flank, and the river run through where the courtine should be, be; and a courtine should even be made, with arches, over the river. It is also necessary to raise, out of the city, out-works on both sides of the river, which should raze it cross-ways: but in case the river should be so wide, that the out-works on both sides could not reach one another (though rivers of such a breadth seldom run through a city) a work ought to be erected in the middle of the river. At large navigable rivers it is best to inclose the principal part of the city towards the river with a rampart, and part it from the other, as a different town. In this manner the *Elbe* passes between the old and the new city of *Dresden*.

The waters of small rivers being necessary for the mills of the city, and being stopt for that purpose with dikes, such dikes are commonly made in the ditch, which are of a double use; for first, they hinder the waters, which are round the city, from running, without passing through the mills of the city; and secondly, the ditches are, thereby, always kept in good condition. It must be observed, that those dikes are to be placed at the point of the bastions, for fear the enemy should make use of it; though others are of opinion, that they are better placed before the middle of the courtine, because the reason why the enemy seldom attacks the point of the bastion, is, that he would be obliged to cover his passage with sides, which would be too difficult; but if he finds there a dike to cover himself with, he will make no difficulty to fasten himself to the point, where the musketeers cannot so well fire, as at the bottom of the face.

There is also a particular manner of fortifying places, situated on eminences.

The cities which are situated on hills, as *Mons* and *Strasbourgh*, are much exposed, because neither the houses nor the streets can be covered by the *fortifications*; though, without this inconveniency, such places are very proper to be fortified; but the *fortifications* on a mountain ought to be made very high at the bottom, and come sloping down, for fear they should be enfiled. If the lines are so long, that they must be raised at the bottom, it is best to make them by degrees, covering them with parapets and traverses.

None but small forts and citadels are built on high rocks, because of the narrowness of the space. The best method is to adapt, as much as possible, the lines of the *fortification*, to the sides and figure of the mountain; the ramparts must be made low; and as the ditches are commonly dry, the best defence must be made at the bottom. The road to the fortress must have from distance, in distance, retrenchments very well defended. The engineer must also take care to make all sorts of works, whence the foot of the mountain can be beaten most, they ought to be disposed in such a manner, that those who defend them may retreat from them in safety, and annoy, without interruption, the enemy, when he has rendered himself master of them.

Against the eminences, which are near a fortress, there should be erected not only good ravelins on the ramparts, but those eminences themselves should also be fortified, by works capable to resist the enemy. At the highest place of the mountain is drawn a line of the height and thickness of a parapet, so that it may be enfiled by the cannon of the fortress. Farther towards the fortress, where the mountain grows lower, are erected redoubts of stone, which are open on the side of the fortress, and distant from one another of a musket-shot; and contrived so low that they should raze the mountain. Taking care besides, lest the enemy should cut the retreat into the fortress to the soldiers, who are lodged on those redoubts, or annoy them with his cannon.

The *fortification*, according to Count *Pagan*'s method, supposes, in the larger *fortifications*, the external polygon A B, to be 100, the face A G, 30 perches; in the smaller, the first 80, and the second 25; and in the middle size, the first 90, and the second $27\frac{1}{2}$: The perpendicular C D, 15; and the flanks G F, and H E, perpendicular to the lines of defence A F and B E, covered with an orillon, and three-fold: to which add a ravelin and counterguard to serve for out-works. This method was received with great applause. But it has its defects; for besides that the *fortifying* of places by it, is very expensive, its triple flank is too close, so as to be exposed to the violence of the bombs; the orillon is so large as to prejudice the length of the flanks; the outer rampart of the bastion is too big, &c.

M. *Blondel*'s method (*See* the *Plate*,) has a great affinity with that of the Count *Pagan*, only that the quantity of the angles and lines are differently determined, thus a right angle being subtracted from the angle of the polygon, and to a third part of the remainder fifteen added; the sum gives the diminished angle. In the greater *fortifications*, the outer polygon is one hundred, and the smaller eighty-five. The internal polygon being divided into ten parts, seven of them give the lines of defenee, and the faces are half those of the tenaille. This method is very well calculated for the purposes of architecture, only being somewhat expensive, it is but little used.

Scheiter, in his method of *fortification*, supposes, the external polygon, in the larger *fortifications*, to be 100 perches; in the middle size, 90; in the lesser, 80; the flanks perpendicular to the lines of defence:

defence: and the lines of defence in the greater *fortifications*, 70 perches; in the middle fize, 65; and in the leffer, 60. It detaches baftions from the courtine, and forms a kind of inner recefs behind the courtine; it affumes the angle of the baftion in a fquare, to be 64 degrees; to this adding eight, the product is the angle of the pentagon; to which adding fix degrees, the fum is the angle of the baftion in an hexagon, and adding five to this, the fum is the fame angle in an heptagon.

When the general has refolved upon the places for carrying on the attacks, the engineers muft go to furvey the ground fo accurately, as to be able to make the moft advantage of it; and to fee whether there are ridges, hedges, or ditches, to run the trenches along them; if there are any dales or hollows, to make ufe of them for places of arms; to contrive the fituation of the redoubts, fo that they may defend the trenches, and look down into the faid deeps and hollows; and though the way be longer by thofe places, than if the trenches were carried along the plain; yet it is generally fafer, for taking the advantages that lie in the way.

The works made for the attacks, by means whereof we approach the place, and force it at laft to furrender, are generally underftood under the name of *trenches*, and confift in *places of arms*, *approaches*, *boyaux*, and *ditches of communication*, *batteries*, *lodgments*, *faps*, *galleries* &c.

A PLACE OF ARMS, in a fiege, is a fpacious place covered from the enemy, by a parapet, or epaulment, where the foldiers are pofted ready to fuftain thofe at work in the trenches againft the foldiers of the garrifon.

APPROACHES, or *lines of approach*, are particularly ufed for trenches dug in the ground, and their earth thrown up on the fide next the place befieged; under fhelter or defence whereof, the foldiers may approach, without lofs, to the parapet of the covert-way; and plant guns, &c. wherewith to cannonade the place. The *lines of approach* are to be connected by parallels, or lines of communication. The befieged frequently make *counter-approaches*, to interrupt and defeat the enemies *approaches*. *See the* PLATE.

BOYAU is a branch of the trenches, or a line, or cut, which runs from the trenches to cover fome fpot of ground; being drawn parallel to the defence of the place, that it may not be enfiladed, that is, that the fhot from the town may not fcour along it.

A BATTERY denotes an eminence caft up, whereon to plant artillery, that it may play to better advantage. In all *batteries*, the open faces to put the muzzles of the great guns out at, are called *embrazures*, and the diftances between the *embrazures*, *merlons*. The guns are generally twelve feet diftant from one another, that the parapet may be ftrong, and the gunners have room to work. The *battery* of a camp, is generally furrounded with a trench and palifades at the bottom; as alfo with a parapet on the top, having as many holes as there are pieces of artillery, and two redoubts on the wings, or certain places of arms, capable of covering the troops, which are appointed for their defence.

There are different forts of *batteries*, viz. *funk*, or *buried batteries*, *crofs batteries*, *battery d' enfilade*, *battery en echarpe*, *battery de revers*, *battery joint*, or *par camarade*, and *battery en rouage*.

SUNK, or BURIED BATTERY, is that, whofe platform is funk or let down in the ground, with trenches cut in the earth againft the muzzles of the guns, to ferve for embrazures. This fort is generally ufed upon the firft making approaches, to beat down the parapet of the place.

CROSS-BATTERIES, are two *batteries*, at a confiderable diftance from each other, which play a-thwart one another at the fame time, and upon the fame point, forming right angles; where, what one bullet fhakes, the other beats down.

BATTERY *d' enfilade* fweeps the whole length of a ftrait line, a ftreet, &c.

BATTERY *en echarpe* plays obliquely.

BATTERY *de revers*, or *murdering battery*, is one that plays on the back of any place; and being placed on an eminence, fees into it.

BATTERY *joint*, or *par camarade*, or *carmaretta*, is when feveral guns play at the fame time upon one place.

BATTERY *en rouage* is that ufed to difmount the enemies cannon.

LODGMENT is a work caft up by the befiegers, during their approaches, in fome dangerous poft, which they have gained, and where it is abfolutely neceffary to fecure themfelves againft the enemy's fire. *Lodgments* are made by cafting up earth, or by gabions *, or palifades, wool-packs,

* *Gabions* are large bafkets, made of ofier twigs, woven of a cylindrical form, fix feet high, and four wide; which being filled with earth, ferve as a defence, or fhelter from the enemy's fire. They are commonly ufed in *batteries*, to fcreen the engineers, &c. in order to which, one is placed on either fide each gun, only leaving room for the muzzle to appear through. There are alfo a fmaller fort of *gabions*, ufed on parapets, trenches, &c. to cover the mufqueteers; being placed fo clofe, as that a mufket can but juft peep through. They alfo ferve as a parapet on lines, lodgments, &c. where the ground proves too hard to dig into. To render the *gabions* ufelefs, they endeavour to fet them on fire, by throwing pitched faggots among them.

fascines †, mantelets ‖, or any thing capable of covering soldiers, in the place they have gained, and are determined to keep.

There must be prepared, from the very beginning, at the tail of the trench, a place of fascines, sacks of earth, and the like, for a secure retreat against the cannon of the place, for those who cover the works, who are most cavalry; for the infantry is commanded to the approaches: hence a trench is dug, four feet deep, and which has, at the beginning, but four or six feet in width; the earth being thrown up on the side of the place. That trench is seldom made longer than 40 yards, and always made in the night; taking all the precautions imaginable to hinder it from being enfiladed, either from the place, or from the counter approaches, the besieged could build.

Three nights and two days, are generally spent in putting batteries into good condition; and the third night the guns are planted; but if care be taken, batteries of two or three cannons may be finished in two nights and one day.

The trenches are to be carried on, and a place of arms made the sixth night.

A redoubt shall be made the seventh night, and all behind is put into a good posture.

The trenches shall be carried on the eighth night, and a great place of arms made within a hundred paces of the glacis.

The more the approaches are advanced, the deeper they must be. At the beginning they are made greater by degrees; so that having at first but four feet in width, they are made, afterwards, from eight to nine feet broad, that the cannon may be transported that way to the batteries. The places of arms must be, as much as possible, over-against one another, that they may flank one another, though traverses must be put to those places of arms, to shelter those posted in them against the bombs. The approaches must intersect one another; and every where, if practicable, there ought to be deep places, covered with trees, and earth, against the bombs; and if a ditch must be conducted directly towards the place, it is proper it should be made towards the end of the faces of the ravelin, towards the angles of the epaule of the bastion, and obliquely towards the points of the ravelin; but an engineer must be very exact in tracing them.

These rules also are to be followed with regard to the *batteries*: 1. Those made to beat the place, ought not to be above 500 paces distant from it. 2. The beginning of the breach can be made at 300 paces. 3. To end the breach, batteries must be erected on the glacis, carried off from the counterscarp. 4. Against works lined with stones, the batteries are erected perpendicularly, the shots which strike perpendicularly being, in that case, the best: but against works of earth, it is best to dispose them so, that it may be beaten with the heavy cannon perpendicularly, and on both sides, also cross ways. 5. The parapets must be very high and thick, well interwove with hosiers, twigs, and faggots, and provided with good embrasures; and, in case of necessity there must be used gabions and wool packs: there should be always a space from 18 to 24 feet between each piece of cannon, according to their bigness; whence the place of a battery of 12 cannons, of the second rank, must have 24 yards in length. 6. The embrazures must be made from two to three feet broad on the inside, and from 10 to 12 on the outside. 7. The floor for the cannons is composed of good boards, and must be very even, that the gunner may be more sure in pointing his cannon. 8. A ditch must be made behind the batteries for the powder, the inside very well lined with boards, covered a top with cows skins, and defended with gabions, covered with earth against the bombs. There are also made behind the batteries several cross ditches, like the approaches, where the munition is distributed into several places.

When the works are advanced near the place, if there be no ridge of ground, or hollow capable of covering men, a serjeant and fifteen men only shall be posted at the head of the work, and battalions in the nearest places of arms, and behind the redoubts, which are nearest the place, to sustain the workmen in case of a sally.

If the lines drawn from the last place of arms, cannot come within four or five paces of the foot of

† *Fascines*, are small branches of trees, or bavins, bound up in bundles; which being mixed with earth, serve to fill up ditches, to screen the men, make the parapets of trenches, *&c.* Some of them are dipped in melted pitch or tar; and being set on fire, serve to burn the enemy's lodgments, or other works. A pitched *fascine* is a foot and a half about: a *fascine* for defence two or three feet.

‖ *Mantelets*, are a kind of moveable parapets made of planks, about three inches thick, nailed one over another, to the height almost of six feet, generally cased with tin, and set upon little wheels; so that in a siege, they may be driven before the pioneers, and serve as blinds to shelter them from the enemy's small shot. There are other sorts of *mantelets* covered on the top, whereof the miners make use to approach the wall of a town or castle.

the glacis, one, or rather two saps * should be made toward the angle, till you are within the said distance, and from thence you must attempt to lodge yourself on the covert way, which is generally the most difficult and bloody action of a siege; and which is done in several manners. For, some are for marching bare-faced to dislodge the enemy, when the trench is within 12 or 15 feet of the glacis, and make a lodgment on the angle at the same time. But the *English*, *Germans*, and *Dutch*, are of a contrary opinion, judging it more safe to make their lodgments by saps.

In order to make the lodgments, by gaining ground without open force, the trenches must be carried on to the nearest place that may be, without exposing them to enfilade; then three or four saps must be carried on by steps, descending directly towards the angle-saliant of the *covert-way*. They are made by driving a mantelet, set on two wheels before them, or else rolling along a *sauciss*, and placing fascines or gabions on the right, or left, as they draw near the place, and blinds at certain distances, to prevent the enemy from looking into the trenches: This work must be continued day and night, and the men being relieved from time to time, that being always fresh they may do the more work. When the sap has been carried on eight or ten fathom, lines must be drawn on the right and left, parallel to the place, and four or five fathom long, which are made small places of arms to contain some soldiers, both to sustain the head of the work, and make the necessary provisions for advancing it. When you come within a stones throw of the *covert-way*, the sap must be covered with clay, and some earth thrown at the top of them, to defend them against stones, and hand granadoes: And when you come to the foot of the glacis, you must begin the *fourneaux*, which are still to be carried on descending, to avoid the counter-mines; and that having more earth upon them, they may take the more effect: and they must be carried far enough to blow up the parapet of the angle.

When the *fourneaux* are carrying on from middle lines, the other saps must be carried on as far as may be on the glacis; and mines must also be carried on to disappoint the enemy, if you apprehend that he will make other *fourneaux*.

As soon as the *fourneaux* are ready, they must be sprung by night or day, and armed workmen shall be sent at the same time, sustained by good soldiers, to place some gabions on the part demolished by the *fourneaux*, and to fill them with earth, which may be easily done, because the blowing up will loosen it all.

As soon as the lodgment is finished, there must be saps carried on, both to go down into the *covert-way*, and to continue the lodgments on the top of the glacis. The descent into the *covert-way* must be very deep, that it may not be seen by the opposite flank, and not be opened till night-fall, at which time a traverse is to be made on each side, and the head of the lodgment on the edge of the ditch. While one part of the workmen are employed about the lodgment, the rest are to carry on the trenches along the edge of the glacis, which must be done by sap, if the enemy make a good defence; but if they make a bad one, this lodgment must be done like that of the angle, that is, with gabions filled with earth; and the epaulements with chandeliers or wooden frames full of faggots to cover the workmen instead of a parapet.

If you would attack the left face of the bastion, the lodgment R shall be made a battery to dismount the guns on the opposite flank, and ruin it as much as may be. While the battery R is firing, the lodgment V is to be made to cover it, from whence the traverse X, shall be drawn and made cannon-proof. The battery shall be covered behind, by the line Y, and if the enemy be daring and daring, the redoubt Z shall be made to secure the batteries against sallies, and all the head of the trenches. When the battery R is finished, and secured by works, the line S shall be pushed on towards the gorge of the half-moon, and defences and traverses shall be made in the *covert-way*, at 3 and 4, as also the line 2. If [illegible] are incommoded by the enemies traverses in the *covert-way*, they must be attacked in the rear by night, and [illegible]

* *Sap*, denotes a work carried on under ground, to gain the descent of a ditch, counterscarp, or the like. It is performed by digging a deep trench, descending by steps from top to bottom under a corridor; carrying it as far as the bottom of the ditch when that is dry, or the surface of the water when wet. When the covert-way is well defended by musqueteers, the besiegers make their way down into it by sapping. When they are got near the foot of the glacis, the trench is carried on directly forwards; the workmen covering themselves with blinds, wool-packs, sand bags, and mantelets upon wheels. They also make epaulments or traverses, on each side, to lodge a good body of men. The *saps* usually made five or six fathoms from the salient angle of the glacis, where the men are only covered side-ways; for which reason they lay planks over-head with hurdles and earth above them. When they have forced the enemy to quit the covert way, the pioneers immediately with sand bags, wool-packs, or other fences, make a lodgment, and cover themselves as well as they can, from the fire of the opposite bastion.

they are dislodged, you may lodge yourself there, if the head of the work be not far off, or else you must raze them. *See the* Plate.

The lodgments on the *covert-way* of the half-moon, which are of the same nature as those that are made on the angle that covers the point of the bastion, are to be perfected, first if you can only make one at once, or both together, provided that you have men enough to carry on both. There must be trenches along the edge of the glacis, and in the *covert-way*, to meet at the gorge with those made before the face of the bastion.

If the half moon can be battered with cannon, the parapet beaten down, the descent into the ditch easy, and little or no water in it, then you may march boldly, and lodge yourself on it, being provided with all things necessary to make a good lodgment, and a way to go to and come from it, under *cover*. If the ditch of the place is full of water, and the enemy can have no communication with it but by boats, there will be no very great danger in attempting this sort of lodgment; but if the ditch be dry, or if the enemy have one side of the *covert-way* free to succour the half-moon, and the garrison is strong, it must be attempted with more precaution.

To pass the ditches of half-moons, when they are full of water, after you have made the descents on the edge of the water, fascines, loaded with stones, must be thrown into the ditch, till they are above water, and then earth or stones cast over both to settle them; and to prevent their being burnt, and an empalement made with earth and fascines next the place.

As soon as you are master of the half moon, you must contrive to pass the ditch of the place, in order to fix the miner to the face of the bastion; but before you attempt to pass, lodgments must be made all along the *covert-way*, both on the top of the glacis, and the edge of the ditch.

If the ditch is dry, and its counterscarp is very steep, or faced with a wall, you must begin the descent from the foot of the glacis of the *covert-way*; or father off, if the ditch be very deep: if it were but eight or ten feet deep, you might begin the descent within the *covert-way*. If the enemy be strong and bold, several descents must be made, that the lodgments may be succoured with more ease, and the men in the ditch.

The passage of the ditch being secured, all possible care must be taken to advance the mines; and to oblige the miners to work more vigorously, you must encourage them with money. It is also expedient to enhance their price according to the expedition they make in finishing the mine: as for example, if they are to have fifteen pounds for making a good one in three or four days, promise them double, if they perform it in two.

Opinions vary as to the part of the face of the bastion, to which the miner is to be fixed: Some will have him towards the angle, because the semicircle made in the bastion, by the effect of the mine, is not seen from the bastions of the place: others will have the mine made nearer the flank than the flanked angle, to blow up the retrenchment, if there be any.

If the opposite faces B and A are attacked, the miners will be better in the midst of the place, or rather nearer the flank to ruin entirely the face of the bastion, and the first retrenchment, and to draw the nearer to the gorge of the bastion, where is generally a second retrenchment. But if only one face of the bastion be attacked on one front of the place, the mine will be better at the angle, to prevent the effect of the mine's being laid in the view of the opposite bastion: most men desiring that the effect of the mine may be great, making a large breach in the wall, and overthrowing abundance of earth, that there may be an easy ascent to the bastion, and many men mount a-breast to make a lodgment: but as the lodgments designed on the top of the bastion seldom succeed, and when they do, they are attended with a great loss of men, it is better to make an indifferent breach only to overthrow the wall, to prevent countermines; and then begin another mine on the ruins, to be carried on into the body of the bastion, to take the intended effect.

Many inconveniences attend large breaches, if you fail to lodge yourself upon them: one is the easy descent it gives to the besieged to come down upon the lodgments you are making, or have made, either at the bottom, or half way up the breach, in order to fix the miner. Another is, that the enemy having raised a parapet on the edge of the mine, the larger it is the more it overlooks all the ruins of the said mine. Besides, it must be considered, that to the end the mine may have a great effect, it must be carried far into the earth, which often gives you an opportunity of disappointing the enemy's countermines: I would therefore make the mine in the wall, and after the effect, make a lodgment at one third of the height after this manner. Ten or twelve sturdy soldiers with shovels, shall go as privately as possible, to level the place where the lodgment is to be made, so that three or four gabions may stand on it, in a range; then four ranks of gabions, at about seven or eight feet distance from one another, shall be pushed on covered with wool-packs; and then two or three soldiers shall throw earth on them, to secure the lodgment against every thing that may be thrown from

from above. Thus four ranks of gabions covered, as heretofore described, will make three little lodgments; the middlemost shall serve for the miners, who shall presently fall to work to make a mine in the earth of the bastion; and the lodgments on the right and left, shall each of them contain four or five soldiers well armed, with head-pieces and breast-plates, musket-proof, and with javelins and pistols.

For the greater security, two lines may be made at the same time, one at the angle, and the other towards the orillon, that the second line may ruin the retrenchments made within, as those in the bastion A B C, which might be ruined by the effect of the mine, were it not for fear they should be disappointed, and the enemy be in a condition to ruin the lodgment on the top of the breach.

If the retrenchment be made as in the bastion C, and its ditch deep, it will be hard to be master of it, unless you lodge yourselves on the top of the bastion, after the first or second mine have taken effect. There if you think you cannot easily begin a mine at the breach of the rampart, you may carry it under the ditch of the retrenchment, spring it, and by that means plant cannon at the top of the bastion, and batter the retrenchment; or else make a lodgment at the edge of its ditch: then passing it, fix the miner to the retrenchment. While the first mines are carrying on, it will be proper to begin other mines in such places where the effect of the first may not ruin them, so that the one may be used if the other be disappointed; or else by that means to carry on mines into the body of the bastion, and under the retrenchments, if it should prove more practicable that way, than by the breach the first mines have made.

If there be a gallery in the thickness of the wall, either of the body of the place, or of the detached works, three *fourneaux* shall be made at the same time, upon one and the same face, which shall only blow up the thickness of the wall as far as the gallery; and being laid open in three places, the middle may serve to fix the miner again to make a large mine, and the holes on the right and left will prevent the enemy from passing the gallery, to obstruct the work of the mine. But when the out-works are taken, and a breach made in the bastions, the town generally surrenders.

The besiegers encompass their camp, to defend it against any army that may attempt to relieve the place with lines of *circumvallation*, *countervallation*, and *communication*. A line of *circumvallation*, is a line or trench, with a parapet, which must be cannon-shot distant from the place, ordinarily about twelve feet broad, and seven deep; it is bordered with a breast-work, and flanked with redoubts, or little forts, erected from space to space: It serves both to prevent any succour from being sent into the place, to keep in deserters, and prevent incursions of the enemy's garrison. Care must be taken that the line of *circumvallation* never passes by the foot of an eminence; lest the enemy, seizing on the eminence, lodge there his cannon, and command the line. *Countervallation*, is a counter-line, or ditch, made around a place besieged, to prevent the sallies and excursions of the garrison when it is strong. Along its edge, on the side of the place, runs a parapet, and it is flanked from space to space. It is without musket shot of the town, and sometimes goes quite round it, sometimes not, according as the general finds occasion. The army forming a siege, lies between the lines of *circumvallation*, and *countervallation*. The lines of *communication* are trenches six or seven feet deep, and twelve broad, made between one fort, or work, and another; in order for a safe passage between one quarter and another.

While a place is besieged, the besieged are employed in works for their own defence, and to oppose the besiegers. The works they do, on that occasion, are *counter-approaches*, *retrenchments*, *caponieres*, *countermines*, *fougades*, &c.

COUNTER-APPROACHES are lines or trenches made by the besieged, when they come out to attack the lines of the besiegers in form. A line of *counter-approach*, is a trench which the besieged make, from their *covert-way*, to the right and left of the attacks, in order to scour or ensilade the enemy's works. It should commence in the angle of the place of arms of the half moon that is not attacked; above 50 or 60 fathom from the attacks; and continued as far as shall be found necessary, in order to see the enemy in his trenches and parallels. This line must be perfectly ensiladed from the *covert-way*, and the half-moon, that if the enemy get possession of it, it may be of no service to him. In this line the governor must frequently, in the night-time, send small parties of horse and foot, to drive the workmen from their posts; and if possible carry off the engineers, who have the direction of the work.

The CAPONIERE, or *caponniere*, is a covered lodgment, sunk four or five feet into the ground, encompassed with a little parapet two feet high, serving to support several planks covered with earth. The *caponiere* is large enough to contain fifteen or twenty soldiers; and is usually placed in the glacis, on the extremity of the counterscarp, and in dry moats; having little embrazures for the soldiers to fire through.

COUNTER-MINE is a subterraneous vault, running the whole length of a wall, three feet broad, and

and ſix deep, with ſeveral holes and apertures therein, contrived to prevent the effect of mines, in caſe the enemy ſhould make any, to blow up the wall; but this ſort of counter-mine is now little in uſe. The modern counter-mine is a well, or pit, and a gallery, ſunk on purpoſe till it meets the enemy's mine, and prevent its effect; it being firſt pretty well known whereabouts it is.

Fougade, or *fougaſſe*, is a little mine in the manner of a well, ſcarce exceeding ten feet in width, and twelve in depth; dug under ſome work, or poſt, that is like to be loſt; and charged with barrels, or ſacks of gunpowder, covered with earth: It is ſet on fire, like other mines, with a *fauciſſe*, i. e. a long train of powder ſewed up in a roll of pitched cloth, about two inches in diameter; the length of the *fauciſſe* is to extend from the chamber of the mine, to the place where the engineer ſtands to ſpring the mine. There are uſually two *fauciſſes* to every mine, that if one ſhould fail, the other may take effect.

F O U N D E R Y.

Foundery (from the latin word *fundo*, I melt) is the art of melting and caſting all ſorts of metals; particularly braſs, iron, bell-metal, &c.

For the exerciſing of this art in general, the workman muſt be provided with furnaces, moulds, preſſes, and other tools proper for particular branches thereof.

The branches, into which we ſhall divide *foundery*, ſhall be that of (1.) *ſmall works*, or the art of caſting in ſand, which is thus performed.

The ſand uſed for caſting ſmall works, is, at firſt, of a pretty ſoft, yellowiſh, and clammy nature: but it being neceſſary to ſtrew charcoal duſt in the mould, it at length becomes of a quite black colour. This ſand is worked over and over, on a board, with a roller, and a ſort of knife; being placed over a trough to receive it, after it is by these means ſufficiently prepared.

This done, they take a wooden board of a length and breadth proportioned to the things to be caſt, and putting a ledge round it, they fill it with ſand, a little moiſtened, to make it duly cohere. Then they take either wood or metal models of what they intend to caſt, and apply them ſo to the mould, and preſs them into the ſand, as to leave their impreſſion there. Along the middle of the mould is laid half a ſmall braſs cylinder, as the chief canal for the metal to run through when melted, into the models or patterns; and from this chief canal are placed ſeveral others, which extend to each model or pattern placed in the frame. After this frame is finiſhed, they take out the patterns, by firſt looſening them all round, that the ſand may not give way.

Then they proceed to work the other half of the mould with the ſame patterns in juſt ſuch another frame, only that it has pins, which, entering into holes that correſpond to it in the other, make the two cavities of the pattern fall exactly on each.

The frame thus moulded, is carried to the melter, who, after extending the chief canal of the counterpart, and adding the croſs canals to the ſeveral models in both, and ſtrewing mill duſt over them, dries them in a kind of oven for that purpoſe.

Both parts of the mould being dry, they are joined together by means of the pins; and to prevent their giving way, by reaſon of the melted metal paſſing through the chief cylindrical canal, they are ſcrewed or wedged up like a a kind of a preſs.

While the moulds are thus preparing, the metal is fuſing in a crucible of a ſize proportionate to the quantity of metal intended to be caſt.

Some of theſe ſmall work founder's furnaces are like a ſmith's forge; others ſtand a few feet under ground for the more eaſily and ſafely taking out a weighty pot of metal; which is done by means of a circular pair of tongs that graſps round the top of the crucible. When the metal is melted, the workman pours it through the chief canal of each mould, which conveys it to every diſtinct pattern.

When the moulds are cooliſh, the frames are unſcrewed or unwedged, and the caſt work taken out of the ſand, which ſand is worked over again for other caſtings.

(2.) Of Statues. The caſting of ſtatues depends on the due preparation of the pit, the core, the wax, the outer mould, the inferior furnace to melt off the wax, and the upper to fuſe the metal.

The pit is a hole dug in a dry place ſomething deeper than the intended figure, and made according to the prominence of certain parts thereof. The inſide of the pit is commonly lined with ſtone, or brick; or when the figure is very large, they ſometimes work on the ground, and raiſe a proper fence to reſiſt the impulſion of the melted metal.

The inner mould, or core, is a rude maſs to which is given the intended attitude and contours.

It is raifed on an iron-grate, ftrong enough to fuftain it, and is ftrengthened within by feveral bars of iron. It is generally made either of potter's clay, mixed with hair, and horfe-dung; or of plafter of paris mixed with brick-duft. The ufe of the core is to fupport the wax, the fhell, and leffen the weight of the metal. The iron-bars, and the core are taken out of the brafs figure through an aperture left in it for that purpofe, which it foldered up afterwards. It is neceffary to leave fome of the iron-bars of the core, that contribute to the fteadinefs of the projecting part, within the brafs figure.

The wax is a reprefentation of the intended ftatue. If it be a piece of fculpture, the wax fhould be all of the fculpture's own hand, who ufually forms it on the core; though it may be wrought feparately in cavities, moulded on a model, and afterwards aranged on the ribs of iron over the grate; filling the vacant fpace in the middle with liquid plafter and brick-duft, whereby the inner core is proportioned as the fculpture carries on the wax.

When the wax, which is the intended thicknefs of the metal, is finifhed, they fill fmall waxen tubes perpendicular to it from top to bottom, to ferve both as canals for the conveyance of the metal to all parts of the work; and as vent-holes, to give paffage to the air, which would otherwife occafion great diforder, when the hot metal came to encompafs it.

The work being brought thus far, muft be covered with its fhell, which is a kind of cruft laid over the wax, and which being of a foft matter, eafily receives the impreffion of every part, which is afterwards communicated to the metal upon its taking the place of the wax, between the fhell and the mould. The matter of this outer mould is varied according as different layers are applied. The firft is generally a compofition of clay, and old white crucibles well ground and fifted, and mixed up with water, to the confiftence of a colour fit for painting: accordingly they apply it with a pencil, laying it feven or eight times over, and letting it dry between whiles. For the fecond impreffion, they add horfe-dung, and natural earth to the former compofition. The third impreffion is only horfe-dung and earth. Laftly, the fhell is finifhed by laying on feveral more impreffions of this laft matter, made very thick with the hand.

The fhell, thus finifhed, is fecured by feveral iron-girts, bound round it, at a about half a foot diftance from each other, and faftened at the bottom to the grate under the ftatue, and at top to a circle of iron where they all terminate.

If the ftatue be fo big that it would not be eafy to move the moulds with fafety, they muft be wrought on the fpot where it is to be caft. This is performed two ways; in the firft a fquare hole is dug under ground, much bigger than the mould to be made therein, and its infide lined with walls of free-ftone, or brick. At the bottom is made a hole of the fame materials with a kind of furnace, having its aperture outwards: in this is a fire made to dry the mould, and afterwards melt the wax. Over this furnace is placed the grate, and upon this the mould, &c. formed as above. Laftly, at one of the edges of the fquare pit, is made another large furnace to melt the metal. In the other way, it is fufficient to work the mould above ground, but with the like precaution of a furnace and grate underneath. When finifhed, four walls are to be run around it, and by the fide thereof a maffive made for a melting furnace. For the reft, the method is the fame in both. The mould being finifhed, and inclofed as defcribed, whether under-ground or above it, a moderate fire is lighted in the furnace under it, and the whole covered with planks, that the wax may melt gently down, and run out at pipes contrived for that purpofe, at the foot of the mould, which are afterwards exactly clofed with earth, fo foon as the wax is carried off. This done, the hole is filled up with bricks thrown in at random, and the fire in the furnace augmented, till fuch time as both the bricks and mould become red hot. After this, the fire being extinguifhed, and every thing cold again, they take out the bricks and fill up their place with earth, moiftened, and a little beaten to the top of the mould, in order to make it the more firm and fteady. Thefe preparatory meafures being duly taken, there remains nothing but to melt the metal, and run it into the mould. This is the office of the furnace above defcribed, which is commonly made in the form of an oven with three apertures, one to put in the wood, another for a vent, and a third to run the metal out at. From this laft aperture, which is kept very clofe, while the metal is in fufion, a fmall tube is laid, whereby the melted metal is conveyed into a large earthen bafon, over the mould, into the bottom of which all the big branches of the jets, or cafts, which are to convey the metal into all the parts of the mould, are inferted.

Thefe cafts, or jets, are all terminated with a kind of plugs, which are kept clofe, that, upon opening the furnace, the brafs, which guthes out with violence, may not enter any of them, till the bafon be full enough of matter to run into them all at once. Upon which occafion, they pull out the plugs, which are long iron-rods with a head at one end, capable of filling the whole diameter of each tube. The whole of the furnace is opened with

with a long piece of iron fitted at the end of each pole, and the mould filled in an inſtant. This completes the work in relation to the caſting part; the reſt being the ſculptor's or carvers buſineſs, who taking the figure out of the mould and earth, wherewith it is encompaſſed, ſaws off the jets with which it appears covered over, and repairs it with chiſſels, gravers, puncheons, *&c.*

(3) Foundery of Bells. The metal, it is to be obſerved, is different for bells, from what it is for ſtatues; there being no tin in the ſtatue metal: but there is a fifth, and ſometimes more, in the bell-metal

The dimenſions of the core, and the wax, for bells, if a ring of bells eſpecially, are not left to chance, but muſt be meaſured on a ſcale, or diapaſon, which gives the height, aperture, and thickneſs neceſſary for the ſeveral tones required.

It is on the wax that the ſeveral mouldings and other ornaments are formed to be repreſented in relievo, on the outſide of the bell.

The buſineſs of *bell-foundery* is reduced to three particulars. 1. The proportion of a bell. 2. The forming of the mould; and, 3. The melting of the metal.

The proportions of our bells differ much from thoſe of the *Chineſe*: in ours the modern proportions are to make the diameter fifteen times the thickneſs of the brim, and twelve times the height.

There are two kinds of preparations, *viz.* the ſimple and the relative: the former are thoſe proportions only that are between the ſeveral parts of a bell, to render it ſonorous; the relative proportions eſtabliſh a requiſite harmony between ſeveral bells.

The particulars neceſſary for making the mould of a bell, are, 1. The earth: the moſt coheſive is the beſt: it muſt be well ground and ſifted, to prevent any chinks. 2. Brick-ſtone; which muſt be uſed for the mine, mould, or core, and for the furnace. 3. Horſe-dung, hair, and hemp, mixed with the earth, to render the cement more binding. 4. The wax for inſcriptions, coats of arms, *&c.* 5. The tallow equally mixed with the wax, in order to put a ſlight lay of it upon the outer mould, before any letters are applied to it. 6. The coals to dry the mould.

For making the mould, they have a ſcaffold conſiſting of four boards, ranged upon treſſels. Upon this, they carry the earth, groſsly diluted, to mix it with horſe-dung, beating the whole with a large ſpatula.

The compaſſes of conſtruction is the chief inſtrument for making the mould, which conſiſt of two different legs, joined by a third piece. And laſt of all, the founders ſhelves, on which are the engravings of the letters, cartridges, coats of arms, *&c.*

They firſt dig a hole, of a ſufficient depth to contain the mould of the bell, together with the caſe, or cannon, under ground; and about ſix inches lower than the terreplain, where the work is performed. The hole muſt be wide enough for a free paſſage between the mould and walls of the hole; or between one mould and another, when ſeveral bells are to be caſt. At the center of the hole is a ſtake erected, that is ſtrongly faſtened in the ground. This ſupports an iron-peg, on which the pivot of the ſecond branch of the compaſſes turns. The ſtake is encompaſſed with a ſolid brick-work, perfectly round, about half a foot high, and of the propoſed bell's diameter. This they call a mill-ſtone. The parts of the mould are the core, the model of the bell, and the ſhell. When the outer ſurface of the core is formed, they begin to raiſe the core, which is made of bricks that are laid in courſes of equal height upon a lay of plain earth. At the laying each brick, they bring near it the branch of the compaſſes, on which the curve of the core is ſhaped, ſo as that there may remain between it and the curve the diſtance of a line, to be afterwards filled up with layers of cement. The work is continued to the top, only leaving an opening for the coals to bake the core. This work is covered with a layer of cement, made of earth and horſe-dung, on which they move the compaſſes of conſtruction, to make it of an even ſmoothneſs every where.

The firſt layer being finiſhed, they put the fire to the core, by filling it half with coals, through an opening that is kept ſhut, during the baking, with a cake of earth, that has been ſeparately baked. The firſt fire conſumes the ſtake, and the fire is left in the core half, or, ſometimes, a whole day: the firſt layer being thoroughly dry, they cover it with a ſecond, third, and fourth; each being ſmoothed by the board of the compaſſes, and thoroughly dried before they proceed to another.

The core being completed, they take the compaſſes to pieces. with intent to cut off the thickneſs of the model, and the compaſſes are immediately put in their place, to begin a ſecond piece of the mould. It conſiſts of a mixture of earth and hair, applied with the hand on the core, in ſeveral cakes that cloſe together. This work is finiſhed by ſeveral layers of a thinner cement of the ſame matter, ſmoothed by the compaſſes, and thoroughly dried, before another is laid on. The firſt layer of the model is a mixture of wax and greaſe ſpread over

over the whole. After which are applied the inscriptions, coat of arms, &c. besmeared with a pencil dipped in a vessel of wax in a chaffing-dish: this is done for every letter. Before the shell is begun, the compasses are taken to pieces, to cut off all the wood that fills the place of the thickness to be given to the shell.

The first layer is the same earth with the rest, sifted very fine; whilst it is tempering in water, it is mixed with cow's hair, to make it cohere. The whole being a thin cullis, is gently poured on the model, that fills exactly all the sinuosities of the figures, &c. and this is repeated till the whole is two lines thick over the model. When this layer is thoroughly dried, they cover it with a second of the same matter, but something thicker: when this second layer becomes of some consistence, they apply the compasses again, and light a fire in the core, so as to melt off the wax of the inscriptions, &c.

After this, they go on with other layers of the shell, by means of the compasses. Here they add to the cow's hair a quantity of hemp, spread upon the layers, and afterwards smoothed by the board of the compasses. The thickness of the shell comes to four or five inches lower than the mill-stone before observed, and surrounds it quite close, which prevents the extravasation of the metal. The wax should be taken out before the melting of the metal.

The ear of the bell requires a separate work, which is done during the drying of the several incrustations of the cement. It has seven rings, the seventh is called the bridge, and unites the others, being a perpendicular support to strengthen the curves. It has an aperture at the top, to admit a large iron-peg, bent at the bottom; and this is introduced into two holes in the beam, fastened with two strong iron-keys. There are models made of the rings, with masses of beaten earth, that are dried in the fire, in order to have the hollow of them. These rings are gently pressed upon a layer of earth and cow's hair, one half of its depth; and then taken out, without breaking the mould. This operation is repeated twelve times for twelve half-moulds, that two and two united may make the hollows of the six rings: the same they do for the hollow of the bridge, and bake them all, to unite them together.

Upon the open place left for the coals to be put in, are placed the rings that constitute the ear. They first put into this open place the iron-ring to support the clapper of the bell; then they make a round cake of clay, to fill up the diameter of the thickness of the core. This cake after baking, is clapped upon the opening, and soldered with a thin mortar spread over it, which binds the cover close to the core.

The hollow of the model is filled with an earth, sufficiently moist, to fix on the place, which is strewed, at several times, upon the cover of the core; and they beat it gently with a pestle, to a proper height; and a workman smooths the earth at top with a wooden trowel dipped in water.

Upon this cover, to be taken off afterwards, they assemble the hollows of the rings. When every thing is in its proper place, they strengthen the outsides of the hollows with mortar, in order to bind them with the bridge, and keep them steady at the bottom, by means of a cake of the same mortar, which fills up the whole aperture of the shell. This they let dry, that it may be removed without breaking. To make room for the metal they pull off the hollows of the rings, through which the metal is to pass, before it enters into the vacuity of the mould. The shell being unloaded of its ear, they range under the mill-stone five or six pieces of wood, about two feet long, and thick enough to reach almost the lower part of the shell; between these and the mould they drive in wooden wedges with a mallet, to shake the shell of the model whereon it rests, so as to be pulled up, and got out of the pit.

When this and the wax are removed, they break the model and the layer of earth, through which the metal must run, from the hollow of the rings, between the shell and the core. They smoke the inside of the shell, by burning straw under it, that helps to smooth the surface of the bell. Then they put the shell in the place, so as to leave the same interval between that and the core; and before the hollows of the rings or the cap are put on again, they add two vents, that are united to the rings, and to each other, by a mass of baked cement. After which they put on this mass of the cap, the rings, and the vent, over the shell, and solder it with thin cement, which is dried gradually by covering it with burning coals. Then they fill up the pit with earth; beating it strongly all the time, round the mould.

The furnace has a place for the fire, and another for the metal. The fire-place has a large chimney with a spacious ash-hole. The furnace which contains the metal, is vaulted, whose bottom is made of earth rammed down; the rest is built with brick. It has four apertures; the first, through which the flame reverberates; the second is closed with a stopple that is opened for the metal to run; the others are to separate the dross, or scoriæ, of the metal by wooden rakes: through these last apertures passes the thick smoke. The ground of the furnace is built sloping, for the metal to run down.

(4.) Foundery *of great guns and mortar-pieces.* The method of caſting theſe pieces is little different from that of bells: they are run maſſy, without any core, being determined by the hollow of the ſhell; and they are afterwards bored with a ſteel trepan, that is worked either by horſes, or a water-mill.

The *metal* of which *cannons* are compoſed, is either iron, or which is more uſual, a mixture of copper, tin, and braſs; the tin being added to the copper, to make the metal more denſe and compact; ſo that the better and heavier the copper is, the leſs tin is required. Some to an hundred pounds of copper add ten of tin, and eight of braſs; others ten of tin, five of braſs, and ten of lead. The ſieur *Bereau* pretends, that when old pieces of metal are uſed, the founder ought to add to one hundred weight of that metal, twenty-five pounds of good copper, and five pounds of tin. *Braudius* deſcribes a method of making cannon of leather: and it is certain the *Swedes* made uſe of ſuch in the long war of the laſt century; but theſe burſt too eaſily to have much effect.

A *cannon* conſiſts of *ſeveral members*, the principal of which are as follows, *viz.* The uppermoſt part round about the piece is the *ſuperficies* of the metal; the ſubſtance or whole maſs of metal is called the *body* of the cannon; the hollowneſs is called the *concave cylinder*, or *ſoul*, the whole length is the *chaſe*; that part of the bore, which contains the powder and ſhot, is the *chamber*, or charged cylinder; the remainder is the *vacant cylinder*; the ſpindles or ears are called *trunnions*, and the ſpace between them the *gravity of her center*; the pumel at her coyl is called the *caſcabel*, or *deck*; the little hole, the *touch-hole*; the metal behind the touch-hole is called the *breech*, or *coyl*; the greateſt ring at the touch hole, her *baſe ring*; the next ring, or circle, is the *reinforced ring*; the next to this, the *trunnion ring*; and the foremoſt circle is the *muzzle ring*; the ring between the trunnions and muzzle ring is called the *corniſh ring*; and all the rings, circles, and eminences at her muzzle, are called the *frize*.

Cannons are diſtinguiſhed by the diameters of the balls they carry. The rule for their length is, that it be ſuch as that the whole charge of powder be on fire, before the ball quit the piece. If it be too long, the quantity of air to be drawn out before the ball, will give too much reſiſtance to the impulſe; and that impulſe ceaſing, the friction of the ball againſt the ſurface of the piece, will take off from the motion.

In former days, cannon were made much longer than they are now; but experience has taught us, that a ball moves with a greater impetus thro' a leſs ſpace than a greater: and accordingly it is found, that an iron ball of 48 pound weight, goes farther from a ſhort cannon, than another ball of 96 pound out of a longer piece; whereas, in other reſpects, it is certain, the larger the bore and ball, the greater the range. It is found too, by experience, that of two cannons of equal bore, but different lengths, the longer requires a greater charge of powder than the ſhorter. But the ordinary charge of a cannon is, for the weight of its gunpowder to be half that of its ball.

A table exhibiting the names of the ſeveral cannon, their length, their weight, and that of their ball, as they obtain among us.

Names of cannon.	wt of an iron ball.		weight of the cannon.	length of the cannon.	
	℔.	oz.	℔.	ft	inch.
Cannon royal	48	0	8000	12	0
Demi-cannon large	36	0	6000	12	0
Demi-cannon ordinary	32	0	5600	12	0
Demi cannon leaſt	30	0	5400	11	0
Culverin largeſt	20	0	4800	12	0
Culverin ordinary	17	5	4500	12	0
Culverin leaſt	15	0	4000	11	0
Demi-culverin ordinary	10	11	2700	11	0
Demi-culverin leaſt	9	0	2000	10	0
Saker ordinary	6	0	1500	10	0
Saker leaſt	4	12	1400	8	0
Minion largeſt	3	12	1000	8	0
Minion ordinary	3	4	800	7	0
Falcon	2	8	750	6	0
Falconet	1	5	400	5	6
Rabinet	0	8	300	5	6
Baſe	0	5	200	4	6

Cannon are likewiſe diſtinguiſhed according to the diameter of their mouth, or *calibre*. This calibre is divided into thirty-ſix parts, in order to determine by theſe parts the dimenſions of the different moulds for cannon.

An account of the dimenſions of the ſeveral parts of cannon of five different calibres, as they are regulated by an order of the king of *France*, on *Oct.* 7, 1732, in the following table.

Pieces

Pieces of cannon	of 24			of 16			of 12			of 8			of 4		
	feet.	inches.	lines.	feet.	inches.	lines.	feet.	inches.	lines.	feet.	inches.	lines.	feet.	inches.	lines.
Length of the bore	9	6		9	2		8	8		7	10		6	6	
Depth of the chamber	2	6			1	10									
Thickneſs of metal at breech		5	5		4	9		4	4		3	9		3	
Length of the caſcabel		10	11		9	6		8	8		7	7		6	
Diameter of the trunnions		5	5		4	9		4	4		3	10		3	
Projection of the trunnions		5	5		4	9		4	4		3	10		3	
Calibre of the piece		5	8		4	11		4	6		3	11		3	2
Diameter of the ball		5	6		4	9		4	4		3	9		3	
Length of the whole piece	11			10	6		10			8	10		7	3	
Weight of the piece		5400			4200			3200			2100			1150 ℔.	

Letter-Foundery, or *caſting of printing letters*. The firſt thing requiſite is to prepare good ſteel-punches, on the face of which is drawn the exact ſhape of the letter with pen and ink, if the letter be large, or with a ſmooth blunted point of a needle, if ſmall; and then, with proper gravers, the cutter digs deep between the ſtrokes, letting the marks ſtand on the punch; the work of hollowing being generally regulated by the depth of the counter punch: then he files the outſide, till it is fit for the matrix.

They have a mould to juſtify the matrices by, which conſiſts of an upper and under part, both which are alike, except the ſtool and ſpring behind, and a ſmall roundiſh wire in the upper part, for making the nick in the ſhank of the letter. Theſe two parts are exactly fitted into each other, being a male and female gage, to ſlide backwards and forwards.

Then they juſtify the mould, by caſting about twenty ſamples of letters, which are ſet in a compoſing ſtick, with the nicks towards the right hand; and comparing theſe every way with the pattern-letters, ſet up in the ſame manner, they find the exact meaſure of the body to be caſt.

Next they prepare the matrix, which is of braſs or copper, an inch and a half long, and of a proportionable thickneſs to the ſize of the letter it is to contain. In this metal is ſunk the face of the letter, by ſtriking the letter-punch the depth of an *n*. After this, the ſides and face of the matrix are juſtified and cleared, with files, of all bunchings that have been made by ſinking the punch.

Then it is brought to the furnace, which is built upright of brick with four ſquare ſides, and a ſtone at top, in which is a hole for the pan to ſtand in. They have ſeveral of theſe furnaces.

Printing letters are made of lead, hardened with iron or ſtub-nails. To make the iron run, they mingle an equal weight of antimony, beaten ſmall in an iron mortar, and ſtub-nails together. They charge a proper number of earthen pots, that bear the fire, with the two ingredients, as full as they can hold, and melt it in an open furnace built for that purpoſe.

When it bubbles, the iron is then melted, but it evaporates very much. This melted compoſt is ladled into an iron pot, wherein is melted lead, that is fixed on a furnace cloſe to the former, 3 ℔. of melted iron to 25 ℔. of lead; this they incorporate according to art.

The caſter taking the pan off the ſtone, and having kindled a good fire, he ſets the pan in again, and metal in it to melt. If it be a ſmall-bodied letter, or a thin letter with great bodies, that he intends to caſt, his metal muſt be very hot, and ſometimes red hot, to make the letter come. Then taking a ladle, of which he has ſeveral ſorts, that will hold as much as will make the letter and break, he lays it at the hole where the flame burſts out; then he ties a thin leather, cut with its narrow end againſt the face, to the leather groove of the matrix, by whipping a brown thread twice about the leather groove, and faſtening the thread with a knot. Then he puts both pieces of the mould together, and the matrix

matrix into the matrix-check; and places the foot of the matrix on the ſtool of the mould, and the broad end of the leather on the wood of the upper haft of the mould, but not tight up, leſt it hinder the foot of the matrix from ſinking cloſe down upon the ſtool, in a train of work. Afterwards laying a little roſin on the upper part of the mould, and having his caſting ladle hot, he, with the boiling ſide, melts the roſin and preſſes the broad end of the leather hard down on the wood, and ſo faſtens it thereto.

Now he comes to caſting, when placing the under half of the mould in his left hand, with the hook or jag forward, he holds the ends of its wood between the lower part of the ball of his thumb and his three hinder fingers; then he lays the upper half of the mould upon the under half, ſo as the male gages may fall into the female; and, at the ſame time, the foot of the matrix places itſelf upon the ſtool, and claſping his left hand thumb ſtrongly over the upper half, he nimbly catches hold of the bow or ſpring, with his right hand fingers at the top of it, and his thumb under it, and places the point of it againſt the middle of the notch in the backſide of the matrix, preſſing it forwards, as well towards the mould, as downwards, by the ſhoulder of the notch, cloſe upon the ſtool, while at the ſame time with his hinder fingers, as aforeſaid, he draws the under half of the mould towards the ball of his thumb, and thurſts, by the ball of his thumb, the upper part towards his fingers, that both the regiſters of the mould may paſs againſt both ſides of the matrix, and his thumb and fingers preſs both ſides of the mould cloſe together.

Then he takes the handle of his ladle in his right hand, and with the ball of it gives two or three ſtrokes outwards upon the ſurface of the melted metal, to clear it of the ſcum; then he takes up the ladle full, and having the mould in the left hand, turns his left ſide a little from the furnace, and brings the beak of his ladle to the mouth of the mould; and turns the upper part of his right hand towards him, to pour the metal into it, while, at the ſame inſtant, he puts the mould in his left hand forwards, to receive the metal with a ſtrong ſhake, not only into the bodies of the mould, but, while the metal is yet hot, into the very face of the matrix, to receive its perfect form there, as well as in the ſhank. Then he takes the upper half of the mould off, by placing his right thumb on the end of the wood next his left thumb, and his two middle fingers at the other end of the wood: he toſſes the letter, break and all, out upon a ſheet of waſte paper, laid on a bench, a little beyond his left hand; and then is ready to caſt another letter, as before, and likewiſe the whole number in that matrix.

Then boys, commonly employed for this purpoſe, ſeparate the breaks from the ſhanks, and rub them on a ſtone, and afterwards a man fixes them in a wooden frame and cuts them all of an even height with a carpenter's plane, which finiſhes the fount. A workman will ordinarily caſt 3000 of theſe letters in a day.

The perfection of letters thus caſt, conſiſts in their being all ſeverally ſquare and ſtrait on every ſide; and all generally of the ſame height, and evenly lined, without ſtooping one way or other; neither too big in the foot, nor the head; well grooved, ſo as the two extremes of the foot contain half the body of the letter; and well ground, barbed, and ſcraped, with a ſenſible notch, &c.

A ſet or quantity of letters, and all the appendages belonging thereto, as numeral characters, quadrats, points, &c. caſt by a letter-founder, and ſorted, is called a *Fount*. Founts are large or ſmall, according to the demand of the printer, who orders them by the hundred weight, or by ſheets. When a printer orders a fount of five hundred, he means that the fount, conſiſting of letters, points, ſpaces, quadrats, &c. ſhall weigh 500 lb. When he demands a fount of ten ſheets, it is underſtood, that with that fount he ſhall be able to compoſe ten ſheets, or twenty forms, without being obliged to diſtribute. The founder takes his meaſures accordingly; he reckons 120 lb. for a ſheet, including the quadrats, &c. or 60 lb. for a form, which is only half a ſheet: not that the ſheet always weighs 120 lb. or the form 60 lb. on the contrary, it varies according to the ſize of the form; beſides, it is always ſuppoſed that there are letters left in the caſes. As therefore every ſheet does not comprehend the ſame number of letters, nor the ſame ſort of letters, we muſt obſerve, that, as in every language ſome ſounds recur more frequently than others, ſome letters will be in much more uſe, and oftener repeated than others: and conſequently their cells or caſes ſhould be better ſtored than thoſe of the letters, which do not recur ſo frequently: thus, a fount does not contain an equal number of *a* and *b*, or of *b* and *c*, &c. the letter-founders have therefore a liſt or tariff, or, as the *French* call it, a *police*, by which they regulate the proportions between the different ſorts of characters that compoſe a fount; and it is evident that this tariff will vary in different languages, but will remain the ſame for all ſorts of characters employed in the ſame language.

The art of caſting *ſtatues* in braſs is very antient; inſomuch that its origin was too remote and obſcure, even for the reſearch of *Pliny*, an author admirably ſkilled in diſcovering the authors of other arts. All we can learn for certain, is, that it was practiſed in all its perfection, firſt, among the *Greeks*, and afterwards, among the *Romans*; and that the number of ſtatues

statues consecrated to the gods and heroes surpassed all belief. The single cities of *Athens*, *Delphos*, *Rhodes*, *&c.* had each 3000 statues; and *Marcus Scaurus*, tho' only Ædile, adorned the *Circus* with no less than three thousand statues of brass, for the time of the *Circensian* games. This taste for statues was carried to such a pitch, that it became a proverb, that in *Rome* the people of brass were not less numerous than the *Roman* people. Among us the casting of statues was but little known or practised before the seventeenth century.

We find mention made of *bells* in the poets, *Ovid*, *Tibullus*, *Martial*, *Statius*, *Manilius* and the *Greek* authors, under the appellations of *tintinnabula*, and *sounding brass*. *Suetonius*, *Dion*, *Strabo*, *Polybius*, *Josephus*, and others, mention them under the names of *Petasus*, *Tintinnabulum*, *Æramentum*, *Crotalum*, *Signum*, &c. but these appear to have been no more than baubles, and little like the large bells in use among us. *Hieronymus Magius*, who has a treatise expresly on *bells* (wrote, when in chains in *Turkey*, and which is accounted very remarkable, purely from his memory without the assistance of any books) makes large *bells* a modern invention. Indeed we do not hear of any before the sixth century: in 610, we are told, *Lupus* bishop of *Orleans*, being at *Sens*, then besieged by the army of *Clotharius*, frighten'd away the besiegers, by ringing the *bells* of *St. Stephen*. The first large *bells* in *England* are mentioned by *Bede*, towards the latter end of that century. They seem to have been pretty common in the year 816.

All authors agree, that the first cannon were cast in the fourteenth century; tho' some fix the event to the year 1338, and others to 1380.

Letter-founding was invented by FAUST, a *German*, about the year 1450, who was the first printer and founder of seperate metal types, in the manner now practised.

F O W L I N G.

FOWLING is the art of catching birds, which is done either by *hawks* or other birds of prey trained up for the game; and then is called *Falconry*, already treated of: or by nets, bird lime, decoys, and by other devices, which moderns practise; and also how to feed birds. All which shall be the subject of this treatise.

The *Fowler* must provide himself with such implements, as the branch of his art or game requires. —For SMALL BIRDS, with *bird-lime*, *nets*, and *decoys*.

The *nets* must be proportioned in the size of their meshes to the bigness of the birds fought after: made of the best packthread, about two fathom deep, and six long; verged on each side with strong cord, and extended at each end with poles made on purpose.

The *bird lime* is a viscid preparation from *holly-bark*; made after this manner. Boil this bark ten or twelve hours, then separate the green coat thereof from the other part, and place it cover'd in a moist place for a fortnight: then pound it into a tough paste, so as no fibres of the wood be left; and wash it in running water till no motes appear: then after it has fermented four or five days more, and skimmed as often as needful, it will be fit for use.

To make the *bird-lime* bear water, a pound of it must be washed in spring-water, till made very pliable; and beaten afterwards, till no water is perceived in it; and after it has been well dried, it is put in an earthen pot, mix'd with as much capon's grease as will make it run; to which are added, two spoonfuls of strong vinegar, a spoonful of the best sallad oil, and a small quantity of turpentine; those ingredients must be increased, or diminished, in proportion to the quantity of *bird lime*. Being thus mixed together, they must be boiled gently over a slow fire, stirring them continually: then they are taken off the fire and left to cool. This sort of *bird-lime* is the best, especially for snipes and feldfares.

Decoys are pipes, whistles, and calls.

For BIRDS OF A LARGER SIZE, fit for food, we must provide not only *nets*, but *decoys* of another sort, *fowling-pieces*, and *dogs* properly trained for the game.

The *nets* must be made stronger and larger, both in the meshes and in their length and breadth, according to the species of birds to be fought.

The *decoys* are either a place made to trap pigeons, or other wild fowl; or, a bird (for example, a *duck*) trained to deceive its own species. Thus a *decoy duck* is one that flies abroad, and lights into a company of wild ones, and being become acquainted with them, by her allurement draws them into the *decoy* place, where they become a prey.

Of *fowling-pieces*, those are reputed the best, which have the longest barrel, *viz.* from 5½, to 6 feet; with an indifferent bore under the harquebus; tho' for different occasions they should be of different sorts and sizes; but it its essential, the barrel be well polished and smooth within, and the

the bore of a bigness from end to end; which may be proved by thursting in a piece of wood, cut exactly to the bore of the muzzle, down to the touch-hole.

The powder must not be too old, for keeping weakens it much, especially if it grows damp.

The *dogs* used in this art are of two sorts; such as are trained up for the *water*, and such as are taught to hunt *partridges* and other land birds.

The dog trained for *water-fowling*, is to be well proportioned in his body, and must be well broke to the sport. His hairs must be long, curled, neither loose nor shagged; his head round and curled, his ears broad and hanging, his eye full, lively and quick, his nose very short, his lip hound-like, his chops furnished with a full set of strong teeth, his neck thick and short, his breast sharp, his shoulders broad, his fore-legs strait, his chin square, his buttocks round, his belly gaunt, his thighs brawny, &c.

For the *training* such a dog; as soon as he can lap, he must be taught to lie down, not daring to stir from that posture without leave, neither is he permitted to eat any thing till he deserves it; nor allowed more teachers, feeders, and cherishers than one. That teacher must never alter the word he first used in his lessons; for the dog takes notice of the sound, not of the language. When he is acquainted with the word suitable to his lesson, he must next be taught the word of reprehension; which at first should not be used without a jerk. He must also be used to cherishing words, which gives him encouragement when he does well; and which ought to be always the same, and attended with spitting in his mouth, stroking him with the hand under the belly, &c. There is also a word of advice to instruct him when he does amiss.

When the dog understands well these several words, he must be taught next to lead orderly in a string or collar, neither running too forward, nor hanging backward. This instruction is followed by that of coming close at his master's heels, without leading; for he must not range, unless it be to beat the fowl from their covert, or to fetch the wounded.

His next lesson must be to fetch and carry any thing his master throws to him out of his hands. He must be tried first with the glove, shaking it over his head, and making him snap at it; and sometimes suffering him to hold it in his mouth, and striving to pull it from him; and at last throwing it a little way, and letting him worry it on the ground; and so by degrees making him bring it wherever it is thrown. From the glove he must be taught to fetch cudgels, bags, nets, &c. It will not be amiss to use him to carry dead fowls; for by that means he will never tear or bruise what fowl is shot.

The last lesson which must be given, is to drop something which the dog does not see; and being gone a little way from it, send him back to seek it, by saying, *Back, I have lost*. If he appears amazed, he must be urged to seek out till he has found it. Then something must be dropped at a greater distance, and he made to find out that too; till he is brought to go back a mile.

To train him for the gun, he must be made to stalk after the fowler step by step, or else couch and close till he has shot.

The last use of the *water dog* is in moulting-time, when wild fowls cast their feathers and are unable to fly; which is towards the latter end of the summer. At this time the dog must be brought to their coverts, and hunt them out into the stream; and there they will be taken in the nets.

The *setting dog* to hunt *partridges*, &c. is a big *land spaniel*, taught by nature to hunt the *partridge* more than any chace whatever, running the fields over with such alacrity and nimbleness, as if there was no limit to his fury and desire, and yet by art under such excellent command, that in the very height of his career, by a *hem*, or sound of his master's voice, he shall stand, gaze about him, look in his master's face, and observe his directions, whether to proceed, stand still, or retire: nay, when he is even just upon his prey, that he may even take it up with his mouth, yet his obedience is so framed by art, that presently he shall either stand still, or fall down flat on his belly, without daring either to make any noise or motion, till his master comes to him, and then he will proceed in all things to follow his directions.

To train a dog from a whelp till he comes to that perfection, you must choose him a land spaniel, of a good and nimble size, rather small than great, and of a couragious mettle, and tho' these good qualities cannot be discerned while young; yet they may be justly guessed at, from a right breed, which have been known to be strong, lusty, and nimble rangers, of active feet, wanton tails and busy nostrils,——whose tail was without weariness, their search without changeableness, and which no delight did transport beyond fear and obedience.

When the fowler has made choice of his dog, he begins to instruct him, while about four or six months old; first by making him loving and familiar with his master, to know him from any other person, and following him wherever he goes: which the better to effect, he must very seldom receive his food from any other hand but his; and when he corrects him, to keep him in awe, he must rather do it with words than blows. A dog thus instructed will follow none but his master, and can distinguish his frown from his smile, and smooth words

words from rough. Then he muſt teach him to lie down cloſe to the ground; firſt, by laying him often on the ground, and crying, *lie cloſe:* when he has done any thing to his maſter's mind and pleaſure, he muſt be rewarded with a piece of bread; if otherwiſe, chaſtized with words, but few blows. After this, he muſt be taught to come creeping with his belly and head cloſe on the ground, as far, or as little a way as his maſter ſhall think fit; and this the maſter may do by ſaying, *come nearer, come nearer,* or the like; and at firſt, till he underſtands his meaning, ſhewing him a piece of bread, or ſome other food, to entice him. If he offers to raiſe his body or head, the part thus raiſed muſt not only be thruſt down, but he muſt likewiſe be threatened with an angry voice; which if he ſeems to ſlight, two or three jerks, with a whipcord-laſh, muſt be added to the voice. Theſe leſſons muſt be often repeated, till he be very perfect, ſtill encouraging him when he does well. If the fowler walks abroad with his dog, and he takes a fancy to range, even when he is moſt buſy, he muſt ſpeak to him, and in the height of his paſtime made fall upon his belly, and lie cloſe; and afterwards, come creeping. The next which muſt be given him, is to lead in a ſtring or line, and to follow his maſter cloſe at his heels, without trouble or ſtraining of his collar. By the time the dog has learned all theſe leſſons, he muſt be near twelve months old; at which time, the ſeaſon of the year being proper, he muſt be taken into the field and permitted to range, but ſtill in obedience to his maſter's command.

Being brought to good temper, and right obedience; as ſoon as he comes upon the haunt of any partridge, (which is diſcover'd at his greater eagerneſs in hunting, as alſo at a kind of wimpering and whining in his voice, being very deſirous to open, but not daring) his maſter ſhall ſpeak to him, bidding him take heed, and the like: but if, notwithſtanding, he either ruſhes in, and ſprings the *partridge*, or opens, and ſo the *partridge* eſcapes, he muſt be corrected ſeverely, caſt off again, and made to hunt in ſome haunts where the fowler knows a covy lies, and ſees whether he has mended his fault: and if any *partridge* be catch'd with the net, the dog muſt have the head, neck, and pinions, for his future encouragement.

The implements for fowling thus provided, it is neceſſary to divide the winged game into proper claſſes; as, *water fowls*, and *land fowls*.

The *water fowls* are ſo called from their natural delight in and about water, for their habitation and ſubſiſtance in and from that element. This kind of *fowls* are naturally the ſubtleſt, and wiſeſt of all birds, and moſt careful of their own ſafety: hence they have been compared to a camp, having ſcouts at land afar off, guards, centinels, and all ſorts of other watchful officers, ſurrounding the body, to give an alarm, on any approach or ſeeming danger. They always fly in company, ſo that when a ſingle fowl, or a couple fly together, they muſt have been ſeparated from the reſt, either by the approach of men, or the beating of ſome birds of prey on the river. But though thus ſeparated, they ſeldom leave wing till they meet together again.

There are two ſorts of *water fowls, viz.* thoſe that live of the water, and thoſe that live on the water. The one take their food from the water, by wading and diving for it with their long legs, and without ſwimming thereon; the others are web-foot, and ſwim, as the ſwan, gooſe, mallard, &c.

The large *water fowls*, or thoſe which divide the foot, frequent moſt commonly the edge of ſhallow rivers, brooks, and flaſhes of water; and never fly in company, but are to be found, here one, there a couple, and the like; which renders it difficult to take them by decoys, nets, or any other implement of that kind. They delight likewiſe in low and boggy places, dry parts of drown'd fens, overgrown with tall and long ruſhes, reeds, and hedges; half drown'd moors, or the hollow vales of downs, heaths, or plains, where there is ſhelter either of hedges, hills, tufts of buſhes or trees, where they may lurk obſcurely.

To catch them with *nets*, the fowler muſt know where they feed in the morning and evening; and coming to the place, two hours at leaſt before that time, ſpreads his *net* ſmooth and flat upon the ground, ſtaking the two lower ends firm thereon, and leaving the upper ones extended upon the long cord, the further end whereof muſt be ſtaked faſt down to the earth, two or three fathom from the *net*, and the ſtakes which ſtake down the cord, ſtand in a direct and even line with the lower verge of the *net*; then he ſhall hold in his hand, at the uttermoſt diſtance, the other end of the cord, which muſt be at leaſt ten or twelve fathom long; there he muſt make ſome artificial ſhelter either of graſs, ſods, earth, or ſuch like matter, where he may lie out of ſight of the fowl. He ought alſo to take care to ſtrew over all his *net*, as it lies upon the ground, ſome graſs, that he may hide it from the fowl. It will not be improper to ſtake down near the *net* a live hern, or ſome other fowl formerly taken for a *ſtale*.

When the fowler ſees a ſufficient number of fowls to come within the verge of his *net*, he ought then to draw ſuddenly his cord, and ſo caſt his net over them; continuing to act in that ſame manner, till the ſun be near an hour high, and no longer; for then the fowls feeding is over for that time; but he may return in the evening, from about sun-set till twilight. By these means he may not only take great quantities of large wild fowls, but also plovers, which take their food as much from land as water.

The *lesser fowls*, which are web-footed, haunt continually drown'd fens, where they may have plenty of water, and swim undisturbed by man or beast; main streams of rivers, where the current is swiftest and least subject to freeze; and the broader and deeper such rivers are, the greater delight these fowls take therein; the wild-goose and barnacle excepted, which never abide on waters above their founding; for when they cannot reach the *ouze*, they instantly remove thence, seeking out more shallow places. These two last named, are extremely delighted with green winter corn; therefore they are to be search'd after, where such grain is sown; especially if the ends of the lands have much water about them.

These smaller fowls do also much frequent small brooks, rivers, ponds, drown'd meadows, pastures, moors, loughs, and lakes, especially if well stored with islands unfrequented, and well furnished with shrubs, bushes, reeds, &c. They frequent such places winter and summer, and breed there.

To take these smaller fowls with *nets*, they must be pitch'd for the evening flight before sun-set, staking them down on each side of the river, about half a foot within the water, the lower side of the *net* being so plumb'd, that it may sink so far and no farther: its upper side is to be placed slantwise, shoaling against the water, yet not touching it by near two foot. The strings which support this upper side, ought to be fasten'd to small yielding sticks set in the bank, which as the fowl strikes may give liberty to the *net* to rangle and entangle them.

Several of these *nets* may be placed over divers parts of the river, at a competent distance from one another, or as the river or brook shall give leave.

To hasten the fowls to fly to the *nets*, the fowler must fire his gun in the fens and plashes, round about the river where they are placed; for thereby the fowls will be so frighted, that they'll instantly post to the river.

This kind of fowls are also taken with *lime-twigs*, by fitting them in length according to the depth of the river, besmearing them with very strong water-lime, such as no wet or frost can injure; and pricking them in the water, so that as much of the rod as is lim'd, be above water; staking here and there among the rods, a live *stale*, as a mallard, widgeon, or teal.

The fowler needs not to wait continually on his rods, but may come thrice a day to see what is taken, *viz.* early in the morning, at noon, and late in the evening; and then he must be accompanied with his water-spaniel; for if he perceives any of his rods missing, he may imagine that some fowls are fasten'd to them, which are crept in some hole, bush, or hedge by the river side, which his dog will help him to find.

Small *water fowls* may also be taken by *small*, or *great springs*, which is done in the following manner.

Having took notice where the fowls feed morning and evening, of the furrows and water-tracts where they usually stalk and paddle, to find worms, float-grass roots, and the like; the fowler must mark where many furrows meet in one, and break out, as it were, into one narrow passage, which divides itself afterwards into other parts and branches: then he marks how every furrow breaks and comes into this center or little pit, which is most paddled with the fowl, or which is easiest for fowl to wade in: this being done, he takes small and short sticks, and pricks them cross wise athwart over all the other passages, one stick within half an inch of the other, making, as it were, a kind of fence to guard every way but one, through which he will have the fowl to pass.

Having thus hemmed in all ways but one, he takes a stiff stick cut flat on the one side, and pricks both ends down into the water, making the upper part of the flat side of the stick, to touch the water and no more: this done, he makes a bow of small hazel, or willow, of a foot long, and five or six inches broad, in the form of a pear, broad and round at one end, narrow at the other, making a small nick at the narrow end: then he takes a good stiff grown plant of hazel, free from knots, three or four inches about at the bottom, and an inch at the top, and having sharpened the bottom end, he fastens at the top a very strong loop of about an hundred horse-hairs, plaited very fast together with strong packthread, and made so smooth that it will run and slip at pleasure. Near this loop he fastens a little broad tricker, within an inch and half of the end of the plant, which he makes equally sharp at both ends: he thrusts the bigger sharp end of the plant into the ground, close by the edge of the water; and brings the smaller end with the loop and the tricker down to the first bridge, and then the hoop being laid on the bridge, one end of the tricker is set upon the neck of the hoop, and the other end against a nick made on the small end of the plant, which by the violence and bend of the plant, makes them stick together until the hoop be moved. This done he lays the swickle on the hoop in such a manner as the hoop is proportioned; then from each side of the hoop pricks little sticks, making

ing an impaled path to the hoop; and as he goes farther from the hoop and ſpring, he makes the way wider; therefore the fowl can enter a good way before he perceives the fence, and thereby will be enticed to wade up to the ſpring, which will be no ſooner touch'd, than the part of the bird which touches it, will be preſently catch'd; and thus according to the ſtrength of the plant, a fowler may take a fowl of any bigneſs.

The ſpring for leſſer fowl, as woodcock, ſnipe, plover, *&c.* is made after the ſame manner, differing only in ſtrength, according to the bigneſs of the bird we intend to catch.

When the *fowler* ſeeks for ſport more than profit, he only takes his *piece* and his *dog*; in which caſe he muſt obſerve, in *ſhooting*, to ſhoot with the wind if poſſible, and not againſt it: and rather ſideways, or behind the fowl, than full in their faces. Chuſing the moſt convenient ſhelter he can find, as either hedge, bank, tree, or any thing elſe, which may hide him from the view of the fowl.

If he has not ſhelter enough by reaſon of the nakedneſs of the banks and want of trees, he muſt creep upon his hands and knees under the banks, and laying flat upon his belly, put the noſe of his piece over the bank, and ſo take his level; for a water fowl is ſo fearful of a man, that though a hawk were ſoaring over her head, yet at the ſight of a man ſhe would betake herſelf to her wing, and run that danger. But it happens ſometimes that the fowls are ſo ſhy, there is no getting a ſhoot at them without a ſkreen, or device to hide the fowler, and amuſe the game, while he gets within ſhot.

This device is called *ſtalking*; and there is a *ſtalking hedge*, a *ſtalking horſe*, a *ſtalking tree*, &c.

A *ſtalking hedge*, is an artificial hedge, two or three yards long, and a yard and half high, made with ſmall wands, to be light and portable, yet buſhed out like a real hedge, with ſtakes to ſupport it, while the fowler takes his aim.

Stalking horſe, is an old jade trained up for the purpoſe, which will gently walk up and down as you would have him in water, *&c.* beneath whoſe fore-ſhoulder the ſportſman ſhelters himſelf and gun. When thus got within ſhot, he takes aim from before the fore-part of the horſe, which is much better than ſhooting under his belly. To ſupply the defect of a real *ſtalking* horſe, an artificial one is frequently made of old canvas, ſhaped in form of a horſe, with his head bent down, as if grazing; ſtuffed with any light matter, and painted: in the middle it is fixed to a ſtaff ſhod at the foot, to ſtick into the ground while aim is taken. For change, when the fowls begin to be uſed to the *ſtalking* horſe, and to know it, ſome *ſtalk* with an ox, cow, deer, or the like. Others uſe a *ſtalking tree*, and others a *ſtalking buſh*.

The LAND FOWLS are ſo called from their delighting principally in the cover and ſubſiſtance they meet with upon the earth. Theſe are of divers ſorts, ſome are either fit for food, as *pigeons* of all ſorts, *rook*, *pheaſant*, *partridges*, *quails*, *rails*, *feldfares*, &c. or for pleaſure only, as all manner of birds of prey, *viz. caſtreſs*, *ring-tails*, *buzzards*, &c. or for food and pleaſure together, as *black-bird*, *thruſh*, *nightingale*, *linnet*, *lark*, and *bull-finch*.

Theſe *land fowls*, of all ſorts, are taken either by day or by night. If by day, it is done with the great net, commonly called the *crow-net*, not at all different in length, depth, bigneſs of meſh, manner of laying, *&c.* from the *plover-net*; only it will not be amiſs if the cords be longer.

This net may be laid before a barn-door, or where corn has been winnowed, or in ſtubble-fields; and it muſt be hidden, that the fowls may not diſcover the ſnare. When the fowler, who muſt lie concealed afar off, with the cord in his hand, perceives a quantity of fowls within the net, ſcraping for food, he muſt quickly pull the net over them. But to ſucceed well in this manner of ſport, he muſt carefully obſerve the morning and evening haunts of the fowl, when they come to feed upon the green-ſwarth, and there lay his net, where he will meet with as good ſucceſs as any where elſe; provided he takes care to hide himſelf, and does not pull his cord too haſtily, but wait till he ſees a good number of fowls within the net, then pull freely and quickly; for the leaſt deliberation after the net is rais'd, proves the ruin of the ſport.

There is another manner of taking *land fowls*, eſpecially *ſmall birds*, with *bird-lime*, particularly in froſt and ſnow; for, as thoſe ſmall birds then aſſemble in flocks, (as *larks*, *chaffinches*, *linnets*, *goldfinches*, *yellow-hammers*, *buntings*, *ſparrows*, &c. they all, but the lark, perch on trees or buſhes, as well as feed on the ground) the fowler muſt go into a field and ſcatter chaff and threſh'd ears, twenty yards wide, (it is beſt in ſnow) and then ſtick the limed ears up and down, with the ears leaning, or at the end touching the ground: then he retires from the place, and traverſes the ground round about; the birds being thereby diſturbed in their haunts, fly to the ears, and pecking at them, they ſtick; which perceiving, they ſtraitways mount up from the earth, and in their flight the bird-limed ſtraws lay under their wings, and falling, are not able to diſengage themſelves from the ſtraw, and ſo are certainly taken.

Land fowls are taken by night, with the help of a low bell, and of a net, whoſe meſh is twenty yards deep; and ſo broad, that it may cover five or six lands or more, according to the company the fowler has to carry it: this cannot be used but in plain champain countries, from the end of *October* until the end of *March*.

With these implements the fowler goes into a corn-field; the foremost carries the bell, tolling it as he goes, very mournfully; next follows the net, borne up at each corner and on each side, by several persons; then another carries some iron or earthen vessel, with burning, but not blazing coals in it; at which coals bundles of straw must be lighted, unless one should chuse to carry links. The nets being pitched where the game is supposed to lie, the ground must be beaten, and a noise made, at which the fowls rise, and are entangled in the net.

There is another manner of taking birds by night, which roost in bushes, shrubs, hawthorn-tree, *&c.* called Bat-Fowling; and which is thus: the fowler must be very silent till his lights are blazing; and may chuse if he will carry nets or not. If he carries none, he must have long poles with great bushy tops fixed to them; and having from a vessel to carry fire in, lighted his straw or other blazing matter, he must beat those bushes where he thinks birds are at roost; which done, if there be any in those bushes or trees, he will instantly see them fly above the flames, so that those who have the bushy poles may beat them down at pleasure, and take them up.

Larks, *buntings*, *merlins*, *hobbies*, and any birds which will stoop either to stale, prey, gig, glass, or the like, may be taken from *August* to *September*, with the *day-net*, which must be planted before sun-rising; and the milder the air, the brighter the sun, and the pleasanter the morning, the better will be the sport, and of longer continuance.

The place chosen for this kind of sport must be a plain, either on barley stubble, green lays, and level and flat meadows, remote from villages, but near corn-fields.

These *nets* being staked down with strong stakes, tight on their lines, so as to be cast to and fro at pleasure, with a nimble twitch, a dozen of hand-lines, or drawing cords, a fathom long, must be fastened to the upper end of the foremost staves, and extended of such reasonable straitness, as with little strength they may raise up the nets and cast them over. When the nets are laid, stales, decoys, or playing wantons, must be placed twenty or thirty paces beyond them, upon some perching boughs, which will not only entice birds of their own feathers to stoop, but also hawks, and other birds of prey to swoop into the nets.

A *day-net* must be made of fine pack-thread, the mesh small, and not above half an inch square half-way; three fathom in length, and one in breadth; like the *crow-net* in shape; verged about in the same manner with a small strong cord, the two ends whereof extended upon two small long poles, suitable to the breadth of the net, with four stakes, tail-strings, and drawling lines, as heretofore mentioned; only whereas that was but one single net, here must be two of one length, breadth, and shape. These *nets* must be placed opposite to each other, yet so close and even together, that when they are drawn and pulled over, the sides may touch one another.

Particular Directions *for catching snipes, feldfares, pigeons, magpyes, pheasants, partridges, rails, quails, moor-poots, &c.*

To catch *snipes* with bird-lime, the fowler must know the places they frequent most, which is easily discovered by their dung; and there set two hundred limed twigs, more or less (especially if it be hard, frosty, or snowy weather, where the water lies open; for commonly they lie very thick in such places.) The twigs must be at a yard distant from one another, and sloping, some one way and some another; then the fowler retiring at a convenient distance from the place, must wait the success of the sport, and not be too hasty to stir at the first he sees taken; for the *snipe* will feed with the twig under his wings, and be a means to entice those down, who come over the place. When he sees the coast clear, and but few that are not taken, he must then take up his birds, fastening one or two of them, that the other flying over, may alight at the same place. If there be any other open place near that where the twigs are planted, they ought to be beaten up

Feldfares, as well as *snipes*, are also winter birds, and are taken by setting a dead one at the top of a great birchen bough, cover'd with small lime twigs, and planting the bough where the *feldfares* resort in a morning to feed. By this means, others flying but near, will quickly espy the top-bird, and fall in whole flocks to him.

Pheasants are taken three several ways, **viz.** by *net*, *lime-bush*, or *driver*,

Nets for *pheasants*, must be made of double twined brown thread, dy'd blue or green, the mesh reasonably large and square, almost an inch between knot and knot; its length about three fathoms, and about seven feet broad, verged on each side with strong small cord, and likewise at the ends, that it may lie compass-wise and hollow.

In this kind of sport, the fowler must, as in all others heretofore mentioned, know the haunts of the fowl, which are never in open fields, nor in old high woods, since *pheasants* seldom frequent any other place, but young copses well grown; and of those, none but such as are solitary, and unfrequent-

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ed by men or cattle. But the moſt certain way of finding them out, is to have a *pheaſant-call*, which he muſt learn how to uſe; underſtand all their notes, and how to apply them: for *pheaſants* have ſeveral and different notes; one to cluck them together when the hen would feed them, another to chide them when they ſtraggle too far, a third to call them to meat when ſhe has found it, a fourth to make them look out for food themſelves, and a fifth to call them about her to ſport withal. The call may be uſed early in the morning, at which time they ſtraggle abroad to find provender; or elſe in the evening juſt before ſun-ſetting, which is their time likewiſe for feeding. Tho' they may be called at any other time of the day, by only changing note; for as before ſun-riſing, and at its ſetting, the note muſt be to call them to feed; in the fore-noon, and afternoon, it muſt be to call them to brood, or chide them for ſtraggling, or give them notice of ſome approaching danger.

With all theſe neceſſary inſtructions, the Fowler muſt lodge himſelf as cloſe as poſſible, and then call at firſt very ſoftly, leſt the *pheaſants* being lodged very near him, ſhould be frighted at a loud note, but if nothing reply, he muſt raiſe his note higher and higher, till he extends it to the utmoſt compaſs; and if there be a *pheaſant* within hearing, ſhe will anſwer in a note as loud as his own, provided it be not untunable, for that would ſpoil all. As ſoon as he hears this anſwer, if it be from afar, and from a ſingle fowl, he muſt creep nearer and nearer unto it, ſo will the *pheaſant* to him, and as he alters his note ſo will ſhe, and in all points he muſt endeavour to imitate her, whereby he'll get ſight of her at laſt, either on the ground or perch; which got he ceaſes his calling, and ſpreads his net between the *pheaſant* and himſelf, in the moſt convenient place he can find, with much ſecrecy and ſilence, making one end of the net faſt to the ground, and holding the other end by a long line in his hand, whereby when any thing ſtrains it, he may pull the net cloſe together. This done he calls again, and as ſoon as he perceives the *pheaſant* come underneath the net, he riſes up and ſhews himſelf, whereby the *pheaſant* being frighted, offering to mount, finds herſelf entangled within the net.

But if it happens that the Fowler hears many anſwers, and from different parts of the wood, he muſt not ſtir, but keep his place, and as he hears them by their ſound, to come nearer and nearer unto him, he muſt make his nets ready, and ſpread them conveniently about him, one net on the one ſide, and another on the other; then lie cloſe and apply himſelf to the call, till he has allured them under his nets, which done, he muſt ſtand up and ſhew himſelf, to fright them, and make them mount, whereby they are entangled.

Pheaſant-powts, or young *pheaſants*, are driven into nets, with an inſtrument made of ſtrong white wands, or oſiers, ſet faſt in a handle, twiſted about in two or three places, and bound with other wands, in the ſhape of thoſe things cloth-dreſſers uſually dreſs their cloth withal. With this driver the Fowler muſt make a gentle noiſe, raking upon the boughs and buſhes round about him, which will make the *powts* run from it a little way, and then ſtand and liſten, keeping all cloſe together, till by another rake of the driver, they are made to run again as before, and by thus raking they will be driven like ſo many ſheep into the nets, which muſt be placed a-croſs the little pads and ways which the fowler ſees they have made, which are like ſheep-tracks, and as near their ordinary haunt as poſſible, which may be diſcovered by the barenneſs of the ground, mutings, and looſe feathers.

Two things are to be obſerved in uſing the *driver*; the firſt is ſecrecy in concealing one's ſelf from the ſight of the *pheaſants*; for if they chance to ſee the Fowler, they will inſtantly hide themſelves in holes and bottoms of buſhes, and will not ſtir from thence till night. The other is circumſpection in the work, for nothing obſtructs this paſtime more, than too much precipitation or haſte, for *pheaſants* are fearful creatures, ſoon ſtartle, and when once alarmed, they all fly in an inſtant, without ſtaying to behold what they are ſo much afraid of.

To take *pheaſants* with a lime-buſh; the Fowler having diſcovered their haunts, beſmears the top branch of a willow, or ſingle rod twelve inches long, with the ſtongeſt birdlime. The branch muſt have a pretty long handle, made ſharp at bottom to ſtick it into the ground, or into ſhrubs and buſhes; which muſt be done near the branch or tree, where the pheaſant perches. When the buſh or rods are placed, the Fowler, lying cloſe, takes out his call. If the call be good, and he knows how to uſe it, he will ſoon have all the *pheaſants* within hearing about him, and if one happens to be entangled, ſhe will go near to entangle all the reſt, either by her extraordinary fluttering, or their own amazement and confuſion; and as they are taken by the rods on the ground, they will likewiſe be ſurpriſed with the buſhes, for being ſeared from below, they will mount to the perch or buſhes, to ſee what becomes of their companions, and there be taken themſelves.

Lime is only for the winter-ſeaſon, beginning from *November* when the trees have ſhed their leaves, and ending in *May*. Nets are uſed from the beginning of *May*, till the latter end of *October*. So that there is no time of the year but their

 breeding-

breeding-time, which may not be employed in this pleaſure.

Partridges are alſo taken ſeveral wa s, either by *net*, *engine*, *driving*, or *ſetting*. They are naturally ſo fearful and ſimple, that they may eaſily be deceived, without any train, bait, or other device.

The uſual haunts of *partridges* are corn-fields, either while the corn grows, or after it is cut down. In winter, when the fields are ploughed up, or over-ſoiled with cattle, they fly to the upland meadows, and lodge in the dead graſs, or fog, under hedges, among mole-hills, or under the roots of trees. Sometimes they fly to copſes, and underwoods, eſpecially if any corn-fields be near; or where broom, brakes, fern, &c. grows. In the harveſt time, when every field is full of men and cattle, they are found in day-time, in the fallow-fields, next to the corn-fields, where they lie lurking till the evening, and then feed among the ſhocks, or ſheaves of corn, which they do likewiſe in the morning.

When the haunts of *partridges* are known, the Fowler has ſeveral ways to find them; either by the eye, for they are a very lazy bird, and ſo unwilling to take to the wing, that the Fowler may even ſet his foot upon them before they will ſtir, provided he do not ſtand and gaze on them, but be in continual motion, otherwiſe they will ſpring up and be gone: Or, by going to their haunts early in the morning, or at the cloſe of the evening, which is called the *jucking-time*, and there liſtening for the calling of the cock *partridge*, and for the anſwering of the hen; after which they meet together, which may be diſcovered at their rejoicing, and chattering; then the Fowler may take his range about them, drawing nearer to the place he hears them *juck* in, and caſting his eyes towards the furrows of the land, he will ſoon find where the covy lies. Or by the *call*, having firſt learned the true and natural note of the *partridge*, and how to tune it in its proper key. Being perfect herein, he muſt frequent their haunts morning and evening, and hiding himſelf in ſome ſecret place, where he may ſee and not be ſeen, liſten if he can hear the *partridges* call; if he hears them, he muſt anſwer them in the ſame notes, and imitate them as near as poſſible, as they change or double thoſe notes; continuing thus till they draw nearer unto him. Having them in view he lays himſelf on his back, as if he was dead, without motion, by which means he may count their whole number.

Having proceeded thus far, the next thing he muſt do is to catch them. If he wants to do it with nets, having found out the covy, he draws forth his nets, and taking a large circumference, walks a good round pace with a careleſs eye, rather from them towards the *partridges*, till he has trimmed his nets, and made them ready for the purpoſe, which done, he muſt draw his circumference leſs and leſs, till he comes within the length of his net, then pricking down a ſtick about three foot in length, faſtens one end of the net to it, and walking about, letting the net ſlip out of his hands, he ſpreads it open as he goes, and thus lays it all over the *partridges*. But if they ſhould lay ſtraggling, ſo that he cannot cover them all with one net, he muſt draw forth another, and do with that as he has done with the former, which being done, he ruſhes in upon them, who frightened will fly up, and ſo be entangled in the nets.

Partridges are taken with birdlime, either in ſtubble fields, from *Auguſt* till *Chriſtmas*, or in woods, paſtures, or meadows. If in ſtubble fields, the Fowler muſt take the largeſt wheat-ſtraws he can get, and cut them off between knot and knot, and lime them with the ſtrongeſt lime. Then he goes to the haunts of *partridges*, and calls; if they anſwer he pricks at ſome diſtance from him, his lime-ſtraws in many croſs rows and ranks acroſs the lands and furrows, taking in two or three lands at leaſt; then lies cloſe and calls again, not ceaſing till he has drawn them towards him, ſo that they be intercepted by the way by the limed ſtraws, which they ſhall no ſooner touch, but they will be enſnared, and by reaſon they all run together like a brood of chickens, they will ſo beſmear and daub one another, that very few of them will eſcape.

But if *partridges* are to be taken in paſtures, woods, or meadows, the rods muſt be limed as for *pheaſants*, and ſtuck in the ground after the ſame manner.

The moſt pleaſant manner of taking *partridges* is by a *ſetting-dog*. The Fowler muſt take him where *partridges* do haunt, caſt him off, and by ſome word of encouragement wherewith he is acquainted, engage him to range, but never too far from his maſter, who muſt ſee that he beats his ground juſtly and even, without caſting about, or flying here and there, which the mettle of ſome will do if not corrected and reproved. Therefore when the Fowler perceives this fault, he muſt preſently call his dog in with a *hem*, and ſo check him, that he dare not do the like again for that day; ſo he will range afterwards with more temperance. If in the dog's ranging he be perceived to ſtop on a ſudden, or ſtand ſtill, his maſter muſt then make in to him (for without doubt he has ſet the *partridge)* and as ſoon as he comes to him command him to get nearer, and if he goes not, but either lies ſtill, or ſtands ſhaking of his tail, as if he would ſay, here they are under my noſe; and withal

withal now and then looks back, then the Fowler muſt ceaſe urging him further, and take his circumference, walking faſt with a careleſs eye, looking ſtrait before the noſe of the dog, and thereby ſee how the covy lies, whether cloſe or ſtraggling: Then commanding the dog to lie ſtill, he draws forth his net and pricks one end to the ground, and ſpreads it all open, and thus covers as many of the *partridges* as he can. Which done he makes in with a noiſe and ſprings up the *partridges*, which no ſooner riſe but they are entangled with the net. The Fowler muſt always let go the old cock and hen.

Rails, Quails; More-poots, &c. are taken in the ſame manner as *partridges*, either with nets, limed buſhes or rods, engine, or a ſetting dog. The way of finding them is alſo the ſame, by the eye, the ear, and haunt; though the chiefeſt of all is the *call* or *pipe*; to which they liſten with ſuch earneſtneſs, that you can no ſooner imitate their notes, but they will anſwer them, and purſue the *call* with ſuch greedineſs, that they will play and ſkip about you, nay, run over you, eſpecially the *quail*. The notes of the male and female differ very much; therefore the Fowler muſt have them both at his command; and when he hears the male call, he muſt anſwer in the female's note; and when the female calls, anſwer in the male's note; and thus will have them both come to him. Their haunts are alſo much like thoſe of *partridges*, only the *quail* loves moſt the wheat fields; the *morepoot* the heath and foreſt-grounds; and the *rails* the long high graſs, where they may lie obſcure.

We'll cloſe this treatiſe with directions for catching, preſerving and keeping Singing Birds; and with remedies for their peculiar diſtempers.

The *nightingale* claims our firſt attention. She is the chief ſongſter in the woods, where ſhe appears at the latter end of *March*, or at the beginning of *April*. She builds her neſt commonly about two feet above the ground, either in quickſet-hedges, or in beds of nettles; hatching her young ones about the beginning of *May*, and naturally delighting in cool places, where ſmall brooks are garniſhed with pleaſant groves, where they ſing melodiouſly till they have hatched, for then they grow mutes.

Nightingales muſt be taken out of their neſts; when they are indifferently well fledged; for if well feathered they will be ſullen, and if too little, they are ſo tender the cold will kill them.

The way of taking old and young is thus: for the young, you muſt take notice where the cock ſings; and if he ſings long the hen is not far, who often betrays her off-ſpring by being too careful: for when you come near her neſt, ſhe will *ſweet* and *cur*: if notwithſtanding this you cannot find her neſt, ſtick a meal-worm or two upon a thorn, and laying down or ſtanding, obſerve which way it is carried by the old one, and drawing near, you'll hear the young ones while ſhe feeds them. When you have found out the neſt touch not the young; for if you do, they will not tarry in the neſt.

The *branchers*, or *puſhers* (thus called, becauſe when thoroughly fledged, the old ones puſh them out of the neſt) are taken with a bird-trap, or net-trap, made with green ſilk or thread, about the compaſs of a yard, and in the ſhape of a ſhove-net for fiſhes; then a large wire bended round, and the two ends joined, muſt be put into a ſhort ſtick about an inch and an half long, and a piece of iron, with two cheeks and a hole on each ſide, through which muſt be ran ſome fine whip-cord three or four times double, that it may hold the piece of wood the faſter, into which the ends of the wire are put, and with a button on each ſide of the iron the whip-cord is twiſted; then the net is faſtened to the wire, and the two cheeks of the iron joined at the handle of a board of the compaſs of the wire; to which is added a piece of ſtick about two inches long, with a hole at the top of it, which muſt have a plug to put in, with two wires to ſtick the meal-worm upon; then a ſtring is tied in the middle of the top of the net, which net is to be drawn up, and having an eye at the end of the handle to put the thread through, it muſt be pulled till it ſtands upright. When the net and worms are ready, having firſt ſcraped the place, ants muſt be put into the trap-cage; which cage is to be placed near the place where the *nightingales* are heard calling, and left there

When the *nightingales* are taken, the ends of their wings muſt be tied with ſome thread, to hinder them from beating themſelves againſt the cage, which ought to be above half covered with green bays, and they left for four or five days undiſturbed; though they muſt be fed ſix times a day with ſheep's heart and egg ſhred very fine, and mingled with ſome piſmires; and if thro' ſullenneſs they refuſe to eat, their bill muſt be forced open.

In the ſummer they muſt be fed every day with freſh meat; and when they begin to moult, with half an egg hard boiled, and half a ſheep's heart, mingled with ſaffron and water; and ſometimes red worms, caterpillars, hog-lice, and meal-worms.

The *nightingales* taken in *July* or *Auguſt*, will not ſing till the middle of *October*, and then they will hold in ſong till the middle of *June*; but thoſe taken from the firſt of *April* to the twentieth, are the

the beft birds for fong. The *neftlings* and *branchers* (except they have an old bird to fing over them) have not the true fong for the firft twelve months. When they are fo tamed that they begin to *cur* and *fweet*, with chearfulnefs, and record foftly to themfelves, it is a certain fign that they eat, one need not trouble himfelf with feeding them; but if they fing before they feed, they commonly prove excellent birds: thofe which are long a feeding, and make no *curring* nor *fweeting*, are not worth the keeping. One which flutters, and bolts up his head in the night againft the top of the cage ought not to be kept; for he is not only good for nothing, but his bad example will teach the beft of birds to do the like.

The beft fort of *nightingales* frequent high-ways, orchards, and fing clofe by houfes: thefe when taken will feed fooneft, being more ufed to company; and after their feeding will grow familiar, and fing fpeedily.

To diftinguifh the cock from the hen; the cock is both longer and bigger: if a *neftling* (before he he can feed himfelf) records a little to himfelf, and in his recording his throat is perceived to wag, he is a cock; but when they come to feed themfelves, the hen will record as well as the cock. *Branchers*, whether cocks or hens, (when taken and do feed themfelves) will record; but the cock does it much longer, louder, and oftner.

Nightingales are fubject to feveral difeafes; for if they are not kept clean, their feet are clogged, their claws rot off; and they are fubject to the gout and cramp. To cure them of thefe difeafes, their feet muft be anointed four or five days with frefh butter, and they will be well again. They are likewife troubled with impofthumes and breakings out about their eyes and neb, for which capon's greafe muft be ufed: if they be melancholy, fome liquorice with a little fugar-candy muft be put in their drinking pots.

The CANARY-BIRDS are originally from the *Canary-Iflands*; from whence they were brought into *Europe*. They are in colour much like our green birds, but differ much in their fong, and nature: for as other birds are fubject to be fat, the cocks of thefe are always lean, by reafon of the greatnefs of their mettle, and their lavifh finging: the beft are long fhaped, ftanding ftrait and boldly. There are no certain rules to be given for the choice of *Canary-birds*, every one confulting his own fancy.

To difcover if a *Canary-bird* be in health, before he is purchafed, he muft be taken out of the ftore-cage, and put into a clean one alone; where if he ftands boldly without crouching, without fhrinking feathers, and his eyes looking brifk and chearfully, thefe are good figns of a healthy bird; but if he bolts his tail like a *nightingale*, after he has dunged, it fhews he is not well; though he feems lively for the prefent, there is fome diftemper near attending: likewife, if he either dung very thin and watry, or of a flimy white, and no blacknefs in it; thefe are dangerous figns of approaching death.

Canary-Birds above three years old are called *Runts*; at two years old they are called *Eriffs*; and thofe of the firft year are called *Branchers*; when they are new flown, and cannot feed themfelves, they are called *Pufhers*; and thofe that are brought up by hand, *Neftlings*.

The BLACKBIRD builds her neft upon old ftumps of trees by ditch-fides, or in thick hedges; they are brought up almoft with any meat whatfoever; but above all, they love ground worms, fheep's heart, hard eggs, and white bread and milk mixed together. This bird fings fomewhat more than three months in the year; his note is harfh and loud, therefore to add a value to him, he muft be taught to whiftle

There are five kinds of thrufhes, *viz.* the *miftle-thrufh*, the *northern-thrufh*, or *feldfare*, the *wind-thrufh*, the *wood-fong-thrufh*, and the *heath-thrufh*.

The firft is the largeft of all five, and the moft beautiful; but as he fings but little, and his notes are rambling and confufed, he is not worth the keeping. The fecond is the *feldfare*, who comes into *England* before *Michaelmas*, and goes away about the beginning of *March*. They breed upon certain rocks near the *Scotifh* fhore three or four times a year, and are there in very great numbers: they are not fo fit for the cage as for the fpit, having a moft lamentable untuned chattering tone. The third is the *wind-trufh*, or *whindle*, which travels with the *feldfare* out of the north, and is a fmaller bird, with a dark red under his wing. She breeds in woods and fhaws as *fong-thrufhes* do, and has an indifferent fong exceeding the two former; but yet is fitter for the pot or fpit, than for a cage or avery. The fourth is the *wood-fong-thrufh*, and fings moft incomparably, both lavifhly and with variety of notes; and fings at leaft nine of the twelve months in the year She builds about the fame time, place, and manner the *blackbird* does; the compofure of her neft is fo marvellous that it cannot be mended by the art of men; befides the curious building, fhe leaves a little hole in the bottom of her neft, to let out the water, as may be fuppofed, if a violent fhower fhould come, that fo her eggs or young ones may not be drowned. If the weather favours them, they go very foon to neft, and breed three times a year. *viz* in *March*, *April*, *May* and *June*; but the firft birds ufually prove the beft; which muft be taken in the neft

when

when fourteen days old, and kept warm and clean, not suffering them to sit on their dung, but must be so contrived that they dung over the nest. They are to be fed with raw meat and some bread chopped together with bruised hempseed, wetting the bread before it is mingled with the meat. Being thoroughly fledged, they must be put in a cage with two or three perches, where they may have room enough, and some moss at the bottom to keep them clean; for otherwise they will be troubled with the cramp, and for want of delighting in themselves their singing will be spoiled. They must also have fresh water twice a week, that they may bathe and plume themselves therein, otherwise they will not thrive. The fifth and last is the *heath-thrush*, which is the least we have in *England*, having a dark breast. Some are of opinion, that this bird exceeds the *song-thrush*, having better notes, and neater plume. The hen builds by the heath-side in a fern-bush, or stump of an old hawthorn, and makes not shaws and woods her haunt as other thrushes do. She begins to breed towards the middle of *April*, and breeds but twice in a year; and if kept clean and well fed, will sing three parts in four of the year. To know the cock from the hen, according to some, is to chuse the top bird of the nest, which commonly is most fledged. Others think that to be the cock which has the largest eyes and most speckles on his breast. Others chuse the cock by the pinion on his wing; but the best marks are a white gullet, with black streaks on each side, the spots on the breast large and black, and the head of a light shining brown, with black streaks under each eye, and upon the pinion of the wing.

The Robin-red-Breast, for sweetness of note, is very little inferior to the *nightingale*: He is taken either in a pit-fall, or with a trap-cage and a meal-worm. They breed very early in the spring, and commonly twice a year. When the young ones are about ten days old they must be taken from the old ones, and kept in a little bower-basket. They are fed in all respects like the *nightingale*: when they grow strong they are put in a cage, with moss at the bottom; but as they are very tender birds the cage must be lined, to keep them warm. The cock has his breast of a darker red, and his red goes further up upon the head than the hen.

The Wren is a little bird, as pleasant to the ear as he is to the eye: he builds twice a year about the latter end of *April*, in shrubs where ivy grows thick, and sometimes in old hovels and barns. They lay a numerous quantity of eggs. Their second time of breeding is in the middle of *June*; of either breed, what you intend to keep must be taken out of the nest at thirteen and fourteen days old; and fed every day very often, but a little at a time, with sheep's hearts and eggs minced very small; and when they begin to pick their meat of their own accord, off the stick they are fed with, they must be caged, and meat put in a little pan, and about the sides of the cage, to entice them to eat, though they must be fed too, lest they neglect themselves and die. When they can feed themselves very well, a spider or two must be given them once in three days. The brownest and largest of the young *wrens* are the cocks.

The Wood Lark, is by some preferred to the *nightingale*, because he has a great variety of very excellent and pleasant notes. The *wood-lark* breeds the soonest of any bird, by reason of his extraordinary mettle; therefore if they are not taken in the beginning of *February* at least, they grow so rank that they will prove good for nothing. He delights most in gravelly grounds and hills lying towards the orient, and in oat-stubs. Their building is in layers-grounds, where the grass is rank and russet, making their nests of ben grass, or dead grass of the field, under some large tuffs, to shelter them from the injury of the weather. These birds are never bred from the nest, for they die in a week either of the cramp or scowring. The times of the year to take them is in *June*, *July*, *August*, with a hobby, in this manner: go in a a dewy morning to the sides of some hills which lie to sun-rising, where they most usually frequent, and having sprung them, observe where they fall, then surround them twice or thrice with your hobby on your fist, causing it to hover when you draw near, by which means they will lie still till you clap a net over them. If three or four go together, take a net made in the same manner as that for *partridges*, when you go with a setting-dog, only the mesh must be smaller, *i. e.* a lark mesh, and then your hobby is to the lark what a setting-dog is to partridges. Those taken in this season are called *young branchers*, because they have not moulted yet; and will sing presently, but will not last long, by reason of their moulting.

Wood-Larks taken at the latter end of *September*, having then moulted cannot be distinguished whether old or young. Those taken in *January* and *February* will sing in five or six days, or sooner, and they are the best, being taken in full stomach, and are more perfect in their song than those taken in other seasons.

Upon the first taking of the *wood-lark*, two pans must be put into the cage, one for sheep's heart minced small, and mingled with bread, egg, and hemp-seed; and another for oatmeal and whole hemp-seed. The bottom of the cage ought to be covered with red gravel, which must be shifted

ſhifted every week at furtheſt, and the perch lined with green bays; and leſt they ſhould not find the pan ſoon enough, to prevent famine, there muſt be ſtrewed upon the ſand ſome hemp-ſeed and oatmeal; and if they grow poor at the beginning of the ſpring, there muſt be given to them every two or three days a turf of three leafed graſs. The cock is diſtinguiſhed from the hen, by the largeneſs and length of his call, by his tall walking, his ſtrong ſinging, and the doubling of his notes in the evening.

These birds are very ſubject to the cramp, giddineſs in the head, and louzy. The beſt remedy to prevent the cramp is to ſhift the cage often with freſh gravel, otherwiſe the dung will clog to the feet, which cauſes the cramp. The giddineſs of the head proceeds from feeding upon much hemp-ſeed, and is cured with gentles, or hog-lice, emmets and their eggs, with liquorice, all put into water. Louzineſs is cured by the ſmoak of tobacco.

The Sky-Lark is a hardy bird, and will live upon any food, provided he has once a week a turf of three-leaved graſs. *Sky-larks* commonly build in corn, or thick high graſs meadows, and ſeldom have more than four young ones, which they hatch towards the middle of *May*. They muſt be taken when a fortnight old, and fed at firſt with minced ſheep's hearts, mixed with hard eggs; when they can feed alone, they eat hemp-ſeed and oatmeal; they muſt have ſand in the bottom of their cage, and no perch.

Sky-Larks are taken either with a net and hobby, or a trammel, or a pair of day-nets and a glaſs, or with a low-bell, or with pack-thread.

The *trammel* is only uſed in dark nights, and is above ſix and thirty yards long, aad ſix yards over, run thro' with ſix ribs of pack-thread; which ribs at the ends, are put upon two poles ſixteen feet long, made taper at each end, and ſo is carried between two men half a yard from the ground, to cauſe the birds to fly up, otherwiſe the net might be carried over them without diſturbing them; when they are heard to fly againſt the net, it muſt be clapped down. The *day-nets* are commonly ſeven feet deep, and fifteen long, knit with *French* meſh, and very fine thread. Theſe *nets* take all ſorts of ſmall birds that come within their compaſs, as *bunting-larks*, and *linnets* in abundance. To take *larks* with the low-bell, the bell and a great light in a tub muſt be both carried by one man, and the net by another; this bell and light ſo amazes them, that they lie as dead, and ſtir not till the net over-caſt them. To take them with pack-thread, a hundred, or two hundred yards of packthread muſt be provided, when there is abundance of ſnow upon the ground, faſtening at every ſix inches a nooſe made with horſe-hairs, two hairs are ſufficient.

Larks, deſigned to be kept for ſinging, muſt be taken in *October* or *November*, chuſing the ſtraiteſt, largeſt and loftieſt bird, and he that has moſt white on his tail; for theſe are the marks of the cock.

The Linnet builds his neſt in thorn-buſhes, and fir-buſhes, and ſome of the hotter ſort will breed four times a year. The young ones may be taken at four days old, if you intend to teach them to whiſtle, or learn the ſong of other birds, for being ſo young they know not the tune of the old bird; then they muſt be kept very warm, and fed often, and a little at a time, with bruiſed and ſoaked rape-ſeeds, mixed with an equal quantity of white bread. The cock is known from the hen by the brownneſs of his back, and the white of his wing; that is to ſay, take your young *linnet* when the wing feathers are grown, and ſtretch out his wing, holding his body faſt with the other hand, and then obſerve the white upon the fourth, fifth, and ſixth feather; if it caſt a gliſtering white, and it goes quite to the quill, it is a ſure ſign of a cock.

This bird is ſubject to ſeveral diſeaſes, as the phthyſick, known by his panting, ſtaring feathers, lean breaſt, and ſpilling his ſeeds up and down the cage. Which diſeaſe happens for want of water, or for want of green meat in the ſpring: he is troubled alſo with ſtrains, or convulſions of the breaſt; ſometimes with hoarſeneſs, being over-ſtrained in ſinging; ſometimes he is melancholy, at other times afflicted with ſcouring, of which there are three ſorts, the firſt is thin, or with a black or white ſubſtance in the middle, not very dangerous; the ſecond is between a black and white, clammy and ſticking, this is bad; but the third and laſt is moſt mortal, which is the white clammy ſcouring.

The Gold-Finch breeds commonly in apple trees, and plumb trees, thrice a year. *Gold-finches* are taken in great plenty about *Michaelmas*, and will ſoon become tame. The young ones are taken with the neſt at ten days old, and fed with the beſt hempſeed pounded, ſifted, and mixed with the like quantity of white bread, with ſome flour of canary-ſeed. They muſt be kept very warm till they can feed themſelves.

The Tit-Lark appears at the ſame time of the year as the *nightingale* does, which is the beginning of *April*, and leaves us at the beginning of *September*. He breeds about the latter end of *April*, or the beginning of *May*, and builds his neſt on the ground by ſome pond or ditch. The *tit-larks* are fed, when taken, as the *nightingale*. They are eaſily brought up, being hardy, and are

not

not ſubject to colds or cramps, but live long if preſerved with care. The ſong of this bird is ſhort and ſweet.

The CHAFFINCH builds his neſt in hedges, and trees of all ſorts, and has young ones twice or thrice a year, which are ſeldom bred up from the neſt, becauſe they are not apt to take another bird's ſong, or to whiſtle. The *chaffinch* has but one ſhort plain ſong.

The STARLING, to be excellent, muſt be taken from the old ones at the end of three or four days; for if taken fledged out of the neſt, they retain too much of their own natural harſh notes.. They learn to whiſtle, or ſpeak, or an other bird's ſong, by hanging under him.

The BULLFINCH has no ſong, nor whiſtling of his own, but is very apt to learn any thing, if learned with the mouth.

The GREENFINCH breeds three times a year by the highways, and early before the hedges have leaves upon them. The young ones are very hardy birds to be brought up, and may be fed with white bread and rape-feed bruiſed and ſoaked The *Greenfinch* is a beautiful bird, but very dull.

The HEDGE-SPARROW builds in a white thorn, or private hedge, laying eggs of a fine blue colour. Theſe birds are taken at the latter end of *January*, or beginning of *February*, and will feed almoſt on any thing. They are very tractable, and will take any bird's ſong, if taken young out of the neſt. Old or young they will become tame very quickly.

FULLING.

FULLING is the art or act of *ſcouring* and *preſſing* cloths, ſtuffs, ſtockings, &c. to cleanſe, thicken, and render them more firm and ſtrong, which is done by means of a *water-mill*. See *ſecond* plate of MECHANIC ARTS, Fig. 1. in which, 1. is the track of the wheel, that turns on the outſide; 2. a front view of the wheel; 3. the arbour with its leavers, which as they paſs, raiſe the heads of the wooden mallets, and let them fall alternately; 4. the trough, which in the plate is hid behind the timber work, and is only expreſſed by dots that ſhew its poſition: each trough has at leaſt two, and ſometimes three mallets; 5, the head of the mallet, with three or four notches, which hinder the ſtiff from ſticking under the hammer; 6. the arm or handle; 7. the end of the mallet faſtened by a pin. 8. In the troughs are laid the cloths, ſtuffs, &c. intended to be fulled: then letting the current of water fall on the wheel, the mallets are ſucceſſively let fall upon them, when by their weight and velocity they ſtamp and preſs the ſtuffs very ſtrongly, which by this means become thickened and condenſed.

In this operation, fuller's earth is uſed with ſome proportion of ſoap; but ſoap alone would do much better, was it not dearer than fuller's earth.

Fulling of ſtockings, caps, &c. is performed either with the hands or feet, or a kind of wooden machine, either armed with wooden teeth, or thoſe of horſes or bullocks. The ingredients generally uſed on this occaſion are fuller's earth, urine, white ſoap and green ſoap. But water ſoftened with chalk is far preferable.

The following is M. *Colmet*'s method of *fulling* with ſoap, grounded on experiments made by order of the Marquis *de Louvois*. Let a coloured cloth of about 45 ells, be laid in the uſual manner in the trough of a fulling-mill, without firſt ſoaking it in water, as commonly practiſed in moſt places. To full this troughful of cloth, fifteen pounds of ſoap are required, one half of which is to be melted in two pails of river or ſpring water, made as hot as the hand can bear. Let this ſolution be poured by little and little, upon the cloth, in proportion as it is laid in the trough: thus it is to be fulled for at leaſt two hours; after which, let it be taken out and ſtretched. This done, let the cloth be immediately returned into the ſame trough, without freſh ſoap, and there fulled two hours more. Then take it out, wring it well, and expreſs all the greaſe and filth. After the ſecond fulling, diſſolve the remainder of the ſoap, as the former part, and throw it at four ſeveral times on the cloth, not forgetting to take it out every two hours, to undo the plaits and wrinkles it got in the trough. When it is ſufficiently fulled, and brought to the requiſite quality and thickneſs, it is ſcoured out, for good, in hot water, keeping it in the trough till it be thoroughly clean. As white cloths full more eaſily than coloured ones, a third part of the ſoap may be ſpared.

The *art of fulling* was invented, according to *Pliny*, *lib.* 7. *c.* 56. by one *Nicias* the ſon of *Hermias*: and it appears by an inſcription quoted by Sir *George Wheeler*, in his travels through *Greece*, that

that this ſame *Nicias* was a governor in *Greece*, in the time of the *Romans*.

The *fullers*, among the *Romans*, waſhed, ſcoured, and fitted up cloaths, and their office was judged of that importance, that there were ſeveral laws preſcribed them for the manner of performing it: ſuch was the *lex de fullonibus*, &c.

GAMING.

GAMING conſidered only as an artful contrivance to take advantages over the ignorant and unguarded, has at all times been deteſted by the wiſe and virtuous, looked upon as a practice pernicious to ſociety, and in many places ſeverely prohibited by law.

In *England*, the ſtatute 33 *Hen.* VIII. gives juſtices of peace, and head officers in corporations, a power to enter all houſes ſuſpected of unlawful games; and to arreſt the gameſters, till they give ſecurity not to play for the future.

Perſons keeping any unlawful gaming-houſe, are fined 40*s.* and the gameſters 6*s.* 8*d.* a time.

If any perſons by fraud, deceit, or unlawful device, in playing either at cards or dice, tables, bowls, cock-fighting, horſe races, foot-races, &c. or bearing a ſhare in the ſtakes, or betting, ſhall win any money or valuable thing of another, he ſhall forfeit treble the value thereof: likewiſe if any perſon ſhall play at any of the ſaid games upon tick, and not for ready money, and loſe the ſum of 100*l.* on credit, at any one meeting, if the money be not paid down, his ſecurity taken for it ſhall be void, and the winner becomes liable to a forfeiture of treble value of ſuch money won. 16 *Car.* II. *c.* 7.

Not only all notes, bills, bonds, mortgages, or other ſecurities given for money won at gaming, are declared void; but alſo where lands are granted, they ſhall go to the next perſon intitled, after the deceaſe of the perſon ſo incumbering the ſame: perſons loſing by gaming at one time 10 *l.* may recover the money loſt, from the winner, by an action of debt, brought within three months; and on the loſer's not proſecuting, any other perſon may lawfully do it, and recover treble the value, with coſts. 9 *Ann. c.* 14.

Thoſe who cheat at cards, dice, &c. beſides their forfeitures, have inflicted on them ſuch infamy and corporal puniſhment, as in caſes of perjury; and beating or challenging any other perſon to fight, on account of money won by gaming, ſhall forfeit all their goods, and be impriſoned two years: and where perſons play that have no viſible eſtates, and do not make it appear that the principal part of their maintenance is got by other means than gaming, they may be bound to their good behaviour by two juſtices of the peace, &c. Stat. *ibid.* See 2 *Geo.* II. *c.* 28.

The ace of hearts, pharaoh, baſſet, and hazard, are judged to be lotteries by cards or dice; and perſons who ſet up thoſe games, are ſubject to 200*l.* penalty. And every adventurer, who ſhall play, ſtake, or punt at them, forfeits 50*l.* Alſo any ſales of houſes, goods, plate, &c. in ſuch a way, are void, and the things forfeited to any who will ſue for the ſame. 12 *Geo.* II. *c.* 28.

However, conſidered amongſt the *recreations* of mankind, and ſerving for amuſement in our leiſure hours, it is proper to treat of this art in ſuch a manner, as to ſhew the nature and hazard of *gaming*; and alſo to give a few directions towards forming a juſt idea of certain games, that are moſt in faſhion.

The nature and hazard of *gaming* appear from the doctrine of chance, whoſe variety may be underſtood from what follows.

Suppoſe p the number of caſes in which an event may happen, and q the number of caſes wherein it may not happen, both ſides have the degree of probability, which is to each other, as p to q.

If two gameſters, A and B, engage on this footing, that, if the caſes p happen, A ſhall win; but, if q happen, B ſhall win, and the ſtake be a; the chance of A will be $\frac{pa}{p+q}$ and that of B $\frac{qa}{p+q}$; conſequently, if they ſell the expectances, they ſhould have that for them reſpectively.

If A and B play with a ſingle die, on this condition, that, if A throw two or more aces at eight throws, he ſhall win; otherwiſe B ſhall win, what is the ratio of their chances? Since there is but one caſe wherein an ace may turn up, and five wherein it may not, let $a=1$, and $b=5$. And again, ſince there are eight throws of the die, let $n=8$; and you will have $\overline{a+b}|^{n}-b^{n}-nab^{n-1}$, to $b^{n}+nab^{n-1}$: that is, the chance of A will be to that of B, as 663991 to 1015625, or nearly as 2 to 3.

A and B are engaged at ſingle quoits, and, after playing ſome time, A wants 4 of being up, and B 6; but B is ſo much the better gameſter, that his chance againſt A upon a ſingle throw would be as 3 to 2; what is the ratio of their chances

chances? Since A wants 4, and B 6, the game will be ended at nine throws; therefore, raiſe $a+b$ to the ninth power, and it will be $a^9+9a^8b+36a^7bb+84a^6b^3+126a^5b^4+126a^4b^5$, to $84a^3b^6+36aab^7+6ab^3+b^9$: call a 3, and b 2, and you will have the ratio of chances in numbers, *viz.* 1759077 to 194048.

A and B play at ſingle quoits, and A is the beſt gameſter, ſo that he can give B 2 in 3, what is the ratio of their chances at a ſingle throw? Suppoſe the chances as z to 1, and raiſe $z+1$ to its cube, which will be z^3+3z^2+7z+1. Now ſince A could give B 2 out of 3, A might undertake to win three throws running; and, conſequently, the chances in this caſe be as z^3 to $3z^2+3z+1$. Hence $z^3=3z^2+3z+1$; or, $2z^3=z^3+3z^2+3z+1$. And, therefore, $z\sqrt[3]{2}=z+1$; and, conſequently, $z=\frac{1}{\sqrt[3]{2}-1}$. The chances, therefore, are $\frac{1}{\sqrt[3]{2}-1}$, and 1, reſpectively.

Again, ſuppoſe I have two wagers depending, in the firſt of which I have 3 to 2 the beſt of the lay, and in the ſecond 7 to 4; what is the probability I win both wagers?

1. The probability of winning the firſt is $\frac{3}{5}$, that is the number of chances I have to win, divided by the number of all the chances: the probability of winning the ſecond is $\frac{7}{11}$: therefore, multiplying theſe two fractions together, the product will be $\frac{21}{55}$, which is the probability of winning both wagers. Now, this fraction being ſubtracted from 1, the remainder is $\frac{34}{55}$, which is the probability I do not win both wagers: therefore the odds againſt me are 34 to 21.

2. If I would know what the probability is of winning the firſt, and loſing the ſecond, I argue thus: the probability of winning the firſt is $\frac{3}{5}$, the probability of loſing the ſecond is $\frac{4}{11}$: therefore multiplying $\frac{3}{5}$ by $\frac{4}{11}$, the product $\frac{12}{55}$ will be the probability of my winning the firſt, and loſing the ſecond; which being ſubtracted from 1, there will remain $\frac{43}{55}$, which is the probability I do not win the firſt, and at the ſame time loſe the ſecond.

3. If I would know what the probability is of winning the ſecond, and at the ſame time loſing the firſt, I ſay thus: the probability of winning the ſecond is $\frac{7}{11}$; the probability of loſing the firſt is $\frac{2}{5}$: therefore, multiplying theſe two fractions together, the product $\frac{14}{55}$ is the probability I win the ſecond, and alſo loſe the firſt.

4. If I would know what the probability is of loſing both wagers, I ſay, the probability of loſing the firſt is $\frac{2}{5}$, and the probability of loſing the ſecond $\frac{4}{11}$: therefore, the probability of loſing them both is $\frac{8}{55}$; which being ſubtracted from 1, there remains $\frac{47}{55}$: therefore, the odds of loſing both wagers is 47 to 8.

This way of reaſoning is applicable to the happening or failing of any events that may fall under conſideration. Thus if I would know what the probability is of miſſing an ace 4 times together with a die, this I conſider as the failing of four different events. Now the probability of miſſing the firſt is $\frac{5}{6}$, the ſecond is alſo $\frac{5}{6}$, the third $\frac{5}{6}$, and the fourth $\frac{5}{6}$; therefore the probability of miſſing it four times together is $\frac{5}{6}\times\frac{5}{6}\times\frac{5}{6}\times\frac{5}{6}=\frac{625}{1296}$; which being ſubtracted from 1, there will remain $\frac{671}{1296}$ for the probability of throwing it once or oftner in four times: therefore the odds of throwing an ace in four times is 671 to 625.

But if the flinging an ace was undertaken in three times, the probability of miſſing it three times would be $\frac{5}{6}\times\frac{5}{6}\times\frac{5}{6}=\frac{125}{216}$; which being ſubtracted from 1, there will remain $\frac{91}{216}$, for the probability of throwing it once or oftner in three times: therefore the odds againſt throwing it in three times are 125 to 91.

Again, ſuppoſe we would know the probability of throwing an ace once in four times and no more; ſince the probability of throwing it the firſt time is $\frac{1}{6}$ and of miſſing it the other three times is $\frac{5}{6}\times\frac{5}{6}\times\frac{5}{6}$; it follows that the probability of throwing it the firſt time, and miſſing it the other three ſucceſſive times, is $\frac{1}{6}\times\frac{5}{6}\times\frac{5}{6}\times\frac{5}{6}=\frac{125}{1296}$; but becauſe it is poſſible to hit it every throw as well as the firſt, it follows, that the probability of throwing it once in four throws, and miſſing the other three, is $\frac{4\times125}{1296}=\frac{500}{1296}$ which being ſubtracted from 1, there will remain $\frac{796}{1296}$ for the probability of throwing it once, and no more, in four times. Therefore, if one undertake to throw an ace once, and no more, in four times, he has 500 to 796 the worſt of the lay, or 5 to 8 very near.

Suppoſe two events are ſuch, that one of them has twice as many chances to come up as the other, what is the probability that the event, which has the greater number of chances to come up, does not happen twice before the other happens once, which is the caſe of flinging 7 with 2 dice before 4 once? Since the number of chances are as 2 to 1, the probability of the firſt happening before the ſecond is $\frac{2}{3}$, but the probability of happening twice before it, is but $\frac{2}{3}\times\frac{2}{3}$ or $\frac{4}{9}$: therefore it is 5 to 4 ſeven does not come up twice before 4 once.

But, if it were demanded, what muſt be the proportion of the facilities of the coming up of two events, to make that which has the moſt chances come up twice, before the other comes up once? The anſwer is 12 to 5 very nearly: whence it follows, that the probability of throwing the firſt be-

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fore the ſecond is $\frac{12}{17}$, and the probability of throwing it twice is $\frac{12}{17}\times\frac{12}{17}$, or $\frac{144}{289}$; therefore, the probability of not doing it is $\frac{145}{289}$: therefore the odds againſt it are as 145 to 144, which comes very near an equality.

Suppoſe there is a heap of thirteen cards of one colour, and another heap of thirteen cards of another colour, what is the probability that, taking one card at a venture out of each heap, I ſhall take out the two aces?

The probability of taking the ace out of the firſt heap is $\frac{1}{13}$, the probability of taking the ace out of the ſecond heap is $\frac{1}{13}$; therefore the probability of taking out both aces is $\frac{1}{13}\times\frac{1}{13}=\frac{1}{169}$, which being ſubtracted from 1, there will remain $\frac{168}{169}$: therefore the odds againſt me are 168 to 1.

In caſes where the events depend on one another, the manner of arguing is ſomewhat altered. Thus, ſuppoſe that out of one ſingle heap of thirteen cards of one colour I ſhould undertake to take out the firſt ace; and, ſecondly, the two: though the probability of taking out the ace be $\frac{1}{13}$, and the probability of taking out the two be likewiſe $\frac{1}{13}$; yet, the ace being ſuppoſed as taken out already, there will remain only twelve cards in the heap, which will make the probability of taking out the two to be $\frac{1}{12}$; therefore the probability of taking out the ace, and then the two, will be $\frac{1}{13}\times\frac{1}{12}$.

In this laſt queſtion the two events have a dependence on each other, which conſiſts in this, that one of the events being ſuppoſed as having happened, the probability of the others happening is thereby altered. But the caſe is not ſo in the two heaps of cards.

If the events in queſtion be n in number, and be ſuch as have the ſame number a of chances by which they may happen, and likewiſe the ſame number b of chances by which they may fail, raiſe $a+b$ to the power n. And if A and B play together, on condition that if either one or more of the events in queſtion happen, A ſhall win, and B loſe, the probability of A's winning will be $\frac{\overline{a+b}|^n - b^n}{\overline{a+b}|^n}$; and that of B's winning will be $\frac{b^n}{\overline{a+b}|^n}$; for when $a+b$ is actually raiſed to the power n, the only term in which a does not occur is the laſt b^n: therefore all the terms but the laſt are favourable to A.

Thus if $n=3$, raiſing $a+b$ to the cube $a^3+3a^2b+3ab^2+b^3$, all the terms but b^3 will be favourable to A; and therefore the probability of A's winning will be $\frac{a^3+3a^2b+3ab^2}{\overline{a+b}|^3}$, or $\frac{\overline{a+b}|^3-b^3}{\overline{a+b}|^3}$; and the probability of B's winning will be $\frac{b^3}{\overline{a+b}|^3}$.

But if A and B play on condition, that if either two or more of the events in queſtion happen, A ſhall win; but in caſe one only happen, or none, B ſhall win; the probability of A's winning will be $\frac{\overline{a+b}|^n - nab^{n-1} - b^n}{\overline{a+b}|^n}$; for the only two terms in which aa does not occur, are the two laſt, *viz.* nab^{n-1} and b^n.

The games in faſhion are divided into *games of exerciſe*, and *addreſs*; and games of *chance*, or *hazard*.

Under the firſt appellation we reckon *tennis*, *billiards*, *cheſs*, *bowls*: under the ſecond are numbered *cards*, *dice*, &c.

The game at *tennis* is the moſt active and genteel. The exerciſe is moſt violent; is performed with racquets and hard balls, and requires a good ſight and great agility and dexterity in catching and ſtriking the ball.

Billiards is a game play'd on an oblong table, covered with green cloth, with ivory balls ſtruck with ſticks made on purpoſe: the whole ſecret of this game conſiſts in lodging the ball of our antagoniſt in one of the pockets or holes, of which there are three on each ſide of the table.

The party that is ſtruck into the pocket, looſes two; and he that miſſes his antagoniſt's ball, looſes, every time he miſſes, one.

He that would play well at this game, muſt underſtand perfectly well how to uſe his *maſſe* and alſo the tail or cue, when his ball is nailed cloſe againſt the ſide of the table, or ſo near that of his adverſary, that he cannot uſe the *maſſe* without running the riſk of touching the ball of his adverſary, as well as his own. He muſt alſo endeavour, as much as poſſible, to touch always the ball of his adverſary in full, for when he touches it corner-wiſe, tho' he ſometimes *blouzes* his adverſary, he ſeldom miſſes of *blouzing* himſelf alſo. He ſhould beſides underſtand how to draw perpendiculars, diagonals, and equilateral lines with his eyes, either to touch always the ball, or to lodge it in the hazards or pockets. The adverſary is diſtreſſed in ſeveral manners, 1. By pocketing him. 2. By nailing his ball cloſe againſt the ſide of the table. 3. By bringing it upon the edge of a hole, that he may run the riſk of pocketing himſelf, or miſs touching our ball.

Chess requires both art and addreſs, but no ſtrength nor agility.

The theatre upon which this game, is acted, is a chequered board, half black and half white, like a draught-

draught-board; and by two little armies drawn up in order of battle, opposite to each other; each army is commanded by a king and several great officers, who in all (the king included) are eight principal persons.

The *king* is the first in rank and order; next to him stands the *queen*; two *rooks* next; next to the two *rooks*, two *knights*; two *bishops* next; eight *pawns*, who are no other than common soldiers.

The method of drawing up this little army, is to place the principal pieces on the lowest rank of the board next to the gamester, *viz.* the *king* first upon the fourth spot from the corner, which is white; the *queen* on the black spot on his right; the two *bishops*, one next the *king*, and the other next the *queen*; the *knights* on the sides of the *bishops*, and the two *rook*, one in each corner. The *pawns* are placed just in the rank before those illustrious persons, to serve as their rampart. The other army is drawn up on the opposite side in the same manner; and lest they should not be distinguished when they are engaged, one army is always cloathed in *black*, the other in *white*.

The *king* never moves but from one chequer to another; forward in a line, or side-ways in a line, or backward in a line. If he meets with any scout of the enemy in his way, he may take him prisoner, and place himself, where he stood; and when it is his turn to move again, he may go backwards, side-ways, or retire. The king can also, the first motion, pass over one chequer, but after that he can only move from chequer to chequer.

The *queen*, provided the passage be clear, may pass from one end of the board to the other at one movement, either in a line forwards, or in a line side-ways; and if an enemy stands in her way, she may take him prisoner, and stand in his place.

The *bishop*'s motion is oblique; he may either move from chequer to chequer, or run along a whole row, according as he sees an advantage to snap an enemy. One *bishop* stands upon a black chequer, and the other upon a white; but he who stands upon a black chequer must always move upon the black row, without touching the white; as he who stands upon a white, must always move on the white row, without touching the black.

The *knight* jumps from black to white, and from white to black, in the form of a demi-circle; and if one of the enemy should stand next to him, he can jump over his head.

The *knight* is of great use in the beginning of the battle; for very often he makes a passage through the enemy's army, and forces his way up to the king, whom he attacks, and to whom he gives *cheque-mate*.

The motion of the *rooks* is in a direct line every way; they can neither cross the chequer, as the *bishops* do, nor hop like the *knights*: they may either move from chequer to chequer, or else as far as the passage is clear. If any of the enemy stands in their way to interrupt their march, they may take him prisoner, and stand in his place, as all the others must when they take a prisoner, till the next movement.

The eight *pawn*, at the first movement, may, if it be thought necessary, pass over two chequers, reckoning that they come from one; but afterwards they can only move from chequer to chequer in a direct line forwards: but if one of the enemy should stand next to one of them in an oblique manner, they may take him. And if any of them should make his way up to the first rank of the enemy, he is immediately preferred and made an officer; and the *king* may prefer him to the post of any officer he has lost. If the *queen* herself had been taken prisoner, she must be exchanged for this *pawn*.

The general rules to be observed in playing at *chess*, are, 1. To play at the beginning with a great deal of caution, and not too open, as if there was no danger while the enemy is at a distance; since the *queen*, a *bishop*, and a *rook*, can take a prisoner from one end of the board to the other, if he lies uncovered. 2. That, as it is impossible to proceed without exposing the men or officers, a good player will give up an inferior officer to take a superior one from the enemy. For instance, he'll play his *knight* just in the mouth of a *rook*, when he has placed another officer in ambuscade to surprize the *rook*. 3. A good player endeavours always to get behind the enemy, to attack the *king*, and give him *cheque-mate*. 4. The *king* can be chequered two ways; the first is a *simpl chequer*, when the king can either retire out of danger, or cover himself with an inferior man, or take that man which chequers him: the second is, when the king is so besieged and over-powered, that he can neither move nor defend himself, nor cover himself with another: this is called *cheque mate*, in which case the game is lost.

There are besides several particular rules given by captain *Joseph Bertin*, as will perfect those, who are somewhat skilled in the game of *chess*; which rules are these: 1. The pawns of the king, bishop, and queen, must move before the knights; for were they to move last, the game would be crowded by useless removes. 2. The *queen* is not to be played till the game be well opened; since otherwise some moves would be lost. 3. For the same reason useless cheques ought not to be given. 4. Upon being well posted, either for attack or defence, no opportunity of taking your adversary's men must tempt you, for this may divert you from gaining the

the main deſign. 5. Do not caſtle, but when very neceſſary; becauſe the move is often loſt by it. 6. Never attack or defend the king without a ſufficient force; and take care of ambuſhes and traps. 7. Never crowd your game by too many men in one place. 8. Conſider well before you play, what harm your adverſary is able to do you, that you may oppoſe his deſigns. 9. To free your game, take off ſome of your adverſary's men if poſſible, for nothing; though to ſucceed in your deſign, you muſt often give away ſome of your own, as occaſion ſerves. 10. He who plays firſt, is underſtood to have the attack. When the game is opened you muſt endeavour to defend in your turn; for the defence, if well played, is ſtill the beſt againſt the *gambets*, in which you change all your pieces except the *gambet* that gives three *pawns*, which will be neceſſary to keep a *rook*, to conduct your *pawns* to the *queen*. 11. A good player ought to foreſee the concealed move, from 3 to 5 and 7 moves. The concealed move is a piece that does not play for a long time, but lies ſnug in hope of getting an advantage. 12. At the beginning of a game you may play any *pawn* two moves without danger. 13. The *gambet* is, when he who firſt gives the *pawn* of the king's biſhop in the ſecond move, for nothing, the other keeps it, or takes another for it, if he is obliged to loſe it. 14. The *cloſe game* is, when he that plays firſt, gives no men, unleſs to make good advantage; but in giving a pawn firſt, he loſes his advantage. 15. He who caſtles firſt, the other muſt advance his three *pawns* on the ſide of his adverſary's king, and back them with ſome pieces, in order to force him that way, provided his own king or pieces are not in danger in other places. 16. When your game is opened, to gain the attack, you muſt preſent your pieces to change; and if your adverſary, who has the attack, refuſes to change, he loſes a good ſituation; and either in exchanging or retiring, the defence gets the move: *Ex. gr.* In the beginning of a game, to ſhew the neceſſity of playing the pawns before the pieces, if there were but two pawns on each ſide of the board, *viz.* the pawns of the rooks, the firſt that ſhould play would ſoon win the game, by taking the other pieces by cheque; and that ſituation may come in leſs number of pieces. 17. To play well the latter end of a game, you muſt calculate who has the move, on which the game always depends. 18. To learn well and faſt, you muſt be reſolute to guard the *gambet* pawn, or any other advantage againſt the attack; and when you have the leaſt advantage you muſt change all, man for man. A draw-game ſhews both players to be good.

The common opinion is, that *cheſs* was invented by *Palamedes*, at the ſiege of *Troy*, to divert tedious evenings during that long ſiege. Others attribute the invention to *Diomedes*, who lived in the time of *Alexander*: the *Romance of the Roſe* aſcribes it to one *Attalus*; but the truth is, the game is ſo very antient, there is no tracing its author.

In *China* it makes a conſiderable part of the education of their maids, and ſeems to take the place of dancing among us. In *Spain* whole cities challenge each other at *cheſs*.

Donatus, on *Terence*'s *Eunuch*, obſerves that *Pyrrhus*, the moſt knowing and expert prince of his age, ranging a battle, made uſe of the *men* at *cheſs* to form his deſigns; and to ſhew the ſecrets thereof.

BOWLING is a game of recreation, exerciſe, and addreſs, which conſiſts chiefly in having a kind of compaſs in the eye, to meaſure well the diſtance between the place the gameſter lets fall his bowl at, and the *jack*, that it may neither fall ſhort of it, nor run too far from it.

Amongſt the *games* with CARDS, I ſhall only exemplify the ſociable game at *piquet*, much uſed in the polite world. It is play'd between two perſons, with only 32 cards; all the *duces*, *threes*, *fours*, *fives*, and *ſixes* being ſet aſide.

In reckoning at this game, every card goes for the number it bears, as ten for ten; all court-cards go for ten, and the ace for eleven; and the uſual game is one hundred up. In playing, the *ace* wins the *king*, the *king* the *queen*, and ſo down.

Twelve cards are dealt round, uſually by two and two, which done, the remainder are laid in the middle; if one of the gameſters finds he has not a court-card in his hand, he is to declare he has *carte blanche*, and tell how many cards he will lay out, and deſire the other to diſcard that he may ſhew his game, and ſatisfy his antagoniſt that the *carte-blanche* is real; for which he reckons ten.

Each perſon diſcards, *i. e.* lays aſide a certain number of his cards, and takes in a like number from the ſtock. The eldeſt hand is allowed to take five, though he can take leſs; for he muſt always leave three to his adverſary, who may take them all three if he pleaſes; he can alſo take more than three, if his adverſary leaves more, provided he diſcards as many as he takes; and ſee thoſe he leaves; and the eldeſt hand alſo, if he declares what card he will lead: both are obliged to diſcard at leaſt one card, let their game be ever ſo good.

After diſcarding the eldeſt hand examines what ſuit he has moſt cards of, and reckons how many points he has in that ſuit; if the other has not ſo many in any one ſuit, he is to tell one for every ten of that ſuit: an example will make this plain.

If the eldest has *ace*, *king*, *queen*, and *knave*, of any suit; he asks, are 41 good? If the other cannot reckon up as many or more, he shall tell 4 for them; for if he had 50 he should tell 5; if 60, 6, and so on. But suppose 35 in either hand should be good, he who has them is to reckon as much as for 40, that is to say 4; and the same for any number betwixt 35 and 40; but for any number less than 5, nothing is reckoned: and for 41, 42, 43, or 44, you reckon but 4. He who thus reckons most, is said to win the *point*.

The *point* being over, each examines what *sequences* he has of the same suit, *viz.* how many *tierces*, *quartes*, or fours, *quintes*, or fives, *sixiemes*, or sixes, &c. For a *tierce* they reckon three points, for a *quarte* four, for a *quinte* fifteen, and for a *sixieme* sixteen, &c. And the several *sequences* are distinguished in dignity by the cards they begin from: thus, *ace*, *king*, and *queen*, are called *tierce major*; *king*, *queen*, and *knave*, *tierce to a king*; knave, ten, and nine, *tierce to a knave*: all which tell three. Likewise *ace*, *king*, *queen*, and *knave*, are called *quarte major*; *king*, *queen*, *knave*, *ten*, *quarte* to a king, and thus of the *queen* and *knave*, as in the *tierces*; which *quartes* tell 4. The *ace*, *king*, *queen*, *knave*, *ten*, are QUINTE *major*; the king, queen, knave, ten, and nine, QUINTE to a *king*, &c. all *quintes* tell 15. The ace, king, queen, knave, ten, nine, are a SIXIEME *major*, and this sequence follows the same order of the others, and tells 16. The best *tierce*, *quarte*, *quinte*, or *sixieme*, i. e. that which takes its descent from the best card, prevails, so as to make all the others in that hand good, and destroy all those in the other hand. In like manner a *quarte* in one hand sets aside a tierce in the other.

The sequences over, they proceed to examine how many *aces*, *kings*, *queens*, *knaves*, and *tens*, each holds; reckoning for every three of any sort, three: but here too, as in *sequences*, he that with the same number of threes has one that is higher than any the other has, *ex. gr.* three *aces*, has all his others hereby made good, and his adversary's all set aside: for example, if I have three *aces*, three *knaves*, and three *tens*, and my adversary three *kings*, my three *aces* sets his three *kings* aside, and make my three *knaves* and three *tens* good; so that I reckon of this article only, nine, while my adversary reckons nothing. Four of any sort, *viz.* four *aces*, or four *kings*, *queens*, *knaves*, or *tens*, are called a *quatorze*, and tell 14. The *quatorze* of *aces*, setting aside that of *kings*; that of *kings*, the *quatorze* of *queens*; and thus of the *knaves* and *tens*, for you are allowed nothing for the nines, eights, and sevens.

All the game in hand being thus reckoned, the eldest proceeds to play, reckoning one for every card he plays above a nine, and the other follows him in the suit; and the highest card of the suit wins the trick. If two cards of different suits are play'd, that which leads wins the trick, though the first was but a 7 and the last an *ace*.

It is not the person that wins the trick, who always reckons for it, and in some cases both reckon one for the same trick: of which this is an example. If the person who leads plays a tenth card, he reckons one for it as soon as he plays it down; if another plays another card that is higher he wins it, and also reckons one; thus they both reckon for the same trick.

If the leader plays an 8 or 7 he reckons nothing; and if the follower should win it with a nine he reckons nothing; for as it has been observed before, a card under a ten cannot count at this game: nevertheless that trick serves towards winning the cards. It must be observed that the follower, that is, he who plays last, never reckons for his cards unless he wins the trick; and that he who wins the last trick reckons one for it, though it be won by any card under a 10; and if it be won with a 10 or upwards, he reckons 2 for it.

When the cards are played out, each is to count his tricks, and he that has most is to reckon 10 for winning the cards; if they have tricks alike, neither is to reckon any thing.

The first thing that's reckoned at *piquet*, is the *carte blanche*; if there be no *carte-blanche*, the point is the first thing. The second thing is, the *sequences*, as *tierces*, *quartes*, *quintes*, &c. The next are the *threes* or *quatorzes*; as three *aces*, or four *knaves*, or *tens*, *queens*, or *kings*: for instance, if both parties should be 95 of the game, and one has in his hand 45, or 50 for point, which we will suppose to be good; and the other a *quint*, or a *quatorze* of aces, he who has the point wins the game, because it is to be reckoned first; and the rest have the same preference according to their ranks. If one be 99 of the game before he plays down the first card, he plays it up if it be a tenth card, tho' he loses the trick. If the parties are 99 each when they are to play down, the leader must win the game if he plays a tenth card; because he tells as soon as he plays down, the other cannot, till after the trick is won. When the *points*, *tierces*, *quartes*, or *quintes*, are equal in both hands, neither is to reckon any thing for them.

He who wins all the tricks, instead of reckoning ten, which is his right for winning the cards, reckons 40: and this is called a CAPOT.

He who without playing down, can reckon up 30 in hand, either in *carte-blanche*, *points*, *quintes*, or *quatorzes*, when the other has reckoned nothing, reckons 90 for them; and this is called a REPICQUE: and

and if he can make up above 30 in hand, he reckons as much above 90; *e. g.* if he has 32, 33, or 34, he reckons 92, 93, 94, and ſo on.

He who can make up 30, part in hand and part by play, before the other has told any thing, reckons them for 60; and this is called PICQUE.

There is a great number of accidents attending this game, and which are attended with penalties: for,

1. If the dealer by miſtake, or otherwiſe, ſhould give a card too many, or too few, it is at the option of the eldeſt hand either to play the game, or make him deal again.

2. If the eldeſt having 13 cards dealt him, will play, he muſt lay out 5 cards and take in but 4; and if he plays when he has but 11 cards dealt he muſt lay out a card leſs than what he takes in. The dealer is to do the ſame, if 11 or 13 cards fall into his hand; with this difference, that it is the choice of the eldeſt to play, or make him deal again.

3. If one ſhould have 15 cards, or but 9 dealt him, which may happen when the dealer does not think what he is doing; in this caſe the cards muſt be dealt again, and neither have power to hinder it.

4. He that has *carte-blanche*, *point*, *quinte*, or *quatorze* in his hand, and plays down a card before he remembers to name it, loſes the benefit thereof; and ſo he does of every thing that is to be told in hand, if he does not name them before he plays down.

5. If one party names his *point*, and the other allows it to be good, and does not remember to ſhew it before he plays down a card, he muſt not reckon it; the ſame muſt be ſaid of *tierces*, *quartes*, and *quintes*, if he forgets to ſhew them before he plays down a card; which gives an opportunity to his antagoniſt of telling his *points*, *tierces*, *quartes*, or *quintes*, &c. though they are not ſo good; but the antagoniſt muſt likewiſe ſhew them before he plays down to the leader's card, otherwiſe he loſes the right of reckoning them as well as the other.

6. He that has *three*, or *quatorzes* of *aces*, *kings*, *queens*, *knaves*, or *tens*, is not obliged to ſhew them.

7. If one ſhould count a *three* or *quatorze*, which he has not in his hand, though he laid it out by miſtake, or otherwiſe, if the other finds it out at any time, before the cards are cut for the next deal, he cuts him off from all he reckoned, and he is to count nothing that he got by the deal. And if the eldeſt ſhould count 3 aces when he laid out one of them, and the other three kings, or any thing elſe, he ſhall count his three kings, though he does not diſcover the other's falſe reckoning till the end of the deal. But it muſt be obſerved, that though he who reckons falſe, can count nothing by the deal, yet what he has in his hand may hinder the other, and ſave a *picque* or a *repicque*: as for example, he who counts 3 aces falſe, and has a *quinte-major* in his hand, though he cannot count for it, yet it cuts the other off from counting one inferior *quinte*, *quarte*, or *tierce*.

8. He that takes in a card more than he lays out, counts nothing; but he that takes in a card leſs than he lays out, may count his game; and muſt play card for card with the other as long as his cards laſt.

9. When one has 12 cards, and the other but 10; if he who has the 12 cards ſhould win 10 tricks ſucceſſively, then he has 2 cards left in his hand, which we'll ſuppoſe to be the king of *ſpades*, and any ſmall card of another ſuit; the other has but one card, which we'll ſuppoſe to be the ace of *ſpades*; if the firſt plays his ſmall card, the other muſt play the ace of *ſpades* to it. Thus he ſuffers a *capot* for want of another card; and this ſeems juſt, becauſe it was his own fault that he wanted 1 card.

10. When a card is once played out of hand, it cannot be taken up again, unleſs it be the caſe of a *renounce*; if then by miſtake, one ſhould throw down a card of a different ſuit when he has one of the ſame in his hand, he may take it up again and play down the other.

11. If the leader ſhould play a king, and the other having the ace of the ſame ſuit in his hand, ſhould, in ſurprize, play a ſmall card of the ſame ſort, he cannot recal it, but muſt be content to loſe the trick.

12. If a player has three *aces* in his hand, and by miſtake, ſhould count three *kings* inſtead of three *aces*, he counts nothing that deal, provided he does not recollect his miſtake before he plays down his firſt card; if he does, he ſaves the penalty.

13. If when the deal is half played out, one of the parties expecting to win no more tricks, ſhould throw up the cards, and mix them with the reſt; if he repents after, and would take his cards up again, he is not allowed: but if they are not mixed with the reſt he may take them up again, and play out the deal.

14. When the cards are play'd out, except two or three on one ſide, and one ſuppoſing the other's cards to be better than his own, ſhould throw them down; but finding himſelf miſtaken, he takes up his cards again, he ſhall be obliged to play what card the other directs him.

15. It is not allowed in any caſe to diſcard twice; nor to look before diſcarding, to examine the cards you are to take in, even on the outſide, leſt they ſhould be known by their back.

16. He that takes in firſt, ſhould always tell how many he leaves, if he does not take in all his five; that the other may diſcard accordingly.

17. He

17. He that takes in a card too many, and perceives it before he looks on them, may turn it back again, unleſs he mixes it with the reſt of his game; in which caſe he loſes the whole profit of that deal, and reckons nothing.

18. If any one takes the cards to deal when it is not his turn, and ſhould deal them all out; and if the other examines his cards, provided he that dealt by miſtake has not looked on his cards alſo; he may throw them up to be dealt by the other.

19. If the perſon who is to ſpeak firſt, ſhould ſhew a *point*, or a *tierce*, *quarte*, or *quinte*, *&c.* or a *three*, or *quatorze* of any thing, which the other two ſhould allow to be good; if, after this, he ſhould find he was miſtaken, and that he has a better of that ſort than the eldeſt ſhew'd, he may count it afterwards: and he ſuffers nothing by this miſtake, provided there be not a card play'd down.

20. He that has nothing in his hand, but the *carte-blanche*, ſaves a *picque* or a *repique*.

21. If you ſhould have in your hand three aces, three kings, three queens, three knaves, or three tens, and in diſcarding lay out one, or either of theſe, you are to count but three: then the other may aſk you which *ace*, which *king*, *&c.* you laid out, and you are obliged to tell him; and if he requires it, you muſt ſhew him which you laid out.

22. If it ſhould happen that the pack ſhould be falſe, (as ſometimes there may be two cards of a ſort) when it is found out, that deal goes for nothing; but if you have play'd ſeveral deals before with the ſame pack, they are all good. If the pack ſhould be found falſe, the very firſt deal you play you muſt adjuſt the pack, and begin again; but you are not to cut again for deal, for the firſt cutting ſtands good.

23. Every gameſter is to lay his diſcard near himſelf; which he has the liberty of looking on as often as he pleaſes.

24. He that cuts the cards is not to look at the bottom; if he ſhould, forgetting what he was about, they muſt be ſhuffled, and cut again.

25. Whoever is found taking a card in, that he had laid out before, loſes the game.

26. When by miſtake one has taken a card in, more than he had laid out before; and to avoid the penalty, which is of reckoning nothing that deal, he ſhould attempt ſecretly to lay it out again, he is to loſe the game.

With DICE the moſt ingenious and fair game is *back-gammon*. It requires much ſkill to play it well. The men, which are 30 in number, are equally divided between you and your adverſary, and are thus placed; 2. on the *ace point*, and 5 on the ſide of your left-hand table, and 3 on the cinque, and 5 on the *ace-point* of your right hand table, anſwered on the like points by your adverſary's men with the ſame number; or thus, 2 of your men on the *ace-point*, 5 on the double *ſice*, or *ſice cinque points*, 3 on the *cinque-point* in your tables, and five on the *ſice-point* at home, and all theſe pointed alike by your adverſary.

In your play have a care of being too forward; and be not raſh in hitting every blot, but with diſcretion and conſideration, move ſlowly, but ſecurely.

Be ſure to make good your *trey ace-points*; hit boldly, and come away as faſt as you can; to which end if your *dice* run high, you will make the quicker diſpatch.

When you come to bearing, have a care of making when you need not; and *doublets*, now, will ſtand you moſt in ſtead.

If your table be clear, before your adverſary's men be come in, that is a *back-gammon*, which is three, four or the game.

To play this game accurately the gameſter muſt guard himſelf againſt diſappointment in the *dice*, and not cloud his reaſon with impatience and paſſion: and conſider well the chance before he moves his man. For which he will do well to calculate upon the doctrine of chances laid down at the beginning of this treatiſe, and alſo the following calculation.

To find the number of caſes, wherein any given number of points may be thrown with a given number of dice. Let $p+1$, be the given number of points; n the number of dice; and f the number of ſides or faces of each die; let $p-f=q$, $q-f=r$, $r-f=s$, $s-f=t$, &c. the number of caſes will be.

$$+\frac{p}{1}\times\frac{p-1}{2}\times\frac{p-2}{3}, \text{ \&c.}$$

$$-\frac{q}{1}\times\frac{q-1}{2}\times\frac{q-2}{3}, \text{ \&c. } \times\frac{n}{1}.$$

$$+\frac{r}{1}\times\frac{r-1}{2}\times\frac{r-2}{3}, \text{ \&c. } \times\frac{n}{1}\times\frac{n-1}{2}.$$

$$-\frac{s}{1}\times\frac{s-1}{2}\times\frac{s-2}{3}, \text{ \&c. }\times\frac{n}{1}\times\frac{n-1}{2}\times\frac{n-2}{3}$$

which ſeries is to be continued till ſome of the factors either become equal to nothing, or negative. And note, ſome factors of the ſeveral products $\frac{q}{1}\times\frac{p-1}{2}\, a\, \frac{p-2}{3}$, &c. $\frac{r}{1}\times\frac{r-1}{2}\times\frac{r-2}{3}$, &c. $\frac{s}{1}\, a\, \frac{s-1}{2}$, &c. are to be taken as there are units in $n-s$.

GARDENING.

GARDENING is the art of laying out in taſte, and cultivating a ſpot of ground with a variety of *plants*, *flowers*, *ſhrubs*, and *fruit trees*. Hence

Gardens are uſually diſtinguiſhed into *flower-garden*, *fruit-garden*, and *kitchen-garden*; the firſt of which, being deſigned for pleaſure and ornament, is to be placed in the moſt conſpicuous part, that is, next to the back front of the houſe; and the two latter, being deſigned for uſe, ſhould be placed leſs in ſight. But though the *fruit* and *kitchen-gardens* are here mentioned as two diſtinct gardens, yet they are now uſually in one; and that with good reaſon, ſince they both require a good ſoil and expoſure, and equally require to be placed out of the view of the houſe.

In the choice of a place proper for a garden, the moſt eſſential points to be conſidered are the ſituation, the ſoil, the expoſure, water and proſpect.

1ſt, As to the ſituation, it ought to be ſuch a one as is wholeſome, and in a place neither too high nor too low; for if a garden be too high, it will be expoſed to the winds, which are very prejudicial to trees; and if it be too low, the dampneſs, the vermin, and the venomous creatures that breed in ponds and maſhy places, add much to their inſalubrity. The moſt happy ſituation is on the ſide of a hill, eſpecially if the ſlope be eaſy, and in a manner imperceptible; if a good deal of level ground be near the houſe, and if it abounds with ſprings of water; for, being ſheltered from the fury of the winds, and the violent heat of the ſun, a temperate air will be there enjoyed; and the water that deſcends from the top of the hill, either from ſprings or rain, will not only ſupply fountains, canals, and caſcades for ornament, but when it has preformed its office, will water the adjacent valleys, and, if it be not ſuffered to ſtagnate, will render them fertile and wholeſome. Indeed if the declivity of the hill be too ſteep, and the water be too abundant, a garden on the ſide of it may frequently ſuffer, by having trees torn up by torrents and floods: and by the tumbling down of the earth above, the walls may be demoliſhed, and the walks ſpoiled. It cannot, however, be denied, that the ſituation on a plain or flat, has ſeveral advantages which the higher ſituation has not: for floods and rain commit no damage; there is a continued proſpect of champaigns, interſected by rivers, ponds and brooks, meadows and hills covered with woods or buildings; beſides, the level ſurface is leſs tireſome to walk on, and leſs chargeable, than that on the ſide of an hill, ſince terrace walks and ſteps are not there neceſſary: but the greateſt diſadvantage of flat gardens, is the want of thoſe extenſive proſpects which riſing grounds afford.

2dly. A good earth, or ſoil, is next to be conſidered; for it is ſcarce poſſible to make a fine garden in a bad ſoil; there are indeed ways to meliorate ground, but they are very expenſive; and ſometimes when the expence has been beſtowed of laying good earth three feet deep over the whole ſurface, a whole garden has been ruined, when the roots of the trees have come to reach the natural bottom. To judge of the quality of the ſoil, obſerve whether there be any heath, thiſtles, or ſuch-like weeds growing ſpontaneouſly in it; for they are certain ſigns that the ground is poor. Or if there be large trees growing thereabouts, obſerve whether they grow crooked, ill-ſhaped, and grubby, and whether they are of a faded green, and full of moſs, or infeſted with vermin; if this be the caſe, the place is to be rejected: but, on the contrary, if it be covered with good graſs fit for paſture, you may then be encouraged to try the depth of the ſoil. To know this, dig holes in ſeveral places, ſix feet wide, and four feet deep; and if you find three feet of good earth, it will do very well; but leſs than two, will not be ſufficient. The quality of good ground is neither to be ſtony, nor too hard to work; neither too dry, too moiſt, nor too ſandy and light; nor too ſtrong and clayey, which is the worſt of all for gardens.

3dly, The next requiſite is water, the want of which is one of the greateſt inconveniences that can attend a garden, and will bring a certain mortality upon whatever is planted in it, eſpecially in the greater droughts that often happen in a hot and dry ſituation in ſummer; beſides its uſefulneſs in fine gardens for making fountains, canals, caſcades, *&c.* which are the greateſt ornaments of a garden.

4thly, The laſt thing to be conſidered, is the proſpect of a fine country; and though this is not ſo abſolutely neceſſary as water, yet it is one of the moſt agreeable beauties of a fine garden: beſides, if a garden be planted in a low place that has no kind of proſpect, it will not only be diſagreeable, but unwholſome.

In the laying out and planting of gardens the beauties of nature ſhould always be ſtudied; for the

the nearer a garden approaches to nature, the longer it will please. The area of a handſome garden, may take up thirty or forty acres, but not more; and the following rules ſhould be obſerved in the diſpoſition of it. There ought always to be a deſcent of at leaſt three ſteps from the houſe to the garden; this will render the houſe more dry and wholeſome, and the proſpect on entering the garden more extenſive. The firſt thing that ſhould preſent itſelf to view, ſhould be an open lawn of graſs, which ought to be conſiderably broader than the front of the building; and if the depth be one half more than the width, it will have a better effect: if on the ſides of the lawn there are trees planted irregularly, by way of open groves, the regularity of the lawn will be broken, and the whole rendered more like nature. For the convenience of walking in damp weather, this lawn ſhould be ſurrounded with a gravel walk, on the outſide of which ſhould be borders three or four feet wide, for flowers: and from the back of theſe, the proſpect will be agreeably terminated by a ſlope of ever-green ſhrubs, which, however, ſhould never be ſuffered to exclude agreeable proſpects, or the view of handſome buildings. Theſe walks may lead through the different plantations, gently winding about in an eaſy natural manner, which will be more agreeable than either thoſe long ſtrait walks, too frequently ſeen in gardens, or thoſe ſerpentine windings, that are twiſted about into ſo many ſhort turns, as to render it difficult to walk in them: and as no garden can be pleaſing where there is a want of ſhade and ſhelter, theſe walks ſhould lead as ſoon as poſſible into plantations, where perſons may walk in private, and be ſheltered from the wind. Where the borders of the gardens are fenced with walls or pales, they ſhould be concealed with plantations of flowering ſhrubs intermixed with laurels, and other ever-greens, which will have a good effect, and at the ſame time conceal the fences, which are diſagreeable, when left naked and expoſed to the ſight. Groves are the moſt agreeable parts of a garden, ſo that there cannot be too many of them; only that they muſt not be too near the houſe, nor be ſuffered to block up agreeable proſpects. To accompany parterres, groves opened in compartments, quincunxes, and arbour-work with fountains, *&c.* are very agreeable. Some groves of ever-greens ſhould be planted in proper places, and ſome ſquares of trees of this kind may alſo be planted among the other wood.

Narrow rivulets, if they have a conſtant ſtream, and are judiciouſly led about a garden, have a better effect than many of the large ſtagnating ponds or canals, ſo frequently made in large gardens. When wilderneſſes are intended, they ſhould not be cut into ſtars and other ridiculous figures, nor formed into mazes or labyrinths, which in a great deſign appear trifling. Buildings, ſtatues, and vaſes, appear very beautiful; but they ſhould never be placed too near each other: magnificent fountains are alſo very ornamental; but they ought never to be introduced, except there be water to keep them conſtantly running. The ſame may alſo be obſerved of caſcades and other falls of water.

In ſhort, the ſeveral parts of a garden ſhould be diverſified; but in places where the eye takes in the whole at once, the two ſides ſhould be always the ſame. In the buſineſs of deſigns, the aim ſhould be always at what is natural, great and noble. The general diſpoſition of a garden, and of its parts, ought to be accommodated to the different ſituations of the ground, to humour its inequalities to proportion the number and ſorts of trees and ſhrubs to each part, and to ſhut out from the view of the garden no objects that may become ornamental. And before a garden is planned out, it ought ever to be conſidered, what it will be when the trees have had twenty years growth.

The art of gardening affords a variety of delights. It teaches how to diſpoſe fruit trees, flowers, and herbs to the beſt advantage, whether for profit or pleaſure; and ſhews how to prepare the ſoil for ſowing the different kinds of ſeeds, as well as how to treat the plants when grown up.

So much for GARDENS *in general.* But to deſcend to *particulars.*

The KITCHEN GARDEN, or a commodious piece of ground laid out by art for the cultivation of fruit, herbs, pulſe, and other vegetables, for the uſe of the kitchen, ought to be ſituated on one ſide of the houſe, near the ſtables, from whence the dung may be eaſily conveyed into it; and after having built the wall, borders ſhould be made under them, which, according to *Miller,* ought to be eight or ten feet broad: upon thoſe borders expoſed to the ſouth, many ſorts of early plants may be ſown; and upon thoſe expoſed to the north, you may have ſome late crops, taking care not to plant any ſort of deep-rooting plants, eſpecially beans and peas, too near the fruit trees. You ſhould next proceed to divide the ground into quarters; the beſt figures for theſe is a ſquare, or an oblong, if the ground will admit of it; otherwiſe they may be of that ſhape which will be moſt advantageous to the ground: the ſize of theſe quarters ſhould be proportioned to that of the garden: if they are too ſmall, your ground will be loſt in walks, and the quarters being encloſed by eſpaliers of fruit-fruits, the plants will draw up ſlender, for want of a more open expoſure. The walks ſhould alſo be proportioned to the ſize of the ground; theſe in a ſmall garden ſhould be ſix feet broad, but in a larger one ten; and on each ſide of the walk there ſhould be allowed a border three or four feet wide, between it and the eſpalier, and in theſe borders may be ſown ſome ſmall ſallads, or any other herbs that do not take deep root, or continue long: but theſe quarters ſhould not be ſown or planted with the ſame crop two years together. In one of theſe quarters, ſituated neareſt to the ſtables, and beſt defended from the cold winds, ſhould be the hot-beds, for early cucumbers, melons, *&c.* and to theſe there ſhould be a paſſage from the ſtables, and a gate through which a ſmall cart may enter. The moſt important points of general culture conſiſt in well digging and manuring the ſoil, giving a proper diſtance to each plant, according to their different growths, as alſo in keeping them clear from weeds; for this purpoſe you ſhould always obſerve to keep your dunghills clear from them; if this is not done, their ſeeds will be conſtantly brought in, and ſpread with the dung.

The FLOWER-GARDEN, which alſo is called the *pleaſure garden*, is compoſed of, or laid out in *parterres*, *viſta's*, *glades*, *groves*, *compartments*, *quincunxes*, *verdant walls*, *arbour work*, *mazes*, *labyrinths*, *fountains*, *cabinets*, *caſcades*, *canals*, *terraces*, *&c.*

The PARTERRE, is a level diviſion of ground, which, for the moſt part, faces the ſouth, and beſt front of the houſe, and is generally furniſhed with greens, flowers, *&c.*

There are *parterres* of embroidery; *parterres* cut in ſhell-work, in ſcroll-work, *&c.* with ſand alleys between.

An oblong, or long ſquare, is accounted the moſt proper figure for a *parterre*, the ſides whereof, to be as two, or two and a half to one.

FLOWERS make the greateſt ornament of a *parterre*; theſe flowers are diſtinguiſhed into early or *ſpring flowers*, which flouriſh in the months of *March*, *April*, and *May*.

Such are the anemonies, daffodils, hyacinths, tulips, jonquils, cowſlips, primroſes, *&c.*

Summer FLOWERS, which open in *June*, *July* and *Auguſt*, as pinks, gilliflowers, lilies, daiſies, campanulas, poppies, ſun-flowers, *&c.*

Autumnal, or *late* FLOWERS, denote thoſe of *September* and *October*; as indian pinks, roſes, panſy, flower-gentle, *&c.*

Of theſe FLOWERS, thoſe which ſubſiſt all the year, we mean in the ſtem, or root, at leaſt, are called *perennials.*

And thoſe which are to be planted, or ſowed afreſh every year, according to the ſeaſon, are called *annuals.*

VISTA is an open and light paſſage made through a thick wood, grove, or the like, by lopping off the branches of trees, along the way.

GROVE, in large and magnificent gardens, is uſually a plot of trees, incloſed with paliſadoes, conſiſting of tall trees, as elms, horſe cheſnuts, *&c.* the tops whereof make a tuft, or plump, and ſhade the ground below.

COMPARTMENT is a deſign compoſed of ſeveral different figures, diſpoſed with ſymmetry, to adorn a *parterre.*

ALLEY, in gardening, is a ſtrait, parallel walk, bordered or bounded on each hand with trees, ſhrubs, or the like.

Alleys are uſually laid either with graſs or gravel.

An *alley* is diſtinguiſhed from a *path* in this, that in an *alley* there muſt always be room enough for two perſons, at leaſt, to walk a-breaſt.

In the planting of fruit-trees, if the ſoil be a hungry gravel, or ſand, Mr. *Switzer* directs where the trees are to be planted, to be dug two feet deep, and three or four over, and filled with rotten horſes or cows dung, mixed with rich mould: if it be marle or ſtiff clay, a compoſt of rubbiſh, lime, pieces of brick, aſhes, ſand, *&c.* will be the beſt to mix with dung and mould; though he is of opinion, that untried earth, dug from a waſte or common where cattle have been fed, would prove the beſt ſoil for young trees.

The trees being now taken out of the nurſery, the biggeſt roots are to be ſhortened to about ſix inches; all the ſmall fibres taken off; and the head to be pruned, ſo as not to leave above two branches; and thoſe not above ſix inches long.

The wall-trees to be placed as far from the wall as poſſible; that there may be the more room for the roots to ſpread. Then filling up the hole with mould, there remains nothing but to ſecure the roots from the winter's froſt, by covering the ſpot with ſtraw, fern, dung, *&c.* And in ſummer, from the ſun; by ſand, and pebble ſtones.

For trees planted in borders, the common practice is to make a trench by the wall ſide, two feet broad, and as many deep. This trench they fill with old dung, mixed with earth, lightly laid, near as high as the borders are intended to be; and then trod it down to half the height in the places where the trees are intended to be. It is prudent to plant the trees ſhallow, and to raiſe the earth about them; eſpecially in a wet, clayey ſoil.

The

The places near the walls are moſt advantageouſly filled with dwarfs; they ſeldom grow above four or five feet high, and the fruit they yield is uſually the fineſt and beſt.

There are divers ways of producing *dwarfs*.—*dwarf-pears* are uſually had by inoculating on quince-ſtocks, which grow the *dwarfs* height.

As for *dwarf-apples*, the ſtocks they chuſe to graft on are thoſe raiſed of the cuttings of the apple-tree.——In order to provide ſtocks of each kind, they chuſe ſuch ſtems, and branches, as grow ſtraiteſt, in the month of *October*, from trees whoſe cutttings will grow, or which in the places they are to be grafted in are at leaſt an inch thick: Theſe they cut off an hand's breadth below the knots or burs, which are the places where they uſually put forth their roots; and cut off the top that they may not be above a yard long. If they cannot be got ſo long of quinces, ſhorter muſt do. Cut off all ſide branches cloſe to the body, except one ſmall twig near the top for the ſap to vent itſelf at. Set them in beds, as ſeed plants are: and keep them a foot above ground.

Such trees alone as are apt to put forth roots, are proper for *dwarf* ſtocks; as the Kentiſh codlin. genneting, ſome ſorts of ſweet apples, bitter-ſweets, the quince-tree, mulberry-tree, paradiſe apple-tree.

As for *dwarf* pear-trees, ſtocks may be raiſed for them from the ſuckers of old pear-trees: Elſe cut off the top of ſome old ill pear-tree, and the roots will caſt forth ſuckers.

For *dwarf* cherries and plumbs, ſuckers of the common red cherry, and ordinary plumb-tree are the beſt.

As to the grafting or inoculating of *dwarf ſtocks*, it muſt be done as low as may be, with two cyons, and thoſe longer than in grafting for long ſtandards that they may ſpread from the ground.

As to the planting of *dwarf-trees* it is beſt in a light, hot earth, from the beginning of *October*, to the end of *November*. In cold, wet ſoil, it is beſt in *March* and *April*. The ſtem of the tree to be cut off ſeven or eight inches above the graft; and remember to cut off half the length of the roots and hairy fibres; to turn the cut of the tree towards the north; to let the graft always be two or three inches above the ground, leaſt it take root; to plant them ſhallow, as being apt of themſelves, in light ground to ſink a foot deep, which is ſufficient; and to cover the ground, when they are planted with horſe-litter.

With regard to *fruit-trees*, Monſ. *Quintine* obſerves, 1. That the cutting and trimming of young trees, hinders them from quick bearing; though it contributes both to the beauty of the tree, and the richneſs and flavour of the fruit.

2. That *kernel fruit-trees*, come later to bear than *ſtone fruit-trees*; the time required by the firſt before they arrive at a fit age for bearing, being, one with another, about four or five years: but that when they do begin, they bear in greater plenty than *ſtone-fruit*.

3. That *ſtone-fruit*, figs, and grapes, commonly bear conſiderably in three or four years; and bear full crops the fifth and ſixth years; and hold it for many years, if well ordered.

4. That *fruits* in the ſame neighbourhood will ripen a fortnight ſooner in ſome grounds, than in others of a different temperature.

5. That in the ſame ſpot, hot or cold ſummers ſet conſiderably forward, or put backwards the ſame *fruit*.

6. That the *fruits* of wall-trees generally ripen before thoſe on ſtandards; and thoſe on ſtandards before thoſe on *dwarfs*.

7. That the *fruits* of wall-trees planted in the ſouth and eaſt quarters commonly ripen about the ſame time; only thoſe in the ſouth rather earlier than thoſe in the eaſt; thoſe in the weſt are later by eight or ten days, and thoſe in the north by fifteen or twenty.

Monſieur *de Reſſons*, in the *memoires de l'academie Royale des Sciences*, anno 1716, gives a method of grafting *ſtone fruit-trees* without loſing of time; ſo that a tree which bore ſorry fruit the preceding year, ſhall bear the choiceſt the year following.

In order to this, it is to be obſerved; that there are three kinds of branches: Wood-branches growing immediately from the ſtem or ſtock of the tree: *fruit* branches; and branches half wood half *fruit*; being ſuch as ariſing from the largeſt wood branches preſerve the character thereof, but which in two years time will produce fruit branches. Now, it is theſe intermediate kind of branches, that we are to chuſe for ſcutcheons or grafts. They are readily known by being bigger than the fruit branches, and leſs than the wood-branches: they have each of them two, three, four, or even five leaves to each eye, and the eyes are further diſtant from each other than thoſe of the fruit-branches, but cloſer than thoſe of the wood branches. It muſt be added, that the eyes on ſuch branches are three; one intended for a wood branch, being ſituate between the two leaves, and advancing further than the other two, which are intended for *fruit*, and are placed without ſide the leaves. Theſe laſt are the preciſe ſubjects to be choſen for the grafting withal. Twelve of theſe branches, more or leſs, according to the ſtrength of the tree to be

grafted

grafted on, being duly applied, we may depend on a crop of good *fruit* the very next year, on the same tree, which last year produced the worst.

Engrafting, Grafting, or Graffing, in *agriculture* and *gardening*, is the art, or act, of inserting, or fixing a cyon, shoot, or bud of one tree, in the stock of another; in order to correct and improve its fruit.

Engrafting is the art of applying a graft, or shoot of one plant, to the stock of another; in such manner, as that the sap passing freely through both, the tree *grafted* on may produce the same kind of fruit with that whence the graft is taken.

Engrafting only differs from *inoculation*, in that the latter is performed when the sap is at the highest in summer; and the former ere it rises, at least, in any quantity.

Inoculation, in *Agriculture* and *gardening*, is a kind of grafting, or an artificial operation, by which the bud of one fruit-tree is set into the branch or stock of another, so as sometimes to make different sorts of fruit grow on the same tree.

There are various ways of performing this: the antient method was, by making a shallow incision in the bark, where the knot, or a shoot or eye, *oculus*, (whence the operation takes its name) begins to bud forth, into which a promising shoot of another kind was inserted, and the incision closed up with fat earth or clay.

The method of *inoculation* now in the best repute, as delivered by Mr. *Lawrence*, is as follows: they cut off a vigorous shoot, from the tree that is to be propagated, a month before, or after, midsummer; then chuse out a smooth place in the stock (which should not be above three or four years growth) making a perpendicular slit in the bark a little above an inch long, and another at right angles to it, at the lower end, to give way to the opening of the bark. This done, the bark is gently loosened from the wood on both sides with a pen-knife beginning at the bottom.

They then prepare the bud, cutting it off from the aforesaid vigorous shoot, and taking with it as much of the wood above as below it, and as near as may be to the length of the slit in the stock. When the bud is thus cut off, they take out the woody part of the bud, and put the bud itself in between the bark and the wood of the stock, at the cross slit before opened, leading it upwards by the stalk where the leaf grew, till it exactly closes. They then bind it about with woollen yarn, the better to make all parts of it close exactly, that the bud may imbody itself with the stock, which it will do in three weeks time.

This operation is said to best performed in a cloudy day, or in an evening; and it is observed, that the quicker it is done, the better it succeeds.

This practice has the advantage of engrafting in many respects, both as it is more secure, it seldom failing of having effect, especially if two or three buds are put into the same stock; and as its success is more readily discovered. Indeed when large stocks are to be practised on, *inoculation* is not proper, and they are obliged to have recourse to grafting.

This one rule is observed to hold universally, *viz.* That no success is to be expected in *inoculation*, if the sap does not run well; that is, if the bark will not part readily from the wood of the stock.

Engrafting is one of the principal operations in gardening, and that whereon the goodness of our fruit greatly depends.

It is very extraordinary that the seeds, or kernels, or stones of a fruit, as an apple, pear, peach, plumb, cherry, *&c.* being sown, degenerate in the ground; so that the tree arising from it is of another kind, a sort of wilding, harsher, sourer, and coarser than that of the parent tree. To correct this, trees thus reared, must be *grafted* from other better kinds.

Apples are commonly raised by *engrafting* the intended kinds on crab-stocks, procured by sowing the kernels: so are pears procured by *grafting* on the wild pear-stock: tho' for dwarf or wall-trees, they generally chuse to *engraft* on the quince-stock.

They will do also if *grafted* on the white-thorn. Peaches are produced on an almond or plumb-stock. Indeed in this fruit, it sometimes happens that the stone sown produces better fruit than that from which it was taken: but this is not common; beside, that the tree in such case, is long ere it comes to bear. Plumbs are raised by *engrafting* on a damson, or wild plumb-stock: and cherries on the black cherry, or merry-stock, raised from stones.

Our best gardeners likewise, *engraft* their less kindly trees from other better of the same sort, to mend them; as also the smaller and single flowers, gilliflowers, *&c.* from the larger and finer.

To produce stocks for Engrafting *on*. The curious furnish us with other extraordinary and anomolous instances of *engrafting*: as of apples on plane, elder, thorn, cabbage-stalk, *&c.* and the like of pears, *&c.* Pears on apple-trees, on elms, *&c.* Cherries on the lawrel; coral berries on the plumb: beech on the chesnut, oak on the elm, goosberry on the currant, the vine on the cherry-tree, *&c.*

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The methods, or kinds of *engrafting* are various; as *grafting* in the cleſt, *grafting* in the rind, whip *grafting*, *grafting* by approach, ſcutcheon *grafting*, root *grafting*, reiterated *grafting*, *grafting* on branches, *&c.*

The apparatus, or inſtrument uſed therein, are ſaws to cut off the heads of ſtocks; knives to make clefts; a chiſſel to pare away the wood; clay, mixed with horſe-dung, to prevent freezing, and with tanners hair to prevent cracking; baſs-ſtrings, or woollen-yarn, to tie the *grafts* with, and *grafting* wax.

GRAFTING *in the cleft*, or *ſtock*, called alſo SLIT GRAFTING, is the moſt antient, and ordinary way; we have a very beautiful deſcription of it in *Virgil*, *Geor.* II. *v.* 78. It is chiefly uſed for middle-ſized ſtocks, from one to two inches diameter. Its ſeaſon is the months of *January*, *February*, and *March.*——The method as now practiſed is thus

The head of the ſtock being ſawn, or cut off ſmooth and clean, a perpendicular cleft is made therein, nearly two inches deep, with a ſtrong knife, or chiſſel, as near the pith as may be to miſs it. In this cleft, the *grafting* chiſſel, or wedge, is put to keep it open. The *graft*, or cyon, is prepared by cutting it aſlope, in form of a wedge, to ſuit the cleft; only leaving a ſmall ſhoulder on each ſide: and, when cut, is to be placed exactly in the cleft, ſo, as that the inner bark of the cyon may aptly and cloſely join in the inner part of the bark or rind of the ſtock; in the dexterous performance of which, the chief ſecret conſiſts, if the cleft pinch too tight, a ſmall wedge may be left in it to bear the ſtreſs. And laſtly, the cleft is covered over with clay; or rather, as Mr. *Gentil* adviſes, with moſs, or the freſh bark of a tree bound on with oſier.

GRAFTING *in the rind*, or *ſhoulder grafting*, called alſo *ſlicing*, and *packing*, is practiſed in the latter end of *April* or the beginning of *May.* The method is as follows.

The top of the ſtock is cut off in a ſmooth, ſtrait place: then the cyon, or *graft* is prepared by cutting on one ſide from the joint, or ſeam down ſlopewiſe, making the ſlope about an inch long; and obſerving its bent, that ſo when the cyon is fixed to the ſtock, it may ſtand nearly upright. At the top of the ſlope they make a ſhoulder, whereby it is to reſt on the ſlope of the ſtock. The whole ſlope to be plain and ſmooth, that it may lie even to the ſide of the ſtock. As to the length of the cyon, for a ſtandard-tree, it may lie about four inches from the ſhoulder; but for a dwarf or wall-tree, ſix inches.

The cyon prepared; the out-ſide is applied to the weſt, or ſouth-weſt ſide of the ſtock, and its length and breadth meaſured thereon; which done, the bark of the ſtock is cut away to thoſe dimenſions, that the cut part of the cyon may fit it. Wherein, regard is to be had to the bigneſs of the ſtock, and the thickneſs of the bark, to proportion the length and breadth of the chip thereto; otherwiſe the paſſages of the juice in the ſtock and cyon will not meet. Laſtly, laying the cut-part of the cyon on that of the ſtock, they bind them together with woollen-yarn, and cover the whole with clay an inch above, and as far below, the ſtock's head; working it round the cyon till it become ſharp at top, that the rain may run down it.

GRAFTING, *in the bark*, is performed thus. Prepare the ſtock and cyon, as in *grafting in the rind*; but inſtead of cutting the bark of the ſtock, ſlit the ſame on the ſouth-weſt ſide from the top, almoſt as long as the ſloped part of the cyon, and at the top of the ſlit looſen the bark, with the top of your knife. Thruſt your inſtrument, made of ivory, ſilver or the like, and formed at the end like the ſlope end of the cyon, but much leſs, down, between the bark and wood, to make room for the cyon; which being put in the bark is to be ſo managed, as that it may fall cloſe to the ſtock and edges of the cyon.

GRAFTING *by approach*, called alſo *inarching*, and *ablactation.*

Whip GRAFTING, or *Tongue*-GRAFTING, is a ſort of *grafting* in the rind, proper for ſmall ſtocks, from an inch diameter to a quarter of an inch. Mr. *London* ſpeaks of it as the moſt effectual way of any, and that moſt in uſe.

In this, the ſtock and cyon are to be of the ſame bigneſs. The cyon to be ſloped off a full inch, or more; and the like to be done to the ſtock; and ſo the one to be tied to the other. Otherwiſe the top of the ſtock being cut off, a ſhoulder is to be made in the *graft:* and the reſt to be performed as already ſhewn under *grafting in the rind.*

This method is alſo improved by what they call *tipping* or *tonguing*; which is the making a ſlit with a knife in the bare part of the ſtock downwards; and the like in the ſloped face of the cyon, upwards; and then joining them, by thruſting one ſlice into the other, till the bare place of the cyon cover that of the ſtock.

Side GRAFTING. In this the cyon is prepared as in *whip-grafting*, but the head of the ſtock is not cut off, only from a ſmooth part on the weſt ſide, ſo much of the bark is pared off as the cyon will cover; then ſlitting both cyon and ſtock, as in the laſt article, they bind the two together, and cloſe them up with clay. At the years end the top of the ſtock is cut off at the grafted place, ſlopewiſe, and the place covered with clay.

Scutcheon Grafting is another method of *grafting*, in the rind, practised in *June*, *July*, and *August*; when the bark will not part from the stock. It is performed, by slitting the bark of the stock in form of the capital letter T, loosening it with the point of a knife, and clapping in a cyon, prepared as above.

Crown Grafting is when four or more *grafts* are placed round the stock, between the bark and the rind, somewhat in the manner of a crown. — This is only practised in the larger trees, which are capable of receiving a number of *grafts*, and are too big to be cloven. The method is in all respects the same as that already delivered for *grafting in the rind*.

Root Grafting is a modern invention, treated of at large by *Agricola*: Its intention is somewhat different from the former, being for the propagation, or multiplication of plants.

To perform this, take a *graft*, or sprig of a young tree, which you intend to propagate; and a small piece of the root of another tree of the same kind, or very like it; or else pieces of roots cut off of other trees, in transplanting; and *whip-graft* them together: observing that the two but-ends of the graft and root be united, and that the rind of the root join that of the graft. These may, afterwards, be planted out at pleasure, and the piece of root will draw the sap, and feed the graft, as the stock does the other way.

This way of propagation is very easy and expeditious; roots being more plentiful than stocks: by this method the pieces of roots of one crab stock, or apple-stock, will serve for twenty or thirty apple grafts, and the like of other trees. The same is an excellent way for raising of tender trees, that will hardly bear, being *grafted* in the stock. Add, that trees thus *grafted*, bear sooner, and are more easily dwarfed than those done any other way.

Reiterated Grafting, or *grafting by a double, or triple incision*, is another method mentioned by *Agricola*: To perform which, first graft a good cyon on a stock, and cut it away to one half, or a third part; then fix another graft to it, of a better kind; and a third to that: for still the oftner a tree is *engrafted*, the finer fruit it produces.

By this method, that author assures us, he produced muscat pears that were admirable; making, at first, use of a stock *grafted* with a pound pear, on which he *grafted* a summer *bon chretien*; and when the branch of this latter had shot, he *grafted* on it a cyon of bergamot, which he also cut, and *grafted* on it a cyon of muscat pear.

Engrafting *of branches*, *Agricola* mentions as a very certain and profitable operation best practised on large full grown, and even old trees.

To do this, half or more of the branches must be lopped off, and *grafts* of three or four years old be applied to them; taking care to have stakes or other things to support them against the wind, &c.

He adds, that by this method, you will have, perhaps, the same year, at least, the second or third, such a quantity of fruit, as the youngest and soundest tree would hardly produce.

All sorts of trees are raised in a *nursery*, which is a *seminary* or seed-plot.

Some authors make a difference between *nursery*, and *seminary*, holding the former not to be a place wherein plants are sown; but a place for the reception and rearing of young plants, which are removed, or transplanted hither from the seminary, &c.

Mr. *Lawrence* recommends the having several *nurseries*, for the several kinds of trees: one for tall standards; *viz.* apples, ashes, elms, limes, oaks, pears, sycamores, &c. Another for dwarfs; *viz.* such as are intended for apricots, cherries, peaches, plumbs, &c. And a third for ever-greens.

The *nursery* for standards should be in a rich, light soil, sown with the proper seeds, in *October* or *November*. For apples, and pears, crab and wild pear kernels, are to be preferred for stocks: elms and lime are to be raised from planted suckers: walnuts to be sown with the green shell upon them, to preserve them from mice. This *nursery*, if it be well managed and weeded for two years, the crabs and pears will be fit for grafting and inoculating the third year.

Firs and pines are to be raised from those little seeds taken out of their large apples.

The *nursery* for dwarfs does best by itself, that it may not be over-topped by taller trees. Stones of apricots and peaches are not proper to raise those trees; but in lieu thereof, sow the stones of pear-plumbs, mussel, or *bonum magnum* plumb; which prove better and more lasting than the former. For stocks of all sorts of cherries, black cherry-stones do best.

Mr. *Mortimer* directs all stone-fruit to be sown quickly after gathering; for that if they be kept, they will be two years e'er they come up. Add, that if they have not all the moisture of the winter to rot the shells, the kernel will scarce come up at all.

To furnish the *nursery* of ever-greens, the several sorts of seeds or berries, as yew, holly, juniper, &c. are to be put in so many distinct pots or boxes, with fine mould over them, and thus buried for a year; after which, they are to be taken out and sown.

EVER-GREENS are a ſpecies of perennials, which continue their verdure, leaves, &c. all the year. Of theſe, our gardeners reckon twelve, fit for *Engliſh* air, *viz.* the alternus, arbutus, bay tree, box-tree, holley, juniper, lauruſtinus, phyllirea, pyracantha, or ever green thorn, *Italian* green privet, and the yew tree. If they were to be ſown when gathered, like other ſeeds, they would not come up the firſt year, nor grow ſo kindly.

ORCHARDS are ſtocked by tranſplantation; ſeldom by ſemination.

The ſeaſon for tranſplanting apple-trees into *orchards*, is in the months of *October* and *November*.

If the leaves be not all off at the time they are removed, they muſt be pulled off. They are likewiſe to be pruned. Trees may be tranſplanted into *orchards*, after three years grafting; and ought not to be ſet at a leſs diſtance than eight yards, nor greater than fourteen: and the richer the land, the greater the diſtance.

The trees are tranſplanted to beſt purpoſe, when young: for trees ten or twelve years old, a narrow trench muſt be dug the *November* before, deep enough to meet the ſpreading roots, at ſuch a diſtance all around the tree, as the roots are to be cut off at; in making the trench, the roots to be cut off clean, and without ſplitting or bruiſing the bark, and the trench filled up again. This will enable the tree, upon removal, to draw more nouriſhment than otherwiſe it would; and ſo thrive better in its new manſion.

The ſide branches of all tall *orchard* fruit-trees, are to be cut off, till the tree be arrived at the height deſired.

If the tree be to ſpread low, ſome are to be left on each ſide; ſo as to form a kind of ballance. For the firſt three years, at leaſt, they muſt not grow thick and buſhy headed: this muſt be prevented by cutting off ſome of the inſide ſhoots, and ſuch as grow croſs each other, or pendant.

The ſoil, if not rich enough, is to be amended in two or three years; by opening it around the tree, and on the outſide of the ground firſt dug, when the tree was ſet; and in a month's time filling it up again with a proper compoſt or manure.

TRANSPLANTING of fruit-trees. —— After a ſummer's growth of fruit ſeedlings in the ſeminary, ſuch are pulled up as are above a foot high, and tranſplanted into a nurſery; the reſt to be left in the ſeed-plot till another year.

When drawn up, the ſprigs are to be cut off from about the top, the ſtrings from the roots, and the extremities both of the top, that it may not run too faſt upwards, and of the tap or heart-root, that it may not paſs directly downwards; leſt it go beyond the good ſoil. The holes or pits to be ſo deep, as that the plants may ſtand ſomewhat deeper in the ground, than when in the ſeed-plot; cloſe the mould about them, and if it be a dry time, water them the firſt day, and cover the ſoil with old fern.

Mr. *Bradley* gives us a new method of *tranſplanting* trees of all kinds and ages with ſafety, either while they are in the bloſſom, or with fruit upon them, thus: the holes to receive the trees are to be prepared before the trees are taken up, and the earth which comes out of the holes to be made very fine and put into large tubs, and mixed with water, till it be about the conſiſtence of thin batter. Then the holes wherein the trees are to be planted, are to be filled with this thus-tempered earth, before the earthy parts have time to ſettle.

The advantage hereof is, that the trees thus planted have their roots immediately incloſed and guarded from the air; and the warm ſeaſon of the year diſpoſing every part of the tree for growth and ſhooting, it will loſe very little of its vigour. In winter it does not ſucceed.

The ſame author adds, that in conſideration of the circulation of the ſap, it is as neceſſary to preſerve the veſſels of the trees entire, as thoſe in animal bodies, and therefore in *tranſplanting* trees in the ſummer ſeaſons, it is not proper to cut off any of the branches, or wound any of the veſſels, till they have renewed their roots, which it is of abſolute neceſſity to wound in *tranſplanting* them. For the wounded roots he has provided a plaiſter of a mixture of gums, to prevent the canker and rot, and promote their healing.

PRUNING in *gardening* and *agriculture*, is the operation of lopping or cutting off the ſuperfluous branches of trees; either to diſpoſe them to bear better, to grow higher, or appear more regular.

Pruning is one of the moſt important branches of the gardener's province; and that whereon the weal or woe of his fruit-trees, as well as the form and regularity of his garden, in great meaſure depends.

Pruning is an annual operation; the amputation is uſually made ſloping, ſometimes ſtump-wiſe. Its beſt ſeaſon is about the end of *February*, though it may be begun as ſoon as the leaves are off, *viz.* in *November*; and continued to the time freſh leaves comes on, *viz.* in *April*.

As the *Gardener* has uſually three kinds of trees to manage, *viz.* Some too weak, others too ſtrong, and others in a juſt plight; he will find *pruning-work* enough through all that ſpace; it being proper to prune ſome ſooner and ſome later. The weaker and more languiſhing a tree is, the ſooner it ought to be *pruned*, to eaſe it of its offenſive branches: and the more vigorous the tree is, the longer may the *pruning* be deferred.

For Pruning *a tree of the firſt year*, *i. e.* a tree planted the year before: if it have only ſhot one fine branch from the middle of the ſtem, it muſt be cut to that branch, and the branch ſhortened to four or five eyes or buds: the effect of which is, that the next year there will be, at leaſt, two fine branches oppoſite to each other.

If the tree produce two fine branches, well placed, with weak ones among them, all required is to ſhorten them equally, to the compaſs of five or ſix inches in length; care, however, being taken, that the two laſt eyes or buds, of the extremes of the branches thus ſhortened, look on the right and left, to the two bare ſides, that each may bring forth, at leaſt, two new ones, and the four being ſo well placed, that they may be all preſerved. If one of the two branches be much lower than the other, or both on one ſide, or the like, only one is to be preſerved, and that the fitteſt to begin a fine figure; the other to be cut off ſo cloſe, as that it never may be able to produce thick ones in the ſame place. If a tree have put forth three or four branches, all in the extremity, or a little beneath, they muſt be all pruned by the ſame laws as the two above-mentioned: if they be equally thick they are to be uſed alike; if ſome of them be ſmaller than the reſt, they muſt only be *pruned*, with a proſpect of getting a ſingle branch each, taking care to have it on that ſide which ſhall be found empty; in order to which, they ſhould be ſhortened to an eye or bud, that looks on that ſide; and the ſame care to be taken in the larger, in order to begin to fill up the better: if theſe fine branches ſhoot a little below the extremity, it is but ſhortening the ſtem to them: on the contrary, if the branches be moſt of them ill ones, two at leaſt, if poſſible, are to be preſerved, and *pruned* in the ſame manner as the two fine ones above. Good weak branches are to be carefully preſerved for fruit, only cutting them a little at the extremity, when they appear too weak for their length, not failing to take away all the ſapleſs branches. If the tree have produced five, ſix, or ſeven branches, it is ſufficient to preſerve three or four of the beſt; the reſt to be cut quite off, at leaſt if they be thick; but if they be weak, *i. e.* fit for fruit branches, they ſhould be kept till they have performed what they are capable of doing; and if among the great ones, there happen to be many ſmall ones, two or three of the beſt only to be preſerved, pinching off the ends of the longeſt.

Pruning *of a tree the ſecond year.*—If having put out two fine wood branches, and one or two ſmall ones, for fruit the firſt year, the ſap have altered its courſe in the ſecond year, from the thick branches to the ſmall ones, ſo that the ſmall become wood, and the large, fruit branches. If a tree from the firſt year's *pruning*, have produced four or five branches, or more, it muſt needs be very vigorous: for which reaſon it may be ſometimes adviſeable to preſerve thoſe branches; even though it be not neceſſary to the figure of the tree, but even to conſume part of the ſap, which might otherwiſe be prejudicial to the fruit branches; theſe ſuperfluous branches may be left long, without any ill conſequence; but thoſe eſſential to the beauty of the tree, muſt be all *pruned*, a little longer than thoſe of the preceding year, *i. e.* about two, or at moſt, three eyes, or a good foot. This is making an advantage of the figure of the tree, which without this would not yield fruit in a long time; the redundant ſap converting all the ſap in wood-branches. In theſe vigorous trees, ſome branches cut ſtumpwiſe are to be left on, and even ſome thick ones, though of falſe wood, eſpecially where they are neceſſary to the form of the tree, or employ the exceſs of ſap, and prevent its doing miſchief. Still more to aſſuage its violence, it may be neceſſary to preſerve many long, good, weak branches, when placed ſo as to occaſion no confuſion, and even on the thick branches, a good number of out-lets for the ſap to range in. Be it a general rule, rather to ſpare the lower branches, and cut off the higher, than the contrary: by this means the tree ſpreads more eaſily to the bottom of the wall.

Pruning *of a tree of the third year.* In a tree that has been planted three years, and *pruned* twice, if it be vigorous, as many old branches as poſſible, are to be preſerved, eſpecially for fruit: if it be weak, it muſt be eaſed of the burden of old branches, as well thoſe for fruit, as wood; it muſt be cut ſhort, to enable it to ſhoot out new ones; which if it cannot do with vigour, let it be pulled up, and a new one, with freſh earth, planted in its place.

In all *pruning*, proviſion is to be made for branches to proceed from thoſe now under the *pruning knife*, to prepare ſuch as may be proper for the form; with this aſſurance, that when the high branch is taken down from over the lower, this latter being reinforced with the ſap that would have gone to the former, will certainly produce more branches, than it would have done without ſuch reinforcement.

General rules of Pruning *fruit trees*, 1. The more the branches ſhoot horizontally, the apter and better diſpoſed the tree is to bear fruit; conſequently

ſequently the more upright the branches, the more inclined is the tree to increaſe in wood, and the leſs in fruit.

Hence, ever take care to keep the middle of a tree from great wood, or thick branches; and as thoſe increaſe and grow upon you, you cut them out entirely; for the place will be ſoon filled with better and more fruitful wood.

In dwarfs, you are to prune all open, and clear of wood, leaving none but horizontal branches; and in wall trees, if you do but furniſh your walls with horizontal branches, nature will provide for the middle. Chuſe therefore ſuch ſhoots as are not vigorous, to furniſh bearing branches.

2. Take care the tree be not left over full of wood; nor even of bearing branches; as it is frequently ſeen in the management of peaches, nectarines, and cherries.

Nature cannot ſupply them all with juice enough; whence none will be ſupplied well: the conſequence of which is, that either the bloſſoms will fall off, or the fruit dwindle. It is certain, a multitude of branches crouding on one another, produces neither ſo good, nor ſo much fruit, as where there is a convenient ſpace; beſide the diſagreeable effect of croſſing one another.

3. All ſtrong and vigorous branches are to be left longer on the ſame tree, than weak and feeble ones; conſequently, the branches of a ſickly tree, muſt be *pruned* ſhorter, and fewer in number than thoſe of a ſtrong healthful tree.

4. All branches ſhooting directly forward from trees that grow againſt a wall, are to be *pruned* cloſe to the branch whence they ſpring, *&c.*

5. When a branch, well placed either againſt a wall, or in a dwarf, has ſhot ſome falſe wood, neither fit for the figure nor the fruit, prune it off within the thickneſs of a crown piece, or ſlopingly; though this is beſt *pinched* off in the beginning of ſummer.

6. Cut off all branches ariſing from hard knobs whereon pear-ſtalks grew; or from ſhort branches, like ſpurs.

7. If a tree, in its years, have produced branches of moderate vigour, and afterwards puts forth ſtrong ones, well placed, though of falſe wood; the latter may be uſed as the foundation of the figure, and the other kept a time for bearing fruit.

8. When an old tree ſhoots ſtronger branches towards the bottom than the top, and the top is in ill caſe, cut it off, and form a new figure from the lower ones. If the top be vigorous, cut off the lower ones, unleſs well placed.

9. The order of nature, in the production of roots and branches, is, that branch is always leſs than that out of which it ſhoots: if this order be inverted, uſe them as falſe wood.

10. Regard to be always had to the effects of former *pruning*, in order to correct its defects, or continue its beauties.

11. In vigorous trees, the weaker branches are the fruit bearers; in weaker trees, the ſtronger chiefly: therefore in the latter, *prune* off the feeble and ſmall.

12. In vigorous trees, three good branches may put forth at one eye or bud; in which caſe, the two ſide branches are generally to be preſerved, and the middlemoſt cut off in *May* or *June*.

13. It is difficult to ſtrengthen a weak branch, without cutting off others above it; ſometimes it can ſcarce be done, without cutting off the end of the branch it ſhoots out of.

14. The *pruning* of vigorous peach trees, to be deferred till they are ready to bloſſom, the better to know which are likely to bear fruit.

15. Fruit-buds, next the ends of branches, are commonly thick and better fed than others. In weak trees, therefore, it may be beſt to *prune* them early, that the ſap may not waſte itſelf in ſuch parts as are to be retrenched.

16. The farther a weak branch is from the trunk, the leſs nouriſhment it receives, and therefore, the more it is to be ſhortened; but thick branches, the more diſtant they are from the heart, the more they receive; and are therefore to be removed, that the vigour may extend itſelf to the middle, or lower part.

17. A branch for wood muſt never be *pruned*, without eſpecial occaſion; as where it annoys others.

18. If an old well-liking tree be diſordered with falſe wood, through ill *pruning*, or want of *pruning*; take it lower, by cutting off a branch or two yearly, till it be ſufficiently reduced. Some trees put forth ſo vigorouſly, that they cannot be reduced to compaſs, in one year; but muſt be allowed to extend themſelves, otherwiſe they will produce falſe wood.

19. All trees have a predominant branch or two, if not more; yet the more equally the vigour is divided, the better; where it runs much on one ſide, it is faulty.

20. The buds of all ſtone-fruit, frequently form themſelves the ſame year, in which the branch they grow on was formed: the ſame holds of pears and apples; tho' it is, generally, at leaſt two or three years, ere the latter come to perfection.

21. All ſhoots, put forth in autumn, are to be *pruned* off as naught: the ſame may be ſaid of all ſapleſs branches.

22. When a tree puts forth much ſtronger ſhoots on one ſide, than the other, a great part of the ſtrong ones muſt be cut off cloſe to the body, or ſome of them ſtump-wiſe.

23. In all trees, leſs length to be allowed the weak, than ſtrong branches.

24. Upper branches to be cut off cloſe to others, that they may heal over: lower branches are to be cut ſloping, or at a little diſtance, that new ones may grow out of them.

25. If a young crooked tree produce a fine branch beneath the crook, cut the head off cloſe to the branch.

26. Though five, ſix, or ſeven inches, be the ordinary lengths, wood-branches are left at; yet muſt this be varied on occaſion of the vigour or weakneſs of the tree, thickneſs, or ſmallneſs of the branch, the fulneſs or vacuity of the place, *&c.*

27. Be careful not to *prune* many thick branches ſtanding over weak ones; leſt the ſap, which fed the larger, flow ſo plentifully into the leſs, as to occaſion them to put forth ill wood and ſuckers.

28. Branches ſhot from the ends of others are uſually good wood; ſometimes it happens otherwiſe, and then they muſt be *pruned.*

As to the grand *yearly prunings*:—Fruit branches being of ſhort continuance, and periſhing the firſt year, wherein they produce fruit, are to be cut off, unleſs they put ſorth ſhoots, for bloſſoms the ſucceeding year. In the ſecond *pruning*, about the middle of *May*, where the fruit is ſo cloſe as to be like to obſtruct each other, ſome of them, and their branches are to be taken off, as muſt alſo the multitude of young ſhoots, that cauſe confuſion. Branches more luxurious than others, to be cut clear off.

To preſerve old trees, they muſt be diſburdened, by leaving few branches, for wood on them, and thoſe to be ſhortened to five or ſix inches; and very few weak ones, and none dry, and nigh waſted.

G A U G I N G.

GAUGING is the art or act of meaſuring the capacities or contents of all kinds of veſſels, and determining the quantities of fluids or other matters contained therein.

The art of *gauging* is that branch of the *mathematics* called *ſtereometry*, or the meaſuring of ſolids; becauſe the capacity of all ſorts of veſſels uſed for liquors, as *cubical*, *parallelopipedal*, *cylindrical*, *ſpheroidal*, *conical*, &c. are computed as though they were really ſolid bodies, and reduced thereby to ſome known cubic meaſure, as *gallons*, *quarts*, *pints*, &c. The principal veſſels that come under its operation are *pipes*, *barrels*, *rundlets*, and other *caſks*; alſo *backs*, *coolers*, *vats*, &c.

The ſolid content of cubical, parallelopipedal, and priſmatical veſſels is eaſily found in cubic inches, or the like, by multiplying the area of the baſe by the perpendicular height. And for cylindrical veſſels, the ſame is found by multiplying the area of the baſe by the perpendicular altitude as before.

Caſks of the uſual form of hogſheads, kilderkins, *&c.* may be conſidered as ſegments of a ſpheroid cut off by two planes. perpendicular to the axis; which brings them to *Oughtred*'s theorem for meaſuring ale and wine-caſks, which is thus:

Add twice the area of the circle at the bung, to the area of the circle of the head, multiply the ſum by one third of the length of the caſk, the product is the content of the veſſel in cubic inches.

But for accuracy, Dr. *Wallis*, Mr. *Caſwell*, and others. think that moſt of our caſks had better be conſidered as *fruſtums* of parabolic ſpindles, which are leſs than the *fruſtums* of ſpheroids of the ſame baſe and height, and give the capacity of veſſels nearer the truth than either *Oughtred*'s method, which ſuppoſes them ſpheroids; or than that of multiplying the circles of the bung and head, into half the length of the caſk, which ſuppoſes them parabolic conoids; or than that of *Clavius*, &c. who takes them for two truncated cones, which is fartheſt off of all.

The common rule for all wine or ale-caſks, is to take the diameters at the bung and at the head, by which you may find the area of the circle there; then taking two thirds of the area of the circle at the bung, and one third of the area of the circle at the head, and adding them together into one ſum; this ſum multiplied by the internal length of the caſk, gives the content in ſolid inches; which are converted into gallons by dividing by 282 for ale, and 231 for wine-gallons.

Gauging, as now practiſed, is chiefly done by means of *inſtruments* called *gauging-rods* or *rules*, which do the buſineſs at once, and anſwers the queſtion without ſo much calculation: which is no inconſiderable addition both to the eaſe and diſpatch of the work, though it is not ſo much to be depended on.

The methods of *gauging* which are moſtly uſed, is by the *four-foot gauging-rod*, and *Everard's ſliding rule*: the deſcription and uſes of both are as follows:

The four-foot Gauging-rod (See the figure on the plate of Surveying) is uſually made of box, and conſiſts of four rules, each a foot long, and about

about three eights of an inch ſquare, joined together by three braſs-joints; by which means the rod is rendered four feet long when the four rules are opened, and but one foot when all are folded together.

On the firſt face of this rod, marked 4, are placed two diagonal lines, one for beer and the other for wine; by means of which the content of any common veſſel in beer or wine-gallons, may be readily found, by putting the braſed end of the gauging-rod into the bung-hole of the caſk, with the diagonal lines upwards, and thruſt this braſed end to the meeting of the head and ſtaves; then with chalk make a mark at the middle of the bung-hole of the veſſel, and alſo on the diagonal lines of the rod, right againſt or over one another, when the braſed end is thruſt home to the head and ſtaves; then turn the gauging-rod to the other end of the veſſel, and thruſt the braſed end home to the end as before. Laſtly, ſee if the mark made on the gauging-rod, come even with the mark made on the bung-hole, when the rod was thruſt to the other end; which if it be, the mark made on the diagonal lines, will, on the ſame lines, ſhew the whole content of the caſk in beer or wine-gallons. If the mark made on the bung hole be not right againſt that made on the rod, when you put it the other way, then right againſt the mark made on the bung-hole, make another on the diagonal lines; and the diviſion on the diagonal line, between the two chalks, will ſhew the whole content of the veſſel in beer or wine-gallons.

Thus, *ex. gr*, if the diagonal line of a veſſel be 28 $\frac{4}{10}$ inches, its content in beer-gallons will be nearly 51, and in wine gallons 62.

If a veſſel be open, as a half barrel, tun, or copper, and the meaſure from the middle on one ſide to the head and ſtaves be 38 inches, the diagonal line gives 122 beer-gallons; half of which, *viz.* 61, is the content of the half-tub.

If you have a large veſſel, as a tun or copper, and the diagonal line taken by a long rule be 70 inches; then every inch at the beginning-end of the diagonal line call 10 inches: thus 10 inches become 100 inches; and every tenth of a gallon call 100 gallons; and every whole gallon call 1000 gallons.

On the ſecond face, 5, are a line of inches and the gauge line, which is a line expreſſing the areas of circles (whoſe diameters are the correſpondent inches) in ale-gallons: at the beginning is wrote *ale-area.* Thus, to find the content of any cylindrical veſſel in ale-gallons: ſeek the diameter of the veſſel in inches, and juſt againſt it, on the gauge-line, is the quantity of ale-gallons contained at one inch deep; this multiplied by the length of the cylinder, will give its contents in ale-gallons.

On the third face, 6, are three ſcales of lines; the firſt, at the end of which is written *hogſhead*, is for finding how many gallons there are in a hogſhead, when it is not full, lying with its axis parallel to the horizon. The ſecond line, at the end of which is written *B. L.* is for the ſame purpoſe. The third is to find how much liquor is wanting to fill up a butt, when it is ſtanding; at the end of it is wrote *B. S.* ſignifying, *butt ſtanding*.

Half way the fourth face of the gauging-rod, 7, there are three ſcales of lines, to find the wants in a firkin, kilderkin, and barrel, lying with their areas parallel to the horizon. They are diſtinguiſhed by the letters *F. K. B.* ſignifying a firkin, kilderkin, and barrel.

The uſe of the lines on the two laſt faces is very eaſy; you have only to put it downright into the bung-hole to the oppoſite ſtaves, if the veſſel, you want to know the quantity of ale-gallons contained therein, be lying: and then where the ſurface of the liquor cuts any one of the lines appropriated to that veſſel, will be the number required.

EVERARD's *ſliding-rule* is principally uſed in gauging, being ordinarily made of box, a foot long, an inch broad, and 1 $\frac{6}{10}$ inch thick, with two ſmall ſcales to ſlide in it, which may be drawn out, one towards the right hand, and the other towards the left, till the whole be three feet long. See the figure thereof, *ibid.*

On the firſt broad face of the inſtrument are four lines of numbers; the firſt marked A, conſiſting of two radius's, numbered 1, 2, 3, 4, 5, 6, 7, 8, 9, 10; and then 2, 3, 4, 5, &c. to 10. On this line are four braſs center-pins, two in each radius; one in each whereof is marked M B, to ſignify that the number it is ſet againſt, 2150.42, is the cubic inches in a malt buſhel; the other two are marked with A, to ſignify that the numbers they are ſet againſt, *viz.* 282, are the cubic inches in an ale-gallon. The ſecond and third lines of numbers are on the ſliding pieces, and are exactly the ſame with the firſt. Cloſe to the figure 7, in the firſt radius, is a dot marked S *i*, ſet exactly over 707, denoting .707 to be the ſide of a ſquare inſcribed in a circle, whoſe diameter is unity. Cloſe to 9, is another dot, mark'd S *e*. ſet over .886, which is the ſide of a ſquare, equal to the area of a circle whoſe diameter is unity. Another dot, nigh W, is ſet over 231, the number of cubic inches in a wine gallon, and another near C, is ſet over 3.14, the circumference of a circle, whoſe diameter is unity. The fourth line of numbers marked M D, to ſignify *malt depth*, is a broken line

line of two radius's, numbered 2, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 9, 8, 7, *&c.* the number 1 being directly set against M B on the first radius.

On the second broad face, marked *c d*, are, 1. A line of numbers of one radius, numbered 1, 2, 3, *&c.* to 10, noted by the Letter D, on this are four center pins; the first marked W G, is the *gauge-point* for a wine-gallon, *i. e.* the diameter of a cylinder, whose height is an inch, and contents 231 cubic inches, or a wine-gallon, which is 17.15 inches; the second center-pin A G, stands at the *gauge-point* for an ale gallon, which is 18.95 inches; the third M S, stands at 46.3, the side of a square, whose content is equal to the inches in a solid bushel; the fourth M R, is the *gauging-point* for a malt bushel, which is 52.32 inches. —2. Two lines of numbers on the sliding piece, which are exactly as those on the sliding piece on the other side. Close to the division 8 is a dot marked *c*, which is set to .795, the area of a circle whose diameter is unity; and another marked *d*, stands at .785, the area of a circle whose diameter is unity. — 3. Two lines of segments, each numbered 1, 2, 3, *&c.* to 100; the first for finding the ullage of a cask, taken as the middle frustum of a spheroid, lying with its axis parallel to the horizon; and the other for finding the ullage of a cask standing.—Again, on one of the narrow sides, noted *e*, are 1. A line of inches, numbered 1, 2, 3, *&c.* to 12; each subdivided into ten equal parts. 2. A line by which, with that of inches, we find a mean diameter for a cask, in the figure of a middle frustum of a spheroid; it is numbered 1, 2, 3, *&c.* to 7, and marked *spheroid.* 3. A line for finding the mean diameter of a cask, in the figure of a middle frustum of a parabolic spindle, which *gaugers* call the second variety of casks; it is numbered 1, 2, 3, 4, *&c.* and noted *second variety.* 4. A line by which we find the mean diameter of a cask of the third variety, *i. e.* of a cask in the figure of two parabolic conoids, abutting on a common base; it is numbered 1, 2, 3, and noted *third variety.*—On the other narrow face, marked *f*, are, 1. A foot divided into 100 equal parts, marked *f* M. 2. A line of inches, like that before-mentioned, noted IM. 3 A line for finding the mean diameter for the fourth variety of casks, which is the middle frustum of two cones, abutting on a common base; it is numbered 1, 2, 3, *&c.* and noted *f* C, signifying *frustum of a cone.*—On the backside of the two *sliding* pieces, are a line of inches, from 13 to 36, when the two pieces are put endwise; and against that the correspondent gallons, or hundred parts, that any small tub, as the like open vessel from 13 to 36 inches diameter, will contain at one inch deep.

After this description of *Everard's sliding rule*, we must apply it to the use we intend to make of it in this place, *viz. gauging.* Beginning, by finding the area in inches, or in wine, or ale-gallons, of the diameter of a circle given; and supposing that diameter 20 inches, we will set 1 upon D, to .785 (noted *d)* on C, then against 20 on D is 314.159 the area required. Now to find that circle's area in ale-gallons, we will set 18.95 (marked A G) upon D, to 1 on C; then against the diameter 20 upon D, is the number of ale gallons on C, *viz.* 1.11. The same may serve for wine-gallons, having only regard to the proper *gauge-point.*

The two diameters of an ellipsis being given, to find the area in ale-gallons. Suppose the transverse diameter 72 inches, and the conjugate 50; we will set 359.05, the square of the *gauge point* on B, to one of the diameters (suppose 50) on A; then against the other diameter 72 on B, we will have the area on A, *viz.* 10.02 gallons, the content of this ellipsis at one inch deep: the like may be done for wine-gallons, if instead of 359.05 we use 249.11 the square of the *gauge-point* for wine-gallons.

To find the area of a *triangular surface*, in ale-gallons: suppose the base of the triangle 260 inches, and the perpendicular let fall from the opposite angle 110 inches; we will set 282 (marked A) upon B to 130, half the base on A; then against 110 on B is 50.7 gallons on A.

To find the content of an *oblong* in ale-gallons: suppose one side 130 inches, and the other 180; we will set 282 on B, to 180 on A; then against 130 upon B in 82.97 ale-gallons, the area required.

To find the content of a *regular polygon*, in ale-gallons, one of the sides being given: we find the length of the perpendicular let fall from the center to one of the sides; this multiplied by half the sum of the sides, gives the area. For instance: suppose a pentagon, whose side is 1 inch; here the perpendicular will be found .837, by saying as the sine of half the angle at the center, which in this polygon is 36°, is to half the given side .5, so is the sine of the complement of 36°, *viz.* 54° to the perpendicular aforesaid: whence the area of a pentagon, whose side is unity, will be found 1.72 inches; which divided by 282, give .0061 the ale-gallons in that polygon.

To find the content of a cylinder in ale-gallons: suppose the diameter of the base of the cylinder 120 inches, the perpendicular height 36 inches; we will set, therefore, the *gauging-point* (A G) to the height 36 on C; then against 120, the diameter on D, is found 1443.6, the content in ale-gallons.

The

The bung and head diameters of any caſk, together with its length, being given; to find its content in ale or wine-gallons: 1. Suppoſe the length of a caſk taken (as the middle fruſtum of a ſpheroid, which is the firſt caſe or variety) be 40 inches, its head-diamer 24 inches, and bung-diameter 32 inches; we will ſubtract the head-diameter from that of the bung, the difference is 8. Then we look for 8 inches on the line of inches, on the firſt narrow face of the rule; and againſt it, on the line ſpheroid, ſtands 56 inches, which added to the head-diameter 24, gives 29.6 inches for that caſk's mean diameter; we ſet therefore the *gauge-point* for ale (marked A G) on D, to 40 on C; and againſt 29.6 on D, is 97.45, the content of the caſk in ale-gallons. If the *gauge-point* for wine (marked W G) be uſed inſtead of that for ale, we will have the veſſel's content in wine-gallons. 2. If a caſk of the ſame dimenſions as the former be taken (as the middle fruſtum of a parabolic ſpindle, which is the ſecond variety) we will ſee what inches, and parts, on the line marked *ſecond variety*, ſtand againſt the difference of the bung and head-diameters, which in this example is 8; and we will find 5.1 inches, which added to 24, the head diameter, makes 29.1 inches, the mean diameter of the caſk, we will therefore ſet the rule as before, and againſt 29.1 inches, we will have 94.12 ale-gallons for the content of the caſk. 3. If the caſk taken be the middle fruſtum of two parabolic conoids, which is the *third variety*; againſt 8 inches, the difference of the head and bung-diameter, on the line of inches, we will find 4.57 inches on the line called *third variety*; this added, as before, to 24, gives 28.57 for the caſk's mean diameter: proceeding as before, we will find the content 90.8 gallons. 4. If the caſk taken be the fruſtums of two cones, which is the *fourth variety*, againſt 8 inches, on the line of inches, we will find on the line marked *f* C 4.1 inches, to be added to 24 inches: the reſt carried on as before, gives the content of the caſk 87.93 ale-gallons.

A caſk partly empty, lying with its axis parallel to the horizon, to find the quantity of liquor therein, we find its whole content as above; which ſuppoſe 97.455 gallons, and ſuppoſe the inches left dry 8, and the bung-diameter 32: then as the bung-diameter on C is to 100 on the line of ſegments L, ſo are the dry inches on C to a fourth number on the line of ſegments: and as 100 upon B is to the caſk's whole content on A, ſo is that fourth number to the liquor wanting to fill up the caſk; which ſubtracted from the whole content of the caſk, gives the liquor remaining therein. *ex. gr.* Set 32, the bung-diameter on C, to 100 on the ſegment line L; then againſt 8, the dry inches on C, ſtands 17.6 on the ſegment line: ſet therefore 100 on B, to the caſk's whole content on A; and againſt 17.6 on B, you have 16.5 gallons on A; ſubtracting therefore the ſaid gallons from 97.45, the veſſel's whole content, the liquor in the caſk will be 8.95 gallons.

To find the liquor in a caſk ſtanding upright, or with its axis perpendicular to the horizon; ſuppoſe the length of the caſk 40 inches, and 10 of them dry; we will ſet 40 inches on the line C, to 100 on the ſegment line S; and againſt 10, the dry inches on the line C, ſtand 24.2 on S, the ſegment line. Then we ſet 100 on B, to 97.455, the caſk's whole content on A; againſt 24.2 on B, we will have 23.5 gallons, which is what is wanting to fill up the caſk; this therefore ſubtracted from the whole content 97.455 gives 73.955 gallons, for the quantity of liquor remaining in the caſk.

GEOGRAPHY.

THE ſcience of GEOGRAPHY (from γῆ, *earth*, and γράφω, *I write*) chiefly conſiſts in a deſcription of the ſurface of the *terreſtrial* or *terraqueous globe*; ſo called, becauſe it is compoſed of *land* and *water*: ſo that it differs from *chorography* and *topography*, as the whole from a part; and from *coſmography*, as a part from the whole.

COSMOGRAPHY deſcribes the whole viſible world, both the heavens and the earth.

CHOROGRAPHY deſcribes ſome principal part of the earth, as *England*, *France*, &c.

TOPOGRAPHY only deſcribes ſome particular diſtrict, city, *&c.* in that principal part.

The beſt *Geographers* divide GEOGRAPHY into *general* and *ſpecial*, or *univerſal* and *particular*.

By *univerſal geography* is underſtood that part of the ſcience which conſiders the whole earth in general, and explains its properties without regard to particular countries. This diviſion is diſtinguiſhed into three parts, *abſolute*, *relative*, and *comparative*. The *abſolute* part reſpects the body of the earth itſelf, its parts and peculiar properties, as its *figure*, *magnitude*, and *motion*; its *lands*, *ſeas*, and *rivers*, &c. The *relative* part accounts for the appearances and accidents that happen to it from celeſtial cauſes; and, laſtly, the *comparative* contains an explanation of thoſe properties which ariſe from comparing different parts of the earth together.

Special

Special or *particular geography*, is that division of the science which describes the constitution and situation of each single country by itself; and is twofold, *viz. chorographical* or *topographical*.

Hence the object or subject of *geography* is the *earth*, especially its superficies and exterior parts.

The properties of *geography*, are of three kinds, *viz. celestial*, *terrestrial*, and *human*. The *celestial* properties are such as affect us by reason of the apparent motion of the sun and stars. These are eight in number. 1. The elevation of the pole, or the distance of a place from the equator. 2. The obliquity of the diurnal motion of the stars above the horizon of the place. 3. The time of the longest and shortest day. 4. The climate and zone. 5. Heat, cold, and the seasons of the year; with rain, snow, wind, and other meteors. 6. The rising, appearance and continuance of the stars above the horizon. 7. The stars that pass through the zenith of a place. 8. The celerity of the motion with which, according to the *Copernican* hypothesis, every place constantly revolves.

The *terrestrial* properties are those observed in the face of each country, and are ten in number. 1. The limits and bounds of each country. 2. Its figure. 3 Its magnitude. 4. Its mountains. 5. Its waters, *viz.* springs, rivers, lakes, and bays. 6. Its woods and desarts. 7. The fruitfulness and barrenness of the country, with its various kinds of fruits. 8. The minerals and fossils. 9. The living creatures there. 10. The longitude and latitude of the place.

The third kind of observations to be made in every country is called *human*; because they chiefly regard the inhabitants of the place, and these are also ten in number. 1. Their stature, shape, colour, and the length of their lives; their origin, meat, and drink. 2. Their arts, and the profits which arise from them, with the merchandize and wares they barter one with another. 3. Their virtues and vices, learning, capacities, and schools. 4. Their ceremonies at births, marriages and funerals. 5. The language which the inhabitants use. 6. Their political government. 7. Their religion and church government. 8. Their cities and famous places. 9. Their remarkable histories. 10. Their famous men, artificers, and inventions of the natives.

These are the three kinds of occurrences to be explained in *special geography*.

In *Universal Geography*, the absolute division of the earth, and the constitution of its parts, are examined; and the celestial phænomena in general are to be applied to their respective countries in *special geography*.

Geography is very antient, at least the *special* part thereof; for the antients scarce went beyond the description of countries. It was a constant custom among the *Romans*, after they had conquered and subdued any province, to have a map or printed representation thereof, carried in triumph, and exposed to the view of the spectators. Historians relate, that the *Roman* senate, about an hundred years before Christ sent *geographers* into divers parts to make an accurate survey and mensuration of the whole globe, but they scarce ever saw the twentieth part of it.

Before them, *Neco* king of *Egypt*, ordered the *Phœnicians* to make a survey of the whole coast of *Africa*, which they accomplished in three years. *Darius* procured the *Ethiopic* sea, and the mouth of the *Indus* to be surveyed; and *Pliny* relates, that *Alexander*, in his expedition into *Asia*, took two *geographers* to measure and describe the roads; and that from their *itineraries*, the writers of the following ages took many particulars. Indeed this may be observed, that whereas most other arts and sciences are sufferers by war, *geography* and *fortification* alone have been improved thereby.

Geography, however, must have been exceedingly defective, as a great part of the globe was then unknown, particularly all *America*, the northern parts of *Europe* and *Asia*, with the *Terra Australis*, and *Magellanica*; and as they were ignorant of the earth's being capable to be sailed round, and of the torrid zone's being habitable, &c.

The honour of reducing *geography* to art and system was reserved for *Ptolemy*, who, by adding mathematical advantages to the historical method in which it had been treated off before, has described the world in a much more intelligible manner: he has delineated it under more certain rules, and by fixing the bounds of places from longitude and latitude, hath discovered others mistakes, and has left us a method of discovering his own.

We will begin with *general* or *Universal Geography*.

This division of the science considers the earth as a *spherical globe*, or nearly so; whose circumference is 360 degrees, of 60 geographical miles each; so that the whole circuit is 21600 such miles, and if the diameter was a third part of the circumference, the diameter would be 7200 miles; but the diameter is as 7 to 22, which makes it something less than a third part of the circumference. If we reduce the geographical miles to *English* miles the circumference of the earth will be about 24,000 miles, and the diameter 8000.

This globe rests upon nothing, but appears equally surrounded by the heavens on every side, for

for the better underſtanding whereof, it will be neceſſary to obſerve the ſeveral imaginary circles deſcribed on the artificial globe, *viz.* 1. The equator and the circles parallel to it. 2. The firſt meridian, and the reſt of the meridional lines. 3. The zodiac, which includes the ecliptic. 4. The horizon 5. The two tropics. 6. The arctic and antarctic circles. It is ſuppoſed alſo, that a line paſſes through the center of the globe, called its axis. round which it moves every 24 hours, the ends of which axis are called the poles of the earth; that in the north called the *arctic* or north pole, from a ſtar in the heavens oppoſite to it, which forms part of the conſtellation called the *little bear*, and that in the ſouth called the *antarctic* or ſouth pole, as diametrically oppoſite to the other.

By the *equator* the globe is divided into two equal parts or hemiſpheres, and on this circle are marked the degrees of longitude, from the firſt meridian, either eaſt or weſt. The *parallel circles* are ſo called from their running parallel to the *equator*, of which there are *nine* in number incluſive, between the equator and either pole, ten degrees diſtant from each other, every degree of latitude being 60 geographical miles, and every ten degrees 600 ſuch miles. Conſequently it is 5400 miles from the equator to either pole, which is one quarter of the circumference of the globe.

The *firſt meridian* is repreſented by the brazen circle in which the globe moves, dividing it into the eaſtern and weſtern hemiſpheres, on which circle are marked the degrees of latitude, which are counted northward from the equator to the north pole, and ſouthward from the equator to the ſouth pole.

Where the meridional lines are 24 in number, they are 15 degrees, or one hour aſunder; thoſe who live under the meridian line on the right hand, that is, to the eaſtward of the firſt meridian, have the ſun one hour before us; and thoſe who live under the meridional line on the left hand, that is, weſt of us, have the ſun an hour after us; and this ſhews what is meant by the eaſtern and weſtern longitude. And as *longitude* is nothing more than the diſtance any place is eaſt or weſt of the firſt *meridian*, ſo latitude is the diſtance a place is from the *equator*, north or ſouth. If it be north of the *equator*, it is called *north latitude*; and if it be ſouth of the *equator*, it is called *ſouth latitude*.

The *firſt meridian* in the old *maps* was placed either at *Teneriff*, one of the *Canary* iſles, 17 degrees weſt of *London*, or at *Ferro*, another of the *Canary* iſles, 19 degrees weſt of *London*. But, every nation almoſt at this day places the *firſt meridian* at their reſpective *capital cities* in their ſeveral maps. In *Moll*'s maps, *London* is made the firſt meridian at one end of the map, and *Ferro* at the other; *Ferro* being 19 degrees weſt of *London*. And in theſe maps the upper end is always the north, the lower end the ſouth; the right hand eaſt, and the left hand weſt, the degrees of longitude being marked at the top and bottom of each map, and the degrees of latitude on the ſides of the map.

The *zodiac* is that circle, which cuts the equator obliquely, and is divided into *twelve ſigns*, through which the ſun ſeems to paſs within the ſpace of 12 months, each ſign containing 30 degrees of longitude.

The *ecliptic* is a line paſſing through the middle of the *zodiac*, and ſhews the *ſun*'s, or rather the *earth*'s path or orbit, in which it moves annually.

The *horizon* is the broad circle in which the globe ſtands, dividing it into the upper and lower hemiſpheres; the place where any one ſtands, is the center of the *horizon* and hemiſphere; the ſenſible *horizon* ſeems to touch the ſurface of the earth, and is the utmoſt limits of our ſight upon an extenſive plain The rational *horizon* is ſuppoſed parallel to this, and to be extended to the heavens.

The *poles* of our *horizon* are two imaginary points in the heavens, called the *zenith* and *nadir*; the *zenith* being the vertical point directly over our heads, and the *nadir* that point of the heavens under our feet, diametrically oppoſite to the *zenith*.

The *tropics* ſhew how far the ſun or rather the earth proceeds north or ſouth of the equator every year. The *tropic* of *Cancer* ſurrounds the globe 23 ½ degrees north of the equator, and the *tropic* of *Capricorn* 23 ½ ſouth of the equator.

The *polar circles* are drawn 23 ½ degrees diſtant from each pole, and 66 ½ diſtant from the equator.

The *earth* is divided into five *zones*, viz. The torrid zone, the two frigid zones, and the two temperate zones: and they are denominated zones; becauſe they encompaſs the earth like a girdle.

The *torrid zone* lies between the two *tropics*, and is ſo denominated from the exceſſive heat of the climate, the ſun paſſing over it twice every year.

The two *frigid zones* lie within the polar circles, and are ſo called from the exceſſive cold within thoſe circles.

The *northern temperate zone* lies between the *tropic* of *Cancer* and the *arctic* circle, and the *ſouthern temperate zone* between the *tropic* of *Capricorn* and the *antarctic* circle.

Hence the inhabitants of the earth are diſtinguiſhed into *Periœci*, *Antœci*, or *Antipodes*: according to their ſituations.

The *Periœci* are ſituate under the ſame parallel, but oppoſite meridians: it is midnight with one when it is noon with the other, but the length of their days and their ſeaſons are the ſame; theſe are found by turning the horary index 12 hours, or turning the globe half round.

The *Antœci* are situate under the same meridian, but opposite parallels: these have the seasons opposite to ours, and the same length of days; but when their days are longest, ours are shortest. These are found by numbering as many degrees on the opposite side of the equator as we are on this.

The *Antipodes* lie under opposite meridians, and opposite parallels; these have different seasons, and their noon-day is our midnight, and their longest day our shortest: These are found by turning the horary index 12 hours from the given place, or turning the globe half round, and then counting as many degrees on the opposite side of the equator, as the given place is on this.

The inhabitants of the earth are distinguished by their different shadows at noon-day, and are denominated either *Amphiscii*, *Ascii*, *Heteroscii*, or *Periscii*.

The *Amphiscii* inhabit the torrid zone, and have their noon day shadows both north and south: When the sun is south of them, then their shadows are north, and when the sun is north of them their shadows are south: these are also called *Ascii*, because the sun is vertical twice every year at noon-day, and then they have no shadow.

The *Heteroscii* who inhabit the temperate zones, have their shadows always one way at noon-day. In the northern temperate zone their shadows are always north; and in the southern temperate zone, their shadows are always south at noon-day.

The *Periscii* inhabit within the polar circles, and have their shadows every way, the sun being above their horizon all the 24 hours, several months in the year, *viz.* when it is on the same side of the equator they are of: and if there were any inhabitants at either of the poles, they would have but one day of 6 months, and one night of the same length.

The ancients not being acquainted with the manner of discovering the situation of places by the height of the pole and latitude, or distance of the equator, they sought the situation by the difference in the length of the days: And therefore they divided the surface of the terrestrial globe, by means of circles parallel to the equator, into certain parts or small *zones*, each of which to contain the same length of days, and called them by the name of *climates*, (from κλιμα, *inclination*) and these were subdivided by a circle, or parallel line, into two *demi climates*, to which they gave the name of *parallel*; so that each *climate* contains two *parallels* or *demi-climates*.

There are two sorts of *climates*. Those which are between the equator, and the polar circles, where the artificial days increase insensibly, are regulated by half hours; and those, who live between the polar circles and the poles, which contain continual days, are regulated by months, or 30 continual days.

The *parallels* are likewise of two sorts, the one divides the *climates* of half hours into quarters, and the other divides the days of a month into 15 days.

Therefore *climate* is a space of the surface of the terrestrial globe contained between two parallel circles, or lines, between which there is a variation of an half hour, or of 30 days in the longest days of the year.

Likewise the *parallel* is a space of the earth contained between two lines, or parallel circles, between which there is a difference, either of a quarter of an hour, or of 15 days in the longest days of the year.

The *climates* and *parallels* are, between them, very unequal; in those of artificial days, the more they approach the equator, the broader they are, and diminish in proportion as they depart from the equator and approach the poles.

The *climates* of continual days, on the contrary, are broader in proportion they are nearer the poles; and diminish as they depart from them, and advance towards the tropicks.

The inequality of the latitude of the *climates*, as well of artificial as of continual days, proceeds from the different obliquities of the horizons, with regard to the course of the sun, when it is in the tropick; where it determines the length of the longest days, for all the inhabitants of the same hemisphere.

There are sixty *climates*, thirty between the equator and the arctic pole, for the northern hemisphere, and thirty between the equator and the antarctic pole for the opposite hemisphere, which we commonly call southern.

The thirty *climates* of each hemisphere are divided into *climates* of half hours, or artificial days, and *climates* of continual days.

The *climates* of half hours are reckoned between the equator and the polar circles, to the number of 24. Because the artificial day being always of 12 hours under the equator, and of 24 hours, in the longest day of the year under the polar circles, the increase is of 12 hours, which make up 24 half hours, and consequently 24 *climates*.

The *climates* of continual days are reckoned between the polar circle and the pole, to the number of six, and by months; because the longest day under the polar circle, is of a natural day, *i. e.* of 24 hours, and of six months under the poles; which make up six months of increase, which are distributed by months, each whereof makes a *climate*.

The sixty *climates* making up 120 *demi-climates*, or *parallels*, *i. e.* 60 *parallels* for each hemisphere, there

there will be 48 by quarters of an hour, for the 24 *climates* of half hours, and 12 for the *climates* of months, which together make up the 120 *parallels*.

The people under the equator have no *climate*; those whose longest day is of 12 hours and an half have one *climate*; or are towards the end of the first *climate*: Those whose longest day is of 11 hours, have two *climates*, and thus in order to 66 degrees 31 minutes, where there are, as I have observed already, 24 *climates*, i. e. that they are at the end of the last *climate* of an hour, because their longest day lasts 24 hours; and as from the end of the twenty-fourth *climate*, every quarter of a league towards the pole, the day increases 24 hours at once, afterwards a week, a month, &c. the six last *climates* have been determined by the difference of a month of continual day more at their end than at their beginning.

These particulars well considered, we proceed to the description of the *artificial globe*.

The ARTIFICIAL GLOBE *of the earth* is a sphere on whose surface are delineated the principal parts of the *earth* in their proper situations, distances, &c. and also the imaginary circles already described.

This *globe* is by its position sometimes called a *right* sphere, at other times a *parallel* sphere, and an *oblique* sphere. And by the various position of the horizon the inhabitants of the earth are sometimes distinguished.

In a *right sphere* the equator passes through the *zenith* and *nadir*, and the parallel circles fall perpendicularly on the horizon, which is the case of those people who live under the equinoctial line.

In a *parallel sphere*, the poles are in the *zenith* and *nadir*; the equator is parallel to, and coincides with the horizon, and the parallel circles are parallel to the horizon, which can only be said of people under either pole.

In an *oblique sphere*, the inhabitants have one of the poles above, and the other under the horizon, and the equator and parallel circles cutting the horizon obliquely, as is the case of all people that do not live under the equinoctial or the poles.

In order to find the true situation of a place upon the globe, let it be set upon a level table, and the brazen meridian stand due north and south; then bring the given place to the brazen meridian, and let there be 90 degrees between that place and the horizon, both north and south, and the given place will be in the *zenith*; the *globe* being thus rectified, you may proceed to solve any problem.

As the *longitude* of a place will be found by numbering on the equator so many degrees as the place lies east or west of the first meridian: And the *latitude* will be found by counting so many degrees on the brazen meridian, as the place lies north or south of the equator: You must turn the *globe* therefore either east or west, till the given place is brought to the brazen meridian, and you will see the degree of *longitude* marked on the equator; and the *latitude* is found at the same time, only by numbering the degrees on the brazen meridian either north or south of the equator, till you come to the given place.

To find what places are under the same meridian with a given place; bring the given place to the brazen meridian, and observe what places lie under that meridian, either north or south of the equator.

To find what places have the same *latitude*, turn the *globe* round, and observing on the brazen meridian what places come under the same degree of *latitude*, as the given place is.

To find the *sun's* place in the *ecliptic* at any time of the year. Having found the month and day of the month, you will find, upon the wooden horizon, the sign in which the *sun* is opposite to the day of the month; which is the *sun's* place in the *ecliptic* at that time.

To know the *length* of the days at any time and at any place, bring the given place to the *zenith*; then bring the *sun's* place in the *ecliptic* to the east side of the horizon, and set the index of the hour circle to 12 at noon, or the upper figure of 12, and turn the *globe* till the said place in the *ecliptic* touch the western side of the horizon, and the number of hours between the upper figure of 12, and the hour the index points to, shews how many hours the day is long, and consequently the length of the nights; because so many hours as the day falls short of 24, must be the length of the night; as when the day is 16 hours long, the night must of course be 8 hours long.

To find those places on the *globe* where the sun is in the meridian at any time. The globe being rectified, and the place where you are brought to the brazen meridian, set the index of the horary circle at the hour of the day at that place, then turn the *globe* till the index points to the upper 12, and you will see all those places were the sun is in the meridian; as for example, if it be 11 in the morning at *London*, and you set the index at 11, turn the *Globe* till the index points at the upper 12, and you will find *Naples*, which is an hour or 15 degrees east of *London*. And in all places under the same meridian as *Naples* is, it must consequently be 12 at noon at that time.

In like manner if it be 4 in the afternoon at *London*, and you set the index at 4, and turn the *Globe* till the index points at the upper 12, you wil find *Barbadoes*, which is four hours or 60 degrees west of *London*, and at all places under the same meridian

dian as *Barbadoes* is, it must consequently be 12 at noon at that time.

To discover where the *sun* is *vertical* at any time of the year, (as the *sun* can only be *vertical* in such places as lie between the tropics) to know this, you are only to find what place the sun is in the *ecliptic*, and bringing that place to the brazen meridian, observe what degree of *latitude* it has, for in all places in that *latitude* the *sun* will be *vertical* that day, and you will find all those places, only by turning the *globe* round, and observing them as they come to the brazen meridian.

To find where the *sun* is *above* the horizon, or shines *without setting* all the 24 hours in the northern hemisphere. The day given must be when the *sun* is in the northern signs, and having found the *sun's* place in the *ecliptic*, you must bring that place to the brazen meridian, then count the same number of degrees from the north pole towards the equator, as there is between the equator and the *sun's* place in the *ecliptic*; then turn the *globe* round, and in all the places passing under the last degree counted from the north pole, the *sun* begins to shine constantly without setting on the given day: and the rule will serve *vice versa* for any place set in the southern hemisphere, when the sun is in the southern signs.

To discover the *length* of the longest and shortest days and nights at any place in our northern hemisphere; rectify the *globe* according to the *latitude* of the given place, or which is the same thing, bring the given to the *zenith*, then bring the first degree of *Cancer* to the east side of the horizon, and setting the index of the hour circle to the upper figure of 12, turn the *globe* till the sign of *Cancer* touch the west side of the horizon, and observe the number of hours between the upper figure of 12, and the hour the index points to, and that is the length of the longest day, and the shortest night, consequently consists of so many hours as the day falls short of 24; and as for the length of the days and nights in southern *latitude*, they are just the reverse of those in northern *latitude*, and the table of the *climates* shews both the one and the other.

To find in what places the *sun* is *rising* or *setting*, or in its meridian: or what parts of the earth are enlightened at any particular time: First find where the *sun* is *vertical* at the given hour, and bring that place to the *zenith*, under the brazen meridian; then observe what places are in the eastern semi-circle of the horizon, for there the *sun* is setting, and in those places in the western semi-circle of the horizon the *sun* is rising, and in all places under the brazen meridian it is noon-day: all those places in the upper hemisphere of of the *globe* are enlightened, and those in the lower hemisphere are in darkness.

To find the *distance* of one place from another upon the *globe*: If both places lie under the same meridian, bring them to the brazen meridian, and count thereon how many degrees of *latitude* the two places are from each other, which being reduced to units is the true *distance*. Every degree of *latitude* containing 60 geographical miles, as has been observed already; and 60 geographical miles make near 70 *English* miles. If the two places lie under the same parallel of *latitude*, then observe on the equator how many degrees of longitude they are asunder, and observe in the table A, how many miles a degree of longitude makes in that *latitude*, and then numbering the degrees of longitude on the equator, reduce them to miles, and that will give the distance of the two places. For instance, suppose *Rotterdam* lies in 52 degrees of north latitude, and 4 degrees of eastern longitude, and *Pyrmont* lies under the same parallel 5 degrees east of *Rotterdam*, and I find that every degree of longitude in this *latitude* makes 37 miles, then I multiply 37 by 5, which makes 185 being the number of miles between *Rotterdam* and *Prymont*.

Where the two places differ both in longitude and *latitude*, the distance may be found by measuring the number of degrees they are asunder by the quadrant of altitude, and reducing those degrees to miles. For example, if I find the two places are the length of 10 degrees asunder by the quadrant, they must necessarily be 600 miles distant from each other; because 60 miles which is the extent of one degree of *latitude*, multiplied by 10, makes 600 miles on the *globe*, in whatever direction one place lies from another, as north, east, south, west, *&c.*

To find how one place *bears* of another, that is, whether it *lies* north-east, south-west, or on any other point of the compass from another place: Bring one of the places to the *zenith*, and fix the quadrant of altitude there; then extend it to the other place whose bearing you would know, and the lower part of the quadrant will intersect the wooden horizon at the point of the compass inscribed on the wooden horizon, which is the true bearing of the given place.

To find on what point of the *compass* the *sun rises* or *sets* at any place: Bring the given place to the *zenith*, and having found the *sun's* place in the *ecliptic*, bring the same to the eastern side of the *horizon*, and it will shew on what point of the *compass* the *sun rises*. On the other hand, if you bring the *sun's* place in the *ecliptic* to the west side of the horizon, it will shew on what point of the *compass* the *sun* sets.

The *contents* of this GLOBE are divided first into *land* and *water*.

The *land* on the *earthy* part is again divided into *continents*, *iſlands*, *peninſulas*, *iſthmus's*, *promontories* or *capes*.

A *continent* is a large portion of land, containing ſeveral countries, ſo united together as not to be ſeparated by ſeas: As *Europe*, *Aſia* and *Africa*, form but one *continent* in the eaſt; and *America* another in the weſt.

An *iſland* is a portion of land ſurrounded by water, as *Great-Britain* is from all the world.

A *peninſula* is a portion of the earth ſurrounded by water, except on one part, where it is joined to ſome other land by a narrow neck, or *iſthmus*. As *Africa* is joined to *Aſia* by the *iſthmus* of *Suez*; and the *Morea* is joined to *Achaia* by the *iſthmus* of *Corinth*.

An *iſthmus* is that neck of land, which joins two countries together; as the *iſthmus* of *Darien* joins north and ſouth *America*, and the *iſthmus* of *Corinth*, *Achaia* and the *Morea*.

A *promontory* or *cape* is a point of land which extends itſelf into the ſea; as the *cape* of *Good-Hope* in *Africa*, and *cape Comorin* in the *Eaſt-Indies*.

The waters are divided into *oceans*, *ſeas*, *ſtraights*, *bays* or *gulphs*, *lakes* and *rivers*.

Oceans are vaſt ſeas which divide one part of the earth from another; as the *Atlantic ocean*, which divides *Europe* and *Africa* from *America*, and the pacific *ocean* or *ſouth-ſea*, which divides *America* from *Aſia*

Seas are leſs bodies of waters which divide one country from another; as the *Mediterranean*, which divides *Europe* from *Africa*; and the *Baltic*, which divides *Sweden* from *Germany*.

A *bay* or *gulph* is a ſea encompaſſed with land, except on one part whereby ſhips enter it; as the gulph of *Mexico* in *America*, and the gulph of *Finland* in the *Baltic*. And the leſſer bays are frequently called *creeks* or *ſounds*, as *Plymouth ſound*.

A *ſtraight* is a narrow paſſage into ſome ſea, as the *ſtraight* of *Gibralter*, and this is alſo ſometimes called a *ſound*; as the *ſtraight* by which we enter the *Baltic* ſea is.

A *lake* is properly a great water ſurrounded by land, which has no viſible communication with any ſea, as the *Caſpian* ſea in *Aſia*; but many other waters, which have a communication with the ſea, are denominated *lakes* alſo; as the *Onega* lake in *Ruſſia*, and the *lake* of *Nicaragua* in *America*.

A *river* is a ſtream iſſuing from ſome fountain, which after it has run a conſiderable courſe, diſcharges itſelf uſually into ſome ſea: as the *Danube*, which riſing in the mountains of the *Alps*, after it has run a courſe of many hundred miles from weſt to eaſt, through great part of *Germany*, *Hungary*, and *Turkey*, diſcharges itſelf into the *Euxine* ſea by ſeveral channels.

From the *Globe* let us proceed to the deſcription of *geographical Maps*.

A Map is a plain figure repreſenting the ſurface of the earth, or a part thereof, according to the laws of perſpective.

In *maps* theſe three things are eſſentially requiſite. 1. That all places have the ſame ſituation and diſtance from the great circles therein, as on the *globe*, to ſhew their parallels, longitudes, zones, climates, and other celeſtial appearances, 2. That their magnitudes be *proportionable* to their real magnitudes on the *globe*. 3. That all places have the ſame ſituation, bearing and diſtance, as on the earth itſelf.

The *true chart* performs the firſt and laſt of theſe very exactly, but fails extravagantly in the ſecond; and, indeed, no kind of projection yet found can exhibit more than two of them at once, by reaſon of the great differenee between a plane and convex ſuperficies.

Maps are not always to be uſed as they lie before us, for ſometimes any part is uppermoſt; but, generally, the top is the *north* part, the bottom the *ſouth*, the right hand the *eaſt*, and the left hand the *weſt*, and marked with theſe words, or *latin* ones of the ſame import.

There is alſo inſcribed a *compaſs*, pointing to all the quarters of the world, the *north* one being marked with a *flower de luce*.

The *degrees* of *longitude* are always numbered at top and bottom, and the *degrees* of *latitude* on the eaſt and weſt ſides. In all right-lined, and general circular *maps*, except thoſe of *Wright*'s projection, the degrees of *latitude* on the ſides are of an equal breadth; and in all circular and right-lined maps, except the ſaid *Wright*'s, and the plain charts, the degrees of longitude are unequal.

In *general maps*, the circles correſponding to thoſe in the heavens are inſcribed, *viz.* the equator is expreſſed by a ſtrait eaſt and weſt line; and the firſt meridian, the polar circles, the tropics, and the other meridians and parallels, which are drawn at every five or ten degrees, interſect each other at right angles.

In ſeveral *maps* there are three ſorts of ſcales of miles, according to the various computations in different parts of the ſame country, *viz.* greater, leſſer, and mean; beſides which, there are often affixed ſcales of other country-meaſures, as *Dutch*, *French*, *Italian*, &c.

As for other matters, regarding maps in general, the characters uſed to denote cities, rivers, roads, boundaries, and the like, they are uſually explained

in

in the maps themselves. We shall therefore proceed to shew the several methods of constructing the *geographical maps* in order: and first of

The *stereographic projection of* Maps upon the plane of the equator, the eye being supposed placed in one of the poles. To do this proceed thus: from P, the pole. (*See the second plate of Geography*, Fig. 1. N° 1.) draw a circle A B C D, of what circumference you please, to represent the equator, which cross with two diameters A C, B D, dividing it into four quadrants, then subdivide each of these into nine, and these again into ten more, if the largeness will admit; and from D, the point of intersection of the first meridian B D, number every tenth degree with figures, both on the right hand and on the left, till they meet in the opposite point B 180; so will the *map* be divided into east and west longitude. Then from the pole draw right lines to every such tenth degree in the equator, as is done in the quadrant D C; and these will represent the meridians, and the figures will shew the longitude.

To delineate the parallels of latitude, from B draw lines to every tenth degree in the quadrant A D; and where they intersect the diameter P A, through those points must circles be described from the center P, and then numbered from the equator towards the pole with 10, 20, 30, &c. Thus you have the meridians and parallels projected; and since the polar circles and tropics are only parallels, at a certain distance from the pole and equator, *viz.* 23° 30′; therefore set off 23° 30′, on the equator from D to E, as also from C to F; then through the points H and I, where the points B E and B F intersect A C, describe double circles to distinguish them from other parallels. So shall P H represent the arctic circle, and P I the tropic of *Cancer*. The lineaments of your *map* being thus projected, places may be inserted by help of a table of latitudes and longitudes, as represented (*ibid* N° 2.) but in these maps, the mutual bearings and distances of places cannot be determined; also countries near the equator take up more room than proportionably they should.

Orthographic projection of Maps upon the plane of the equator, wherein the eye is supposed to be at an infinite distance in the axis, two hundred semi-diameters at least; by which means the places about the pole, which may be discerned at any distance, will have a larger projection than those nearer the equator; just the reverse of what happened in the former projection.

In this projection, the equator must be drawn and divided, and meridians delineated in the same manner as taught above; then to describe the parallels proceed thus: from either side of the first meridian A P (*ibid.* Fig. 2. N° 1.) draw right lines through the corresponding degrees, or every tenth degree of the quadrants A B, A D, parallel to the diameter B D; and through the points where these cut the meridian A P, draw circles representing the parallels, numbering them with 10, 20, 30, &c. from A to the pole P, to shew the degrees of latitude. To delineate the polar circles and tropics, set off from B to G, and from D to H 23° 30′; as also from A to I, and from A to K; and drawing lines between each, through the points of intersection of the first meridian A P, draw circles: thus P L will represent the polar circle, and P M the tropic of the Cancer. The ecliptic may be projected, and places laid down in the same manner as above; *ibid.* N° 2.

This kind of the equatorial projection, shews the true decrease of the degrees of the equinoctial, or of longitude, in every parallel of latitude: the circumpolar regions may be delineated better in this than in the former projection; and so may *Tartary*, and the north parts of *Europe*, as *Sweden*, *Norway* and *Muscovy*.

But besides the inconveniencies already mentioned, attending these two kinds of projection, there is no bringing all the places in the eastern or western hemisphere into less than two hemispheres, so as to express *Europe*, *Asia* and *Africa*, or *America* by itself, in one map; Geographers have therefore invented another way, somewhat more difficult indeed, but much more natural and useful, *viz.*

The *stereographic projection of maps* upon the plane of the first meridian, wherein you must conceive the eye to be situated in that point of the equator, which is cut by the meridian 90° distant from the first meridian. In this projection the equator is a right line, as is also the meridian 90° distant from the prime one, and cutting it in the point of the eye's position: but the other meridians, and all the parallels, are arches of circles, and the ecliptic an ellipsis.

The method is this: describe the circle N E S W, (*ibid.* Fig. 3.) representing the first meridian; cross it with two diameters at right angles, and W C E shall represent the equator, W the west part, and E the east; and the other diameter N C S will be the meridian, 90° distant from the first, N representing the north and S the south pole, and C the point where the eye is supposed to be.

To delineate the meridians, proceed thus: from N draw lines through each tenth degree, or each degree, if you think fit, of the quadrants W S or S E, which shall cut the quadrant of the equator W C in F, G, H, I, K, L, O, P; or, to avoid scores in your paper, make a point in the line where the side of the ruler cuts it. You need only divide

one

one quadrant, because the divisions in it may be transferred into the lines CN, CE and CS, which will save the trouble of their particular divisions. Thus are the points in the equator, through which the meridians are to pass; as, also, those points in the perpendicular meridian, determining the ambit of the parallels found out. The centers of all those meridians, whose distance from the first meridian, N W S E, does not exceed 45°, may be found out in the line CE, reckoning every second degree from the point C, for the centers of each degree from the point W. By the same proportion, we must take every twentieth degree, or point, from C, in the line CE, for centers to each tenth degree or point, from W, in the line WC: therefore Q will be the center of F, R of G, T of H, and V of I. But because the centers of the meridians, exceeding 45°, lie without the circumference of the first meridian, in the line CE extended; therefore, laying the ruler upon N, and every second degree, or, according to the projection upon every twentieth degree of the quadrant NE, make points in the extended line CE, which shall be the centers of all the other meridians where the edge of the ruler cuts it. Thus X will be the center of K, the meridian 50° distant from the primitive, and so on. And, in the like manner, may the meridians be described through the points in the line CE, by transferring the center-points of CE to CW continued.

The points for the projection of the parallels being already marked in the lines CN and CS, to find the centers of these points, erect a perpendicular at E, as *a b*; and from C, through each tenth degree of the quadrant NE, draw secant lines to cut the said perpendicular in *c*, *d*, *e*, *f*, &c. Then take the distance C*c* in your compasses, and transfer it upon the line CN, continued, from C to 1, which will be the center to the parallel *b* 80 *b*; C*d* transferred to C 2 will give the center of the parallel *i* 70 *i*: C 3=C*e* will be the center of *k* 60 *k*; and so on for the rest of the parallels.

To project the tropics and polar circles, set off, on each side the equator and poles, 23° 0′; then draw a secant from C, through these points, and transfer the point of intersection with the tangent line, as before, for the centers of those circles.

The construction of the parallels of the other hemisphere is performed in the same manner, *viz.* by transferring the centers found by the intersection of the secants with the tangents, to the line CS, continued.

There are two ways of projecting the ecliptic; for supposing C to be the first point of Aries, and the eye to be in the vertical colure, it will be represented by a right line, drawn from the beginning of Cancer B, through the beginning of Aries C, to the beginning of Capricorn M; which being graduated like the equator, the degrees of each sign are to be marked upon it. To do this, cross the ecliptic BM with a line at right angles, drawn from the opposite points of the polar circles in the meridian, Z, D; divide the quadrant BD into nine equal parts, each containing 10°; and laying a ruler upon Z, and upon each division of the quadrant BD, cut the line BM as you did the equator. But all this trouble may be spared, by transferring the divisions of the equator upon the ecliptic BM.

The other way of projecting the ecliptic, where the eye is supposed to be in the solstitial colure, is the same as in all maps of the hemispheres, where it cuts the points of the intersection of the first meridian and equator, at W and E; and the third point is that wherein the tropic BAY cuts the meridian NCS at A.

The construction is now ready for inserting the places in the maps, which may be done by the help of a table of longitudes and latitudes, as in the former methods.

The advantages of this projection are these: 1. It very agreeably represents the hemisphere intercepted between the two poles, with all the parts entire. 2. It shews the longitudes, latitudes, and distances of places from all the great circles, exactly as on the globe itself.

Its defects are also two. 1. That the degrees of the equator, meridians, and parallels, are unequal, except those of the first meridian, encreasing gradually the nearer they approach to the first or prime meridian; and consequently the parts about C are less, and those about A and C greater than they ought: and, in the same manner, the places about the poles bear an unequal proportion to those nearer the equator. 2. The course and distance between places, are neither with ease or exactness found in their projection.

If you would project a map of any particular portion of the earth, less than an hemisphere, you must make the projection proportionable to the extent of the map you intend to draw, and then cut out so much of it as is terminated by the greatest degree of longitude and latitude of the country to be projected. For example, suppose you would draw a map of *Europe* according to this construction, which being laid down as directed above, through the points where the parallels of the greater and lesser latitude of *Europe*, *viz.* 72° and 34°, cut NC, draw lines parallel to the equator: and because, in the common maps, *Europe* includes 93° of longitude, therefore set off, *viz.* 46° 30′ from *n* to *g* and from *n* to *p*, and draw *g p*=93°, the extent of *Europe* in longitude; then erect perpendiculars

diculars on the points g and p, to square your map; or, to save this trouble, set off ug from q to r, and from q to t, and cut out your map accordingly. However, it is best to allow a little more room in separating your map from the rest of the projection to express the situation thereof in respect of other countries.

The *orthographic projection of Maps* on the plane of the meridian, in which the parallels of latitude are all right lines, and all the meridians, except the first, semi-ellipses, is in construction formed by supposing perpendiculars to fall from all points of each hemisphere on the plane of the first meridian.

Thus let N E S W, (*ibid* fig. 4.) the meridian, be divided, as in the former method, into four quadrants, and each quadrant into 9 or 90 equal parts or degrees; from each tenth degree of the quadrants NW and WS, draw lines to each corresponding tenth degree in the quadrants NE and ES, parallel to the equator WE, and these will be the parallels of latitude: and having numbered each parallel on the first meridian, and in CN and CS, transfer the intersections of these parallels with CN or CS into CW and CE, which will give the points in the equator through which the meridians must pass; and number these from W towards E, for degrees of longitude.

Then, since the meridians are semi-ellipses, you may describe them through the given points, *viz.* the two poles and the divisions of the equator WE, with elliptical compasses; or, by help of a sector, you may find the points in each parallel of latitude, through which the ellipses may be formed. The ecliptic, in this projection, will be represented by an elliptical or strait line, in the same manner as in the former method.

The maps of this construction have this advantage above the preceding methods, that they exhibit the true proportional decrease of the degrees of the equator in each parallel; but this advantage is counter-ballanced by a great inconvenience, *viz.* the too great contraction of the meridians the nearer they lie to the first, which makes this projection unfit for general maps; *Africa* being the only quarter of the globe that would nearly retain its due figure and dimensions.

The *stereographic projection of Maps* upon the plane of the horizon, the eye being supposed in the zenith for the upper hemisphere, and in the nadir for the lower one.

The common method of construction is this: suppose it were required to describe an horizontal projection for the city of *London*, in latitude 50° 32′; from L or Z, (Plate *ibid* fig. 5.) the zenith and *London* being here the same, describe the circle NESW of what extent you please; to represent the horizon, quarter it, and divide each quarter into 90°; or, to avoid confusion, divide only one quadrant NW or WS; draw the diameter NS, which let be the first meridian, then will WE be the prime vertical, or azimuth of east and west. Next take 51° 32′ from the divided quadrant NW, and set it off from N to A; then draw a line from W to A, and where the ruler cuts NS make a point, which shall represent the arctic pole P. Thirdly, take the distance of the arch of any of the quadrants, as NE, and set it off from A to B; and where the line WB cuts the diameter NS, that point Q will be the point of the intersection of the meridian with the equator. Fourthly, divide the semicircle N A E B S, from B, into degrees, the same in proportion to those of the quadrant NW; and from W to each, or each tenth degree, lay a ruler, and mark where it cuts the line NS, for there will be the points of the intersection of the parallels with the first meridian, which fall within the periphery of the projection. But if you would find the opposite point of each parallel, in order to delineate them easily on the projection, continue the division of the periphery from the equatorial point B, upon the quadrant NW, and draw lines as before through each point to cut the diameter NS continued; then describe circles through the points of equal degrees from the pole P, through 80, 70, 60, &c. in the line PS, and 80, 70, 60. &c. in the line PN extended. Thus may all the parallels, tropics, and polar circles be projected.

In the construction of the meridians proceed thus: first, through the points W, P, E, draw a circle, the half of which is CPD, and delineate thereon the meridian projection, by dividing it into 360°; then drawing lines from P to every degree, or tenth degree: and, lastly, describing circles from the centers found in the line C D, continued at both ends, through the division in the diameter W E, and the poles, in the same manner as directed in the stereographic projection upon the meridian, the parallels excepted, which must not be drawn. In describing the meridians, observe to draw each thro' the pole to touch the horizon, which will be the meridians north of the pole. Thus, when you describe the meridian F P, describe at the same time FPG; and the same holds of all the rest.

When you have proceeded thus far, describe a circle round the horizon pretty close, to contain the degrees of graduation, which must be made between the meridians, and not the parallels, each into ten parts or degrees, to shew the longitudes of places. The latitude must be graduated on the first meridian NS, and numbered from the equator towards either pole, and from the pole backward,

backward, towards N. This done, draw a circle with this again, wide enough to hold the figures belonging to the numbered degrees. Laſtly, deſcribe two more circles, the firſt near the former, and divide the quadrants into eight equal parts each, or thirty-two in all, to repreſent the points of the compaſs, and ſhew the bearings of places in reſpect of *London* the center. The outward graduated circles ſupply the place of azimuths, to draw which would occaſion confuſion in the ſcheme; for if a central rule be fixed upon a pivot in the center, or place repreſenting *London*, and graduated with the ſame diviſions as ZN, by moving it about to any place, we may eaſily diſcover not only the bearing, but the diſtance of that place from *London*.

All theſe circles are expreſſed in the lower figure, in which ſo much of the earth is deſcribed as is contained within the horizon of *London*, as a ſpecimen of the nature and uſe of this projection. Thus your projection being completed, it is eaſy to inſert the places, according to their latitudes and longitudes.

The *horizontal projection of Maps*, with azimuth lines. Thoſe who are unwilling to take the trouble of laying down the former projection, and are content to know the bearings and diſtances of places from the center, without the longitude or latitude, may divide the circle NESW (*ibid* Fig. 6.) into degrees and points of the compaſs; where NS repreſents the meridian, WE the eaſt and weſt line, and Z the zenith, or place in the center. This done, you may put *London*, or any other place in the center; and by the help of the ſcale of equal parts ZA, fixed in the center, the bearings and diſtances of places may be laid down from the globe or maps.

A new, eaſy, and exact method of projecting particular Maps. Suppoſe you would draw a map of ſome part of the earth, containing 6° of latitude, *viz.* from 39° to 45°, let the longitude be what it will. 1. Draw the line EF, (*ibid.*) and in its middle raiſe the perpendicular DC, which divide into ſix equal parts, or degrees of latitude; and through C, draw a line parallel to EF. 2. Divide a degree into ten, or if large enough to admit it, into ſixty equal parts; and in the table for decreaſing longitude, find the content of a degree of longitude in the latitude of 39°, *viz.* 46.62 miles. 3. From the degree ſo divided, take the parts 46.62; divide that diſtance, and from D ſet off one half to E, and the other half to F. 4. Find the content of a degree in latitude 45°, *viz.* 42.43 miles; take that diſtance from the ſcale of the degree; divide it, and from the point C lay one half to I, and the other half to K. 5. Draw ſtrait lines from I to E, and from K to F; divide them in like parts with CD, and through thoſe marks draw parallel lines.

Thus IKFE is a projection for one degree of longitude, including ſix degrees of latitude; which may be transferred upon the paper, as often as there is occaſion, by the following method.

1. If the compaſſes be large enough, or the projection will admit it, take the diſtance from E to K, or from F to I, and ſetting one foot firſt in E and then in F, deſcribe the arches L and M. In like manner ſet one foot firſt in I and then in K, and with the ſame extent draw the arches N and O: take the diſtance with another pair of compaſſes, between E and F, and ſet it off from E to N, and from F to O: likewiſe ſet the diſtance between I and K, from I to L, and from K to M; draw lines between L and N, and M and O; divide them into degrees, and draw parallels from thoſe points to the correſponding points in the meridians IE and KF. And, after the ſame manner, may meridians and parallels be drawn, to as many degrees of longitude as your map contains.

2. If the map be very large, ſo that the compaſſes cannot extend to the fartheſt degree, or from F to I, then you may draw one or more diagonals, as you can conveniently, at once; and then proceed to draw the reſt. Thus, when you have laid down the ſquares PGEN (*ibid.*) and HQOF, in the ſame manner as directed above; go on to draw LIGP and KMQH, by the ſame method.

In this projection, the diagonals being all equal, places lying in the remoteſt longitudes or diagonals, are as truly exhibited as thoſe near the middle, and conſequently their diſtances conformable to one common meaſure; ſo that the compaſſes, extended between any two places, and applied to the ſcale, gives the diſtance without more ado. The bearings too will be very conſpicuous by means of a compaſs drawn on a corner or ſide of the map.

The ſcale on the ſides is that by which the diſtances are meaſured; but it muſt be graduated on one of the meridians, and not on the out-lines of the map, as is commonly done.

N.B. Printed maps, on being imported from abroad, pay a duty of 15 *s.* 4$\frac{80}{100}$ *d. per* ream; and draw back, on exportation, 13 *s.* 6 *d.* and, if in frames, for each map 1 *s.* 2$\frac{36\frac{1}{4}}{100}$ *d.* the drawback being 1 *s.* $\frac{93\frac{3}{4}}{100}$ *d.*

Thus far of *general* or *univerſal geography*, we now enter upon that part of the diviſion called *ſpecial* or *particular* GEOGRAPHY, which repreſents the *earth*, firſt to be two great continents, *viz.* the *new* and *old world*; or, the *eastern* and *western continents*: the *eastern continent* comprehending *Europe*, *Asia*, and *Africa*; *Europe* in the north west division; *Asia* in the north east division; and *Africa* in its south division: and the *western continent* all that vast region on the left hand of a map of the world, called *America*.

We now descend to particulars; and first begin with Europe.

Europe is situate between 36 and 72 degrees of north latitude, and between 10 degrees of west, and 65 degrees of eastern longitude, bounded by the frozen ocean on the north, by *Asia* on the east, (from which it is separated by the *Archipelago*, the *Hellespont* or straight of the *Dardanells*, the *Propontis* or sea of *Morea*, the *Bosphorus* or straight of *Constantinople*, the *Euxine* sea, the *Palus Meotis*, the river *Don* or *Tanais*, and a line drawn from that river to the rivers *Irtis* and *Oby*, which being united, run into the frozen ocean.) The *Mediterranean* sea divides *Europe* from *Africa* on the south, and the *Atlantic* ocean divides it from *America* in the west. The greatest length of *Europe*, *viz*. from cape *St. Vincent* in the west, to the mouth of the river *Oby* in the north east, being about three thousand miles; and the breadth from north to south, *viz*. from the north cape in *Norway*, to cape *Cagha*, or *Matapar* in the *Morea*, the most southern promontory in *Europe*, being about two thousand five hundred miles.

Europe is usually thrown into three grand divisions, *viz*. the north, the middle, and the southern division.

The northern division comprehends, 1. *Russia*, or *Moscovy*. 2. *Sweden*. 3. *Denmark*, and *Norway*. And 4. the islands of *Britain*, *Iceland*, *Greenland*, and the islands of the *Baltic*.

The middle division comprehends, 1. *Poland*. 2 *Germany*, and the *Austrian* dominions contiguous thereto. 3. The *Netherlands*. And 4. *France*, and its conquests on the *Rhine*.

The south division contains *Turkey* in *Europe*, (the antient *Greece*) *Romania*, *Servia*, *Bulgaria*, *Bosnia* and *Dalmatia*, with the tributary provinces of *Walachia* and *Moldavia*, *Crim*, *Little Tartary*, *Budziac Tartary* and *Bessarabia*. 2. *Switzerland*, with the *Grisons*, and the rest of their allies. 3. *Italy*. 4. *Spain* and *Portugal*. And 5. the islands of the *Mediterranean*, *viz*. those of the *Archipelago*, *Sicily*, *Sardinia*, *Corsica*, *Majorca*, and *Ivica*.

Russia in *Europe* lies between 46 and 72 degrees of north latitude, and between 21 and 65 degrees of eastern longitude, bounded by the frozen ocean on the north, by *Moscovy* in *Asia* on the east, by the *Palus Meotis*, and *Little Tartary* on the south, and by *Poland*, the *Baltic* sea, *Finland*, and *Swedish* and *Norwegian Lapland* on the west.

The chief towns are *Petersburgh*, *Mosco*, and *Riga*.

The principal rivers of *European Russia*, are the *Wolga*, the *Don*, the *Borysthenes*, and the two *Dwina's*.

The constitution of the *Russian* empire is an absolute monarchy, and the crown hereditary; but different branches of the royal family have of late been advanced to the crown, and the military men seem to dispose of it as they see fit.

Sweden is situate between 55 and 69 degrees of north latitude, and between 10 and 30 degrees of E. longitude, bounded by *Norwegian Lapland* on the north; by *Russia* and *Russian Lapland* on the east; the *Baltic* sea, which separates it from *Germany* and *Livonia* on the south, and by *Denmark* and *Norway* on the west, from which it is separated by the straight called the *Sound*, and the *Dofrine* mountains.

The chief towns in *Sweden*, are *Stockholm* and *Gottenburg*. This is a mixed monarchy, and the king has very little power.

Denmark is situate between 54 and 58 degrees of north latitude, and between 8 and 13 degrees of eastern longitude; being bounded by the *Categat* sea, which divides it from *Norway* on the north. By the same sea and the Sound which separates it from *Sweden* on the east, by the *Baltic* Sea and part of *Germany* on the south, and the *German* ocean on the west.

This is an absolute monarchy, and the crown hereditary. The capital city is *Copenhagen*. *Norway* is situate between 58 and 72 degrees of north latitude, and between 4 and 30 degrees of eastern longitude, bounded by the *Atlantic* ocean on the north and west. By the *Dofrine* mountains, which divide it from *Sweden*, on the east; by the *Categats* sea on the south, and the *German* ocean on the west. The chief town is *Bergen*.

This kingdom is now a province to *Denmark*.

The islands of *Great Britain* and *Ireland*, the *Orcades*, *Hebrides*, the *Isle of Man*, and the rest of the islands subject to *Great Britain*; including *Shetland*, are situated in the *Atlantic* ocean, between 50 and 62 degrees of north latitude, and between ten degrees west, and 3 degrees of eastern longitude, bounded by the northern or *Caledonian* ocean on the north, by the *German* sea, which separates them from *Denmark*, *Germany*, and the *Netherlands* on the east, by the *English* channel and the *Atlantic* ocean on the south, and by another part of the *Atlantic* ocean on the west.

England, the south division of *Great Britain*, is situate between 50 and 56 degrees of north latitude, and

and between 6 degrees weſt, and 2 degrees eaſt longitude, bounded by *Scotland* on the north, the *German* ſea on the eaſt, the *Engliſh* channel on the ſouth, and the *Iriſh* or *St. George's* channel on the weſt, about 400 miles long from north to ſouth, and 300 broad from eaſt to weſt. The capital, *London*; where we place the firſt meridian, [ſituate on the river *Thames* in the county of *Middleſex*;] the latitude whereof is 51 degree 30 minutes, being 200 miles north weſt of *Paris*, 180 weſt of *Amſterdam*, 600 north weſt of *Vienna*, and 800 north eaſt of *Madrid*. The chief rivers are the *Thames*, the *Severn*, the *Trent* or *Humber*, and the *Medway*. *England* is a limited monarchy, and the crown hereditary.

Scotland, the north diviſion of *Great Britain*, is ſituate between 54 and 60 degrees of north latitude, and between 1 and 6 degrees of weſt longitude; bounded by the *Caledonian* ocean on the north, the *German* ſea on the eaſt, by *England* and *Solway Frith* on the ſouth, and by the *Iriſh* ſea and *Atlantic* ocean on the weſt, being about 300 miles long from north to ſouth, and from 50 to 150 miles in breadth from eaſt to weſt. The capiral city *Edinburgh*, in the ſhire of *Lothian*, two miles ſouth diſtant of the *Frith* of *Forth*, and 400 miles north-weſt of *London*. The chief rivers are the *Tay*, the *Clyde*, the *Spey*, the *Dee*, and the *Don*. *Scotland* is united to *England* and ſubject to the ſame ſovereign.

Ireland is ſituate between 51 and 56 degrees north latitude, and between 6 and 10 degrees of weſtern longitude; bounded by the northern ocean on the north, by *St. George*'s channel, which ſeparates it from *Great Britain* on the eaſt and by the *Atlantic* and weſtern ocean on the ſouth and weſt, being about 250 miles long from north to ſouth, and generally 150 miles broad from eaſt to weſt. The capital city, *Dublin*. The chief rivers are, the *Shannon*, *Boyne*, *Liffy*, *Lee*, *Blackwater*, and *Barrow*. *Ireland* is a province to *England*, and many of the *Engliſh* laws are introduced there; but they have a diſtinct parliament, and ſome laws peculiar to that kingdom; however, no law can be enacted till approved by the privy-council of *Great Britain*, and the ſubject may appeal from the courts of *Ireland* to thoſe in *Great Britain*. An act of parliament of *Great Britain*, will bind *Ireland* where that kingdom is expreſly named.

Iceland is an iſland ſituate in the *Atlantic* ocean between 64 and 67 degrees of north latitude, 500 miles off the coaſt of *Norway*, and almoſt as many north of *Scotland*, being about 300 miles in length, and 150 in breadth. The capital town is *Beſtede*, in the ſouth-weſt part of the iſland, ſubject to *Denmark*.

Weſt Greenland extends from the firſt meridian to 50 degrees of weſt longitude, and from 60 to upwards of 80 degrees of north latitude, and in a cold barren country with few inhabitants, but ſubject to the *Danes*, who have ſome colonies here; and claim the ſole right of fiſhing on the coaſt, which the *Dutch* diſpute with them.

Eaſt Greenland, or *Spitſberg*, lies between 10 and 30 degrees of eaſtern longitude, and between 77 and 82 degrees of north latitude, ſo cold and barren a country that there are no inhabitants, and few animals or vegetables; the very fiſh and fowl forſake the coaſt in winter. There is a night of of four months and upwards, the ſeas, as well as other waters, are frozen up in winter. But here is the beſt whale-fiſhery in the world, whither the *Dutch* reſort about *Midſummer*, and kill whales ſufficient to ſupply all *Europe* with whale-bone. The *Engliſh* begun this fiſhery, but were beaten out of it by the *Dutch* for ſome time; but they now have recovered it again, and improved it greatly. This country is ſuppoſed to be contiguous to *Weſt Greenland* by ſome, and to extend as far as the north pole, though it is generally taken to be an iſland.

The chief iſlands in the *Baltic* ſea, are *Zealand*, *Funen*, and *Laland*; which belong to *Denmark*, and are ſituate at the entrance of the *Baltic* ſea.

The iſlands of *Aland*, *Gothland*, *Oeland*, *Bornholm*, and *Rugen*, which belong to *Sweden*.

The iſlands of *Dagoe* and *Oſel*, on the coaſt of *Livonia*, which are ſubject to *Ruſſia*.

The middle diviſion of *Europe* contains *Poland*, *Germany*, the *Auſtrian* dominions in and contiguous to *Germany*, the *Netherlands*, and *France*.

Poland is ſituate between 46 degrees 30 minutes, and 57 degrees 30 minutes north latitude, and between 16 and 34 degrees of eaſt longitude, being bounded by the *Baltic* ſea, *Livonia*, and *Ruſſia* on the north; by *Ruſſia* and *Budziac Tartary* on the eaſt; by *Beſſarabia*, *Moldavia*, *Tranſilvania*, and *Hungary*, (from which it is ſeparated by the *Carpathian* mountains) on the ſouth, and by *Sileſia* and *Brandenburgh* on the weſt; being 660 miles in length from north to ſouth, and 560 in breadth from eaſt to weſt. The chief towns are *Warſaw*, *Cracow*, and *Dantzick*.

The chief rivers in *Poland* are the *Viſtula*, the *Memen*, the *Dwina*, the *Nieper* or *Boryſthenes*, the *Nieſter*, and the *Bog*. The moſt conſiderable hills are the *Carpathian* mountains, which divide *Poland* from *Hungary* and *Tranſilvania*.

Poland is a republic, with a king at the head of it, who is elected by the gentlemen of the country when the throne is vacant; but both the legiſlative and executive power is lodged chiefly in the ſenate, and diet or parliament; the king however has the nomination of officers, but can diſplace none without the concurrence of the diet.

 The

The *Auſtrian* dominions contiguous to *Germany* are the kingdoms of *Bohemia* and *Hungary*, *Tranſilvania*, *Sealvonia*, and *Croatia*.

The kingdom of *Bohemia* comprehends *Bohemia Proper*, part of *Sileſia* and *Moravia*, and is ſituated between 48 and 52 degrees of north latitude, and between 12 and 19 degrees of eaſt longitude, extending near 300 miles in length, and 250 in breadth. The chief towns *Prague*, *Breſlaw*, and *Olmuts*.

Hungary is ſituate between 45 and 49 degrees of north latitude, and between 16 and 23 degrees of eaſtern longitude, being bounded by the *Carpathian* mountains which divide it from *Poland* on the north; by *Tranſilvania* and *Walachia* on the eaſt; by the river *Drave*, which divides it from *Servia* and *Sclavonia* on the ſouth; and by *Auſtria* and *Moravia* on the weſt: and is 300 miles in length from eaſt to weſt, and 240 in breadth from north to ſouth.

The chief towns are *Preſburg* and *Buda*.

Tranſilvania is ſituate between 45 and 48 degrees of north latitude, and between 22 and 26 degrees of eaſt longitude, being bounded by *Poland* on the north, by *Moldavia* and *Walachia* on the eaſt, by *Bulgaria* on the ſouth, and by *Hungary* on the weſt, being 200 miles in length from north to ſouth, and 120 miles in breadth from eaſt to weſt.

The chief rivers are the *Atlanta*, and *Meriſh*: the chief mountains the *Carpathian*, which divide it from *Hungary*, and the *Irongate* mountains, which divide it from *Turky*: and the chief town is *Hermanſtat*.

Tranſilvania was heretofore a diſtinct principality, but is now annexed to *Hungary*, as well as the bannat of *Temeſwaer*, and ſubject to the crown of *Hungary*

Sclavonia is ſituate between 45 and 47 degrees of north latitude, and between 16 and 21 degrees of eaſtern longitude, bounded by the rivers *Drave* and *Danube*, which divide it from *Hungary* on the north-eaſt, and by the river *Save*, which ſeparates it from *Boſnia* and *Servia* on the ſouth-weſt, being 200 miles and more in length, and 60 in breadth. The chief town is *Poſega*. The chief rivers are the *Danube*, the *Drave*, and the *Save*. This country alſo is ſubject to the *Auſtrian* family, who are as abſolute here, as in *Hungary*.

Croatia is ſituate between 45 degrees 30 minutes, and 46 degrees 20 minutes north latitude, and between 16 and 18 degrees of eaſt longitude, bounded by *Sclavonia* on the north and eaſt, by the river *Unna* which divides it from *Boſnia* on the ſouth, and by *Carniola* on the weſt, being about 70 miles long and 60 broad. The chief town is *Carlſtat*. The chief rivers are the *Save*, the *Culp*, and the *Unna*. This country is alſo ſubject to the houſe of *Auſtria*.

Germany Proper is ſituated between 45 and 55 degrees of north latitude, and between 5 and 19 degrees of eaſt longitude, bounded by the *German* ocean, *Denmark* and the *Baltic* ſea on the north, by *Poland* and *Hungary* (if we include *Bohemia*) on the eaſt, by *Switzerland* and the *Alps*, which ſeparate it from *Italy* on the ſouth, and by the dominions of *France* and the *Netherlands* on the weſt: being divided into ten circles, *viz.* 1. three circles in the north of *Germany*, i. e. the circle of *Upper Saxony*, the circle of *Lower Saxony*, and the circle of *Weſtphalia*.

2. Three circles about the middle of *Germany*, *viz.* the circle of *Franconia*, the circle of the *Upper Rhine*, and the circle of the *Lower Rhine*.

3. Three circles in the ſouth of *Germany*, *viz.* the circle of *Auſtria*, the circle of *Bavaria*, and the circle of *Swabia*.

In the circle of *Upper Saxony* is, 1. The marquiſate of *Brandenburg*, ſubject to the elector of *Brandenburg* (king of *Pruſſia*). 2. The dutchy of *Pomerania*, ſubject to the ſame prince, and the king of *Sweden*. 3. The dutchy of *Saxony*, *Miſnia*, *Luſatia*, and *Thuringia*, the greateſt part whereof is ſubject to the elector of *Saxony* (king of *Poland*).

The chief towns in the circle of *Upper Saxony* are, 1. *Berlin*, the capital of *Brandenburgh*. *Note*, The elector of *Brandenburgh*, has at preſent the largeſt territories of all the ſovereigns of *Germany*, except the king of *Bohemia*; for beſides his marquiſate, he is poſſeſſed in *Weſtphalia* of the principality of *Minden*, of the dutchy of *Cleves*, of the counties of *La Mark*, of *Revenſperg*, and of the lordſhip of *Revenſtein* in *Brabant*. He holds in *Lower Saxony*, the principalities of *Magdeburg*, and of *Alberſtad*: the ulterior *Pomerania*, and the ducal *Pruſſia*; alſo was declar'd legitimate heir of *Neuchatell*, and *Velangin*, to the excluſion of the other pretenders; and, laſtly, he has almoſt all *Sileſia*.

2. *Stetin*, the capital of *Brandenburg Pomerania*.

3. *Stralſund*, the capital of *Swediſh Pomerania*.

4. *Dreſden*, the capital of *Miſnia*, and of all the elector of *Saxony*'s *German* dominions.

The countries comprehended in the circle of *Lower Saxony* are the dutchies of *Hanover*, *Zell*, *Luneburg*, *Bremen*, and *Verden*, ſubject to the elector of *Hanover*, king of *Great Britain*. The dutchies of *Brunſwick* and *Wolfembuttle*, ſubject to the duke of *Brunſwick* and *Wolfembuttle*. The biſhoprick of *Hildeſheim*, ſubject to the elector of *Cologn*. The dutchies of *Magdeburg*, and *Halberſtat*, ſubject to the elector of *Brandenburg*. The dutchy of *Holſtein*, ſubject to the king of *Denmark*, and the duke of *Holſtein*. The dutchy of *Mecklenburg*, ſubject to the duke; and the dutchy of *Lawenburg*, ſubject to the elector of *Hanover*.

The

The chief towns in the circle of *Lower Saxony* are, 1. *Hanover*, the capital of the king of *Great Britain*'s *German* dominions.

2. *Brunſwick*, the capital of the duke of *Brunſwick Wolfembuttle*'s territories.

3. *Magdeburg*, the capital of the elector of *Brandenburg*'s dominions in this circle.

4. *Guſtraw*, the capital of the duke of *Mecklenburg*'s dominions.

5. *Hamburgh*, an imperial city and port town, ſituate on the river *Elbe*.

6. *Lubeck*, an imperial city and port town, ſituate on the river *Trave*, near the *Baltic* ſea.

7. *Altena*, the capital of the king of *Denmark*'s territories in *Holſtein*.

8. *Lawenburg*, the capital of the dutchy of *Lawenburg*.

9. *Bremen*, the capital of the dutchy of *Bremen*, an *Imperial* city, ſituated on the river *Weſer*.

The countries comprehended in the circle of *Weſtphalia* are the dutchies of *Munſter* and *Weſtphalia*, the biſhopricks of *Oſnaburg* and *Paderborn*, ſubject to the elector of *Cologn*; the dutchies of *Juliers* and *Bergue*, ſubject to the elector *Palatine*; the dutchy of *Cleve*, and the counties of *Mark Ravenſburg* and *Bentheim*, ſubject to the elector of *Brandenburg*; the biſhoprick of *Liege*, ſubject to its biſhop; the counties of *Lippe*, *Schawenburg*, *Hoye*, *Diepholt*, *Oldenburg*, *Delmonhurſt*, *Embden*, *Tecklenburg*, *Pyrmont*, *Lingen*, *Steinfort*, *Corbey*, *Abbey*, and ſeveral towns and ſmall territories, ſubject to their reſpective ſovereigns.

The chief towns in *Weſtphalia* circle are, 1. *Munſter*, the capital of *Weſtphalia*.

2. *Duſſeldorp*, capital of the dutchy of *Berg*, and of the elector *Palatine*'s dominions in *Weſtphalia*.

3. *Aix la Chapelle*, or *Aken* an imperial city in the dutchy of *Juliers*, celebrated for its baths.

4. *Liege*, capital of the biſhoprick of *Liege*, ſituate on the river *Maes*.

The countries comprehended in the circle of *Franconia* are the territory of *Nurenburg*, the biſhopricks of *Bamberg* and *Wurtſburg*, the marquiſate of *Anſpach* or *Onſpach*, the counties of *Holach*, *Archſtet*, and *Wertheim*, and the territories of the grand maſter of the *Teutonick* order.

The conſiderable towns in the circle of *Franconia* are, 1. *Nurenburg*, the capital of the territory of *Nurenburg* and of all *Franconia*, an imperial city.

2. *Bamberg*, capital of the biſhoprick of *Bamberg*.

3. *Wurtsburg*, capital of the biſhoprick of *Wurtſburg*.

The countries comprehended in the circle of the *Upper Rhine* are the dutchy of *Deux Ponts*, the landgravates of *Heſſe-Caſſel* and *Heſſe-Darmſtat*, and formerly the landgravate of *Alſatia*, but that is now a province of *France*.

The chief towns in the circle of the *Upper Rhine* are, 1. *Heidelburg*, the capital of the *Palatinate*.

2. *Heſſe Caſſel*, the capital of that landgravate.

3. *Heſſe Darmſtat*, capital of that landgravate.

4. *Worms*, an imperial city, ſituate on the *Rhine*.

The countries comprehended in the circle of the *Lower Rhine*, are the three ſpiritual electorates of *Mentz*, *Triers*, and *Cologn*, and moſt part of the *Palatinate* of the *Rhine*, with the territory of *Francfort*.

The conſiderable towns in this electorate are, 1. *Mentz*, capital of the electorate of *Mentz*.

2. *Francfort*, ſituate on the river *Maine*, a free imperial city, ſometimes placed in the circle of the *Lower Rhine*, and at other times in *Franconia*.

3. *Triers* or *Treves*, ſituate on the river *Moſelle*, capital of the electorate of *Triers*.

4. *Cologn*, capital of the electorate of *Cologn*, and of all the circle of the *Lower Rhine*.

The countries contained in the circle of *Swabia* are the dutchy of *Wirtemburg*, the marquiſate of *Baden*, the *Burgaw*, the biſhopricks of *Saſburg* and *Conſtance*, the territories of *Ulm*, the *Briſgaw*, and ſeveral imperial cities and foreſt towns. Whereof the dutchy of *Wirtemburg* is ſubject to the duke of *Wirtemburg*, and the territories of *Baden* to the princes of *Baden*; the *Burgow*, *Briſgow*, *Foreſt Towns*, and ſeveral principalities of *Swabia*, are ſubject to the houſe of *Auſtria*.

The chief towns in *Swabia* are, 1. *Augſburg*, an imperial city, capital of the *Burgow*.

2. *Ulm*, an imperial city, ſituate at the confluence of the rivers *Danube* and *Iller*.

3. *Stutgart*, capital of the duke of *Wirtemburg*'s dominions, ſituate on the river *Neckar*.

4. *Conſtance*, ſituate on the lake of *Conſtance*, and ſubject to the houſe of *Auſtria*.

5. *Baden*, capital of the marquiſate of *Baden*.

6 *Friburgh*, capital of the *Briſgow*.

The countries contained in the circle of *Bavaria* are the dutchy of *Bavaria*, the palatinate of *Bavaria*, the dutchy of *Newburg*, the territory of *Saltsbach*, the archbiſhoprick of *Saltsburg*, and the biſhopricks of *Paſſau*, and *Freiſingen*.

The chief towns in *Bavaria* are, 1. The city of *Munich*, capital of the dutchy and electorate of *Bavaria*.

2. *Ratisbon*, an imperial city where the diet of the empire is uſed to be held.

3. *Amberg*, capital of the palatinate of *Bavaria*.

4. *Saltſburg*, the capital of the archbiſhoprick of *Saltsburg*.

5. *Newburg*, the capital of the dutchy of *Newburg*.

6. *Passau*, the capital of the bishoprick of *Passau*.

The Countries within the circle of *Austria* are the archdutchy of *Austria*, the dutchies of *Stiria*, *Carinthia*, and *Carniola*, the country of *Tyrol*, and the bishopricks of *Trent* and *Brixen*.

The chief towns in the circle of *Austria* are, 1. *Vienna*, the capital of the archdutchy of *Austria*, and of the *German* empire.

2. *Gratz*, the capital of the dutchy of *Stiria*.

3. *Clagenfurt*, the capital of the dutchy of *Carinthia*.

4. *Laubach*, the capital of the dutchy of *Carniola*.

5. *Inspruck*, the capital of the county of *Tirol*, situate on the river *Inn*.

6. *Trent*, the capital of the bishoprick of *Trent*, situate on the river *Adige*.

The considerable rivers in *Germany* are the *Danube*, the *Rhine*, the *Elbe*, the *Weser*, the *Oder*, the *Maes*, the *Inn*, the *Moselle*, and the *Havel*.

The *Germans* are not supposed to be furnished with a vast deal of wit, but they are very good artists, liberal, noble, brave, good, sincere, and very sociable; they are for the generality very handsome, and of a strong constitution. They love naturally war, and good cheer; but they are not esteemed the best civilized people in *Europe*.

Note also, that the empire of *Germany* is composed of five sorts of powers, *viz.* the emperor, who is chief, but not master, since he can dispose of nothing but his own: the electors to the number of nine, *viz.* the archbishop of *Mentz*, high chancellor of the empire in *Germany*: the archbishop of *Triers*, high chancellor of the empire in *Gaul*: the archbishop of *Cologn*, high chancellor of the empire in *Italy*: the king of *Bohemia*, great cup-bearer: the duke of *Bavaria*, high steward: the duke of *Saxony*, grand mareschal: the marquis of *Brandenburg*, grand chamberlain: the count *Palatine* of the *Rhine*, high treasurer: the duke of *Hanover*, called likewise high treasurer: the ecclesiastick princes; the secular princes; the free-towns, which are as many republicks; some of those towns, or cities, are called imperial, and appear at the assemblies, or diets, on the benches of *Swabia* and of the *Rhine*: others are called *Hanse* towns, and appear under four colleges, whose seats are *Lubeck*, *Cologn*, *Brunswick*, and *Dantzick*: these towns have received the name *Hanse*, from the *German* words *An zee Stette*, i. e. cities situated on the sea; because the first which began the confederacy were all situated on the sea, or at least on some considerable rivers: they formed this confederacy, to maintain themselves mutually in trade; and they had once compting-houses in common, *viz.* one at *London*, in *England*; one at *Bruges*, in *Flanders*, and afterwards at *Antwerp*; one at *Novogrod*, in *Muscovy*, then at *Revel*, in *Livonia*, and afterwards at *Narva*; and the other at *Bergen*, in *Norway*.

The *German* powers depend no otherwise on the emperor, than by doing homage to him; otherwise, they can make war, alliances, and confederacies with foreign princes, provided they do not prove prejudicial to the empire.

The Netherlands are situate between 50 and 53 degrees north latitude, and between 2 and 7 degrees of east longitude, bounded by the *German* sea on the north, by *Germany* on the east, by *Lorrain* and *France* on the south, and by another part of *France* and the *British* seas on the west, extending near 300 miles in length, and 200 in breadth.

These provinces are 17 in number, whereof 7, which are under the dominion of the *Dutch*, are called the *United Provinces*, the other ten are called the *Austrian* and *French Netherlands*, being most of them subject to these powers.

The names of the *United Provinces* are, 1. *Holland*. 2. *Zealand*. 3. *Friesland*. 4 *Groningen*. 5. *Overissel*. 6. *Gelderland* with *Zutphen*, and 7. *Utrecht*.

The chief towns in the *United Provinces* are, 1. *Amsterdam*, the capital of the province of *Holland*, and of all the *United Provinces*.

2. *Rotterdam*, situate on the river *Maes*.

3. *Middleburg*, the capital of the province of *Zealand*, situate in the island of *Walcheren*.

4. *Nimeguen*, situate on the river *Waal*, in the province of *Gelderland*.

5. *Utrecht*, the capital of the province *Utrecht*, situate on the channel of the *Old Rhine*.

6. *Lewarden*, the capital of the province of *Friesland*.

The chief rivers in the *United Provinces* are the *Rhine*, the *Lech*, the *Waal*, the *Maes*, and the *Scheld*.

The names of the other ten provinces are, 1. *Brabant*. 2. *Flanders* 3. *Hainault*. 4. *Limburg*. 5 *Luxemburg*. 6. *Namur*. 7. *Artois*. 8. The *Cambresis*. 9. The marquisate of *Antwerp*. And 10. The lordship of *Malines*, or *Mechlin*: Of these the *French* possess the entire provinces of *Artois* and *Cambray*, part of *Flanders*, *Hainault* and *Luxemburg*; and the *Dutch* possess the north of *Brabant* and *Flanders*; all the rest are subject to the house of *Austria*.

The chief towns in the *Austrian* and *French Netherlands* are, 1. *Brussels*, the capital of *Brabant*, and of all the *Austrian Netherlands*, situate on the river *Senne*

2. *Ghent*, or *Gaunt*, the capital of *Austrian Flanders*, situate on the four rivers of the *Scheld*, *Lys*, *Lieue*, and *Mourwater*.

3.

3. *Lisle*, the capital of the *French Netherlands*, situate in the province of *Flanders*, on the river *Deule*.

4. *Mons*, the capital of *Hainault*, situate near the banks of the rivers *Haine* and *Trouille*.

5. *Namur*, the capital of the province of *Namur*, situate at the confluence of the rivers *Sambre* and *Maes*.

6. *Antwerp*, the capital of the marquisate of *Antwerp*, situate on the river *Scheld*.

7. *Malines*, or *Mechlin*, the capital of the lordship of *Mechlin*.

8. *Luxemburg*, the capital of the dutchy of *Luxemburg*, situate on the river *Else*

9. *Limburg*, the capital of the dutchy of *Limburg*, situate on the river *Vese*.

The principal rivers in *Flanders* are the *Maes*, the *Sambre*, the *Scheld*, the *Lys*, the *Scarpe*, the *Senne*, the *Mehain*, the *Deule*, the *Dyle*, and the *Demer*.

France is situate between 5 degrees west and 7 degrees east longitude, and between 43 and 51 degrees of north latitude, being bounded by the *English* channel, and the *Netherlands* on the north, by *Germany*, *Switzerland*, *Savoy*, and *Piedmont* on the east, by the *Mediterranean* sea and the *Pyrenean* mountains on the south, and by the bay of *Biscay* on the west, being almost square, and upwards of 500 miles over either way.

The provinces or governments in *France* are, 1. *Picardy*. 2. *Normandy*. 3. *Britanny*; and 4. the isle of *France*, on the north.—5. *Orleanois*, and 6. *Lionois*, in the middle.—7. *Guienne*, and *Gascony*. 8. *Languedoc*. 9. *Provence*; and 10 *Dauphine*, on the south.—11. *Burgundy*. 12. *Champagne*. 13. The *French Netherlands*. 14. *Lorraine*; and 15. *Alsace*, on the east.

The chief towns are, 1. *Paris*, the capital of the isle of *France*, and of the whole kingdom, situate on the river *Seyne*, in 48 degrees 50 minutes north latitude, and two degrees 25 minutes east longitude.

2. *Rouen*; capital of the province of *Normandy*, situate on the *Seyne*.

3. *Orleans*, capital of the government of *Orleanois*, situate on the river *Loyre*.

4. *Lions*, the capital city of the government of *Lionois*, situate at the confluence of the rivers *Rhone* and *Soane*.

5. *Thoulon*, or *Toulon*, the best port-town in *France*, is situate in *Provence*, on a bay of the *Mediterranean* opposite to the islands of *Hieres*.

6. *Thoulose*, the capital of the province of *Languedoc*, is situate on the river *Garonne*.

7. *Bourdeaux* the capital of the province of *Bourdelois*, and of the government of *Guienne* and *Gascony*, situate on the river *Garonne*.

8. *Nants*, a great port-town in the province of *Britanny*, situate on the river *Loyre*.

9. *Brest*, the most considerable port-town of *France* upon the ocean, situate on the coast of *Britanny*.

The chief rivers in *France* are the *Rhone*, the *Soane*, the *Garonne*, the *Loyre*, the *Seyne*, the *Dordonne*, the *Oyse*, the *Marne*, the *Aube*, the *Isere*, and the *Durance*.

The chief mountains are the *Alps*, which separates *France* from *Italy*; the mountains of the *Cevennes* and *Auverne*; the mountains of *Vauge*, which divide *Franche Comte* from *Alsace* and *Lorrain*; and the *Pyrennes*, which divide it from *Spain*.

The king of *France* in his dominions (the conquests excluded) promotes to eighteen *archbishopries*, a hundred and ten *bishopries*, to seven hundred and fifty *abbeys of monks*, without reckoning those who have been re-united to other commonalties or benefices; and to more than two hundred *abbeys of nuns*.

The *eighteen* ARCHBISHOPRICKS, are, *Aix*, *Alby*, *Ambrun*, *Arles*, *Auch*, *Besancon*, *Bourdeaux*, *Bourges*, *Cambray*, *Lyons*, *Narbonne*, *Paris*, *Rheims*, *Rouen*, *Sens*, *Toulouse*, *Tours*, *Vienne*.

The *hundred and ten* BISHOPRICKS, are, AGDE, *Agen*, *Air*, *Alet*, *Amiens*, *Angiers*, *Angouleme*, *Apt*, *Arras*, *Avranche*, *Autun*, *Auxerre*; BAYEUX, *Bayonne*, *Bazas*, *Beauvois*, *Belley*, *Bethléem*, *Beziers*, *Blois*, *Boulogne*, *St. Brieu*; CAHORS, *Carcassone*, *Castres*, *Châalons*, *Chalons*, *Chartres Cisteron*, *Clermont*, *Cominges*, *Condom*, *Cornoüaille*, *Conserans*, *Coutance*; DAX, *Die*, *Digne*, *Dole*; EVREUX; S. FLOUR, *Frejus*; GAP, *Geneve*, *Glandeve*, *Grace*, *Grenoble*; KEBEO LAITOUR, *Langres*, *Lâon*, *Lavaur*, *Leon*, *Lescar*. *Limoges*, *Lisieux*, *Lodeve*, *Lombes*, *Lucon*; MAACON, *S. Malo*, *Mande*, *Mans*, *Marseille*, *Meaux*, *Metz*, *Mirepoix*, *Montauban*, *Montpellier*; NANTES, *Nevers*, *Nice*, *Nimes*, *Noyon*; OLERON, *S. Omer*, *Orange*, *Orleans*; PAMIERS, *S. Papoul*, *S. Paul trois Chateaux*, *Perigueux*, *Perpignan*, *Poictiers*, *S. Pol de Leon*, *S. Pons de Tanieres*, *Puy*; RENNES, *Rieux*, *Riez*, *Rochelle*. *Rodez*; SAINTES, *Sais*, *Sarlat*, *Senez*, *Senlis*, *Soissons*, *Strasbourg*; TARBES, *Toul*, *Toulon*, *Tournay*. *Trequier*, *Troyes*, *Tulles*; VABRES, *Valence*, *Vennes*, *Vence*, *Verdun*, *Viviers*, *Usaiz*.

Turkey in *Europe*, is the south-east part of *Europe*, and comprehends all those countries, enumerated already in the general division of *Europe*, which lie between 36 and 44 degrees of north lat. and between 17 and 40 degrees of eastern long. extending 1000 miles and upwards in length from

from eaſt to weſt, and 500 miles in breadth from north to ſouth.

The chief towns of *Turkey* in *Europe*, are

1. *Conſtantinople*, ſituate on the *Boſphorus* or *Straight*, which ſeparates *Europe* from *Aſia*, being the capital of the province of *Romania*, and of the whole *Turkiſh* empire.

2. *Adrianople*, ſituate in the province of *Romania*.

3. *Belgrade*, the capital of the province of *Servia*, ſituate on the river *Danube*.

4. *Salonichi* or *Theſſalonica*, a port-town of *Macedonia*, ſituate on the *Archipelago*, or *Egean ſea*.

5. *Athens* or *Settines*, the capital of *Achaia* or *Livadia*.

6. *Napoli de Romania*, a port-town, the capital of the *Morea*.

7. *Lepanto*, ſituate on the gulph of *Lepanto* in the province of *Achaia*.

8. *Negropont* or *Egripos*, the capital of the iſland of *Negropont*, the largeſt iſland in the *Egean* ſea or *Archipelago*.

The chief rivers of *Turkey* in *Europe*, are the *Danube*, the *Save*, the *Alauta*, the *Nieſter*, and the *Pruth*.

The chief mountains are thoſe of *Rhodope* or *Argentum*, which divide *Romania* and *Macedon* from *Bulgaria* and *Servia*, and the mountain *Parnaſſus* in *Greece*.

The principal *Turkiſh* iſlands in *Europe* are the numerous iſlands in the *Archipelago* or *Egean* ſea, are all ſubject to the *Turks*, whereof part lies in *Europe*, and part in *Aſia*, of which the largeſt *European* iſland is that of *Negropont* already mentioned, anciently called *Eubea*, ſituate north eaſt of the coaſt of *Achaia* or *Livadia*, by which it is ſeparated by the narrow ſea called the *Euripus*, remarkable for its irregular tides, which flow ſometimes 13 or 14 times in 24 hours. The iſlands of *Lemnos*, *Sciros*, *Andros*, and *Melos*, are of a conſiderable extent. Theſe and the reſt, are inhabited chiefly by *Grecian* chriſtians.

Italy is ſituate between 38 and 46 degrees of north latitude, and between 7 and 19 degrees of eaſtern longitude, being about 600 miles long, and from 80 to 400 broad. It is bounded by *Switzerland*, and the *Alps*, which ſeparate it from *Germany* on the north, by the gulph of *Venice* on the eaſt, by the *Mediterranean* ſea on the ſouth, and by the ſame ſea and the *Alps*, which ſeparate it from *France*, on the weſt, and comprehends the following countries: viz. 1. The principality of *Piedmont*, the dutchy of *Savoy*, and the dutchy of *Monſerrat*, ſubject to the king of *Sardinia*. 2. The dutchies of [illegible] and *Parma*, ſubject to the [illegible]. The dutchy of *Modena*, ſubject to its own duke. 4. The large dominions of the republick of *Venice*; all which lie in the north of *Italy*. 5. The dutchy of *Tuſcany*, ſubject to the grand duke, the preſent emperor of *Germany*. 6. The little republic of *Lucca*. 7. The pope's extenſive territories, which laſt three lie in the middle of *Italy*. 8. The kingdom of *Naples*, which takes up the ſouth of *Italy*, and is ſubject to the king of the two *Sicilies*.

The chief towns in *Italy* are. 1. *Turin*, the capital of *Piedmont*, and of the king of *Sardinia*'s dominions, ſituate on the river *Po*.

2. *Chamberry*, the capital of *Savoy*.

3. *Genoa*, the capital of the republick of *Genoa*.

4. *Milan*, the capital of the dutchy of *Milan* and of the *Auſtrian* dominions in *Italy*.

5. *Mantua*, the capital of *Mantua*, ſituate in the middle of a lake.

6. *Parma*, the capital of the dutchy of *Parma*.

7. *Venice*, the capital of the *Venetian* dominions, ſituate on ſeveral iſlands at the bottom of the gulph of *Venice*, five miles from the continent.

8. *Florence*, the capital of the dutchy of *Tuſcany*, ſituate on the river *Arno*.

9. *Leghorn*, or *Livorno*, the moſt conſiderable port town in all *Italy*, ſituate on the *Tuſcan* ſea.

10. *Modena*, the capital of the dutchy of *Modena*.

11. *Lucca*, the capital of the republick of *Lucca*.

12. *Rome*, the capital of the *Campania*, and of all the pope's dominions, ſituate on the river *Tiber*, once the ſeat of univerſal empire.

13. *Naples*, the capital of the kingdom of *Naples*, ſituate on a bay of the *Tuſcan* ſea.

The moſt conſiderable rivers of *Italy* are the *Po*, the *Adige*, the *Stura*, the *Arno*, the *Tiber*, and the *Volturno*.

The higheſt mountains are the *Alps* which divide *Italy* from *Germany*, and *France*; and the *Appenine*, which run the whole length of *Italy*; and mount *Veſuvius* in *Naples*, remarkable for its vulcano.

The moſt conſiderable *Italian* iſlands are *Sicily*, *Sardinia*, *Corſica*, the *Lipari* iſlands, and that of *Elba*.

Sicily, is ſituate in the *Mediterranean* ſea, between 37 and 38 degrees 30 minutes north latitude, and between 12 and 15 degrees of eaſt longitude, being about 160 miles long, and 100 broad, ſeparated from the kingdom of *Naples* in *Italy*, by the narrow ſtraight of *Meſſina*.

The principal towns are 1. *Palermo*, the capital of *Sicily*.

2. *Meſſina*, a great port town, ſituate at the eaſt end of the iſland, oppoſite to *Regio* in *Naples*. This iſland with the kingdom of *Naples*, is ſubject

ject to *Don Carlos*, who stiles himself king of the *Two Sicilies*.

In the island of *Sicily*, is *Mount Etna*, the most terrible vulcano in *Europe*, which has by its eruptions and earthquakes, destroyed some of the best towns in the island.

Sardinia is situate in the *Mediterranean* sea, between 39 and 41 degrees of north latitude, and between 8 and 10 degrees of eastern longitude, being 140 miles in length from north to south, and 70 in breadth from east to west; the capital town *Cagliari*, situate on a bay of the sea, at the south end of the island in 39 degrees of north latitude, and 9 degrees of eastern longitude, subject to the king of *Sardinia*.

Corsica is situate between 41 and 43 degrees of north latitude, and between 9 and 10 degrees of east longitude, in the *Mediterranean* sea, separated from the island of *Sardinia*, on the south by the straight of *Bonifacio*; the chief town, *Bastia*, is situate on the east side of the island, in 42 degrees 40 minutes north latitude, and 9 degrees 50 minutes east longitude. The island is subject to the republic of *Genoa*.

Switzerland is situate between 45 and 48 degrees of north latitude, and between 6 and 10 degrees of east longitude, bounded by *Germany* on the north and east, by the territories of *Venice*, *Piedmont*, and *Savoy* in *Italy*, on the south, and by *France* on the west, being 180 miles in length from east to west, and 140 in breadth from north to south, consisting of a great many independent cantons, or republicks, of which those of *Bern*, *Zurick*, and the *Grisons*, are the chief.

The chief towns in *Switzerland* are 1. *Bern*, the capital of the canton of *Bern*, and of all *Switzerland*, situate on the river *Aar*..

2. *Coire*, the capital of the *Grisons*, situate on the river *Rhine*.

3. *Zurich* the capital of the canton of *Zurich*, situate at the north end of the lake of *Zurich*.

4. *Geneva*, situate on the river *Rhone*, at the west end of the lake *Lemain* or *Geneva*.

5. *Basil*, the capital of the canton of *Basil*, situate on the river *Rhine*, near the confines of *Alsace*.

6. *Baden*, the capital of the territory of *Baden*, where the states or representatives of the cantons assemble.

Switzerland is the most mountainous country in *Europe*, being situate on the *Alps*.

Several of the largest rivers also, have their sources here: *viz.* the *Danube*, the *Rhine*, the *Rhone*, and innumerable torrents, which fall precipitately from the mountains on the melting of the snow: and there are lakes on the tops of their highest mountains.

Spain is a peninsula, surrounded by the *Atlantic* ocean and the *Mediterranean* sea, except on the north east where it is joined to *France*, by the *Pyrenean* mountains, and is situate between 36 and 44 degrees of north latitude, and between 10 degrees west, and 3 degrees eastern longitude, being bounded by the bay of *Biscay*, part of the *Atlantic* ocean and *France* on the north, by the *Mediterranean* and the straight of *Gibraltar* and the *Atlantic* ocean on the south, and by the same *Atlantic* ocean on the west, being upwards of 600 miles in length from east to west, and almost as many in breadth; but in this description *Portugal* is included, which was once a province of *Spain*.

The provinces comprehended in the kingdom of *Spain* are, 1. *Galicia*. 2. *Asturia*. 3. *Biscay* on the north. 4. *Navarre*. 5. *Arragon*. 6. *Catalonia*. 7. *Valencia* on the east. 8. *Murcia*. 9. *Granada*. 10. *Andalusia* on the south. 11. *Old Castile*. 12. *New Castile*. 13. *Leon*, and 14. *Estremadura* in the middle of *Spain*.

The chief towns in *Spain* are 1. *Madrid*, the capital of the kingdom, situate in the province of *New Castile*.

2. *Toledo*, heretofore the capital of the kingdom, situate in the province of *New Castile*, on the river *Tagus*.

3. *Compostella*, the capital of *Galicia*.

4. *Bilboa*, the capital of the province of *Biscay*.

5. *Saragossa*, the capital of the province of *Arragon*.

6. *Barcelona*, the capital of the province of *Catalonia*.

7. *Valencia*, the capital of the province of *Valencia*.

8. *Carthagena*, in the province of *Mercia*, situate on a bay of the *Mediterranean*, one of the best harbours in *Spain*.

9. *Granada*, the capital of the province of *Granada*.

10. *Gibraltar*, a strong fortified port-town in *Andalusia*, situate on the straight, between the ocean and the *Mediterranean*, which separates *Europe* from *Africa*.

11. *Cadiz*, the most considerable port-town in *Spain*, chief station of the *Spanish* men of war and galleons, situate on the island of *Leon*, in the province of *Andalusia*.

12. *Seville*, the capital of the province of *Andalusia*, situate on the river *Guadalquivir*.

The most considerable rivers and mountains in *Spain* are the *Ebro*, the *Guadalquivir*, the *Guadiana*, the *Tagus*, the *Douro*, and the *Minho*.

The most considerable mountains are those of the *Pyrenees*, which separate *France* and *Spain*, and branches of those, under several names, run through

Spain from eaſt to weſt; it being generally a very mountainous country. *Mount Calpe* which covers the town of *Gibraltar* is one of the pillars of *Hercules*; that of *Mount Abile* in *Africa* on the oppoſite ſide of the ſtraight of *Gibraltar* being the other.

The chief *Spaniſh* iſlands are theſe anciently called the *Baleares: viz. Majorca, Minorca,* and *Ivica.*

Majorca the largeſt is ſituate between 2 and 3 degrees of eaſtern longitude, and between 39 and 40 degrees of north latitude; the chief town *Majorca.*

Minorca, the leaſt of theſe iſlands, is ſituate in 40 degrees north latitude, and 4 degrees of eaſt longitude; the chief town *Port mahone,* lately taken by *France* from *Great Britain.*

Ivica, is ſituate in 39 degrees of north latitude, and 1 degree of eaſt longitude.

Portugal is ſituate between 37 and 42 degrees of north latitude, and between 7 and 10 degrees of weſt longitude, being upwards of 300 miles in length from north to ſouth, and 100 in breadth; bounded by the *Spaniſh* province of *Galicia* on the north, by other parts of *Spain* on the eaſt, and by the *Atlantic* ocean on the ſouth and weſt.

The provinces comprehended in *Portugal* are 1. *Entre* and *Minho Douro.* 2. *Tralos Montes* on the north 3. *Beia,* and 4. *Eſtremadura* in the middle. 5 *Alentcio,* and 6. *Algarves* in the ſouth.

The chief towns are 1. *Liſbon,* the capital of the province of *Eſtremadura* and of the whole kingdom, ſituate near the mouth of the river *Tagus,* and the *Atlantic* ocean, in 38 degrees, 45 minutes north latitude, and 9 degrees weſt longitude. It was almoſt totally deſtroyed by an earthquake on *Nov.* 1, 1755, and is now rebuilding in a more magnificent taſte.

2. St. *Ubes,* ſituate on a bay of the *Atlantic* ocean.

3. *Porto,* ſituate near the mouth of the river *Douro,* and the ocean, in the province of *Entre Minho* and *Douro.*

The chief rivers in *Portugal,* are the *Tagus,* the *Guadiana,* the *Minho,* and the *Douro.*

There are ſeveral ſorts of governments in *Europe, viz.* The *monarchical*; as in *France, Spain,* &c. The *deſpotick,* as in *Turky,* and *Muſcovy*; the *ariſtocratical,* as the republick of *Venice* in *Italy*; the *democratical,* as that of *Switzerland,* and of the *united provinces.* Others, which are a mixture of *monarchy, ariſtocracy,* and *democracy*; as, in *England, Germany,* and *Poland.*

The *monarchial ſtate,* is that governed by a ſole ſovereign.

The *deſpotick,* is that where a ſovereign has power of life and death over his ſubjects, without any other formality than his own will.

The *ariſtocracy,* is that which is governed by the nobles.

The *democratick,* is that where the governors are choſen among the people.

There are ſeveral ſorts of *religions* profeſſed in *Europe*; though among ſo many there are but five principal, the others being only branches, or ſects of thoſe five.

1. The moſt general of the five is the ROMAN CATHOLICK RELIGION; which is the reigning one in *France, Spain, Portugal, Italy,* part of *Germany, Poland,* &c. and in all places, that belong in *America, Aſia* and *Africa,* to the crowns of *France, Spain, Portugal,* &c.

2. LUTHERANISM, profeſſed in *Germany,* in *Sweden, Denmark,* &c.

3. CALVINISM, profeſſed in *Scotland,* in ſome parts of *Germany, Poland,* &c.

4. The ESTABLISHED CHURCH OF ENGLAND, profeſſed in moſt of the BRITISH dominions.

5. The GREEK RELIGION, profeſſed in the dominions of the grand ſeignior, in *Muſcovy,* and in ſome parts of *Poland.*

EUROPE has five general LANGUAGES, four of which are natural to its inhabitants, *viz.* the *Latin, Greek, Teutonick, Eſclavonic,* and a foreign one which they have received from *Aſia,* and which is the *Tartarian,* under which is compriſed the *Turkiſh* tongue.

Europe has one prince eccleſiaſtick, three emperors, ten kings, ſix republicks, and more than three hundred ſovereign princes; whoſe eſtates are as fiefs or tributaries of ſuperior powers.

The eccleſiaſtick prince is the POPE, who ſtyles himſelf *Servus Servorum Dei.*

The three emperors are, the EMPEROR *of Germany,* called emperor of the holy *Roman* empire.

The EMPEROR *of the Turks,* who calls himſelf ſultan of the *Ottomans,* or grand ſeignior of the *Turks*

The EMPEROR *of Muſcovy,* who aſſumes the title of emperor, of the *Two Ruſſias*; vulgarly called *Czar* of *Muſcovy.*

The ten kings are;

The *moſt* CHRISTIAN KING, or king of *France,* who notwithſtanding the vaſt extent of his dominions, compoſed of ſeveral ſovereignties, *viz. Britanny, Normandy, Burgundy, Provence, Languedoc,* &c. takes no other title than that of king of *France* and *Navarre.*

The CATHOLICK KING, or king of *Spain.*

The KING OF GREAT BRITAIN, and *defender* of the *faith.*

The

The King of *Portugal*.
The King of *Sweden*.
The King of *Denmark*.
The King of *Poland*.
The King of *Prussia*.
The King of *Naples* and *Sicily*.
And the King of *Sardinia*.

The six republicks, are 1. *Venice*. 2. *Genoa*. 3. *Lucca* in *Italy*. 4. The *United Provinces*. 5. The *Switzers*. 6. The *Grisons*, in *Germany*.

The 300 subaltern sovereign Princes, are of two sorts, viz. *Ecclesiasticks* and *Laicks*.

Among the *Ecclesiasticks* are two *Grand Masters*.

1. The Grand Master of the *Knights of Malta*.

2. The Grand Master of the *Teutonick Order*.

Four *Archbishops*, and the three first *Electors* of the empire.

1. The Archbishop and Elector of *Mentz*
2. The Archbishop and Elector of *Treves*.
3. The Archbishop and Elector of *Cologn*.
4. The Archbishop of *Saltzbourg*.

Twenty-two Bishops, who are, 1. *Munster*. 2. *Paderborn*. 3. *Liege*. 4. *Worms*. 5. *Spire*. 6. *Strasbourg*. 7. *Basil*. 8. *Syon*. 9. *Coire*. 10. *Brisen*. 11. *Trente*. 12. *Constance* 13. *Augsbourg*. 14. *Frisingue*. 15. *Passau*. 16. *Ratisbon*. 17. *Richstott*. 18. *Wurtzbourg*. 19. *Bamberg*. 20. *Hidelsheim*. 21. *Osnabrug*. 22. *Lubeck*.

A Grand Prior of *Malta*, who calls himself *Grand Prior* of *Germany*.

Several Abbots, that of *Fulde*, who has a greater extent of lands than any of the others.

Several Prevosties, the most considerable of which is that of *Berchtelsgaden*.

Among the *Laick* Sovereigns, are five *Electors*.

1. The Elector and Duke of *Bavaria*.
2. The Elector and Duke of *Saxony*.
3. The Elector and Marquis of *Brandenburg*.
4. The Elector and Count *Palatine*.
5. The Elector and Duke of *Hanover*.

An Archduke of *Austria*.

A Gteat Duke of *Tuscany*.

The several *Dukes* are those of *Newbourg Weimar*, *Lunenbourg*, *Brunswick*, *Wertemberg*, *Mecklenbourg*, *Lawenbourg*, *Holstein*, &c. and all in *Germany*.

Those of *Savoy*, *Mantua*, *Modena*, *Parma*, and several others whose territories are of a lesser extent, are in *Italy*.

That of *Bouillou* is between *France* and the *Low-Countries*.

And that of *Courland* in *Poland*.

Among the *Marquisses*, the most considerable are, those of *Baden*, and *Durlach*, of *Anspach*, and of *Culmbach* in *Germany*.

And several in *Italy*, but whose territories are of a little extent.

Several Landgraves, some of whom are Princes, *viz*.

The Landgrave of *Hesse-Cassel*, and of *Hesse-Darmstad*.

Several *Princes*, and the most considerable among them are,

The Prince of *Anhalt* in *Germany*.

The Princes of *Monaco*, of *Solfarini*, and of *Castillione* in *Italy*.

Several *Counts* or *Earls*, among whom are the Princes, of *Nassau*, *Furstemberg*, *West-Friseland*, *Hohenzollern*, *Amberg*.

Besides whom are,

The Cham of the *Little Tartary*.

The *Vaivodes* of *Transilvania*, *Walachia*, *Moldavia*, and of *Ukrania*.

And the republick of Ragusa.—This republick, and the five last Princes, are tributaries of the *Ottoman* empire.

From *Europe*, we will pass into *Asia*, which is the most eastern, and the most extended of the parts, the antient world, or our continent, is composed of; chosen by a special favour, by the author of nature, for the creation of the first man. It has been the laboratory (if I may use that expression) where he has formed all his other works: It has the advantage of having served as a sacred temple, where the almighty has pronounced his oracles: It has furnished the matter on which he himself printed the sacred characters of his divine commandments, to give them to *Moses*: And it had the glory to witness the birth of the saviour of the world; to have possessed his divine presence during the whole course of his mortal life; having been as a new temple, where he has accomplished the mysteries of our redemption.

I will say more, that it is from *Asia* all the colonies which have peopled the other parts of the world have been taken; that it has been the seat of the most antient and most powerful monarchies of the earth: For after the deluge, it saw the beginning of the empire of the *Assyrians* by *Belus*, or *Ninus*, which continued as far as *Sardanapalus*: It passed afterwards to the *Medes* by *Arbaces*, as far as *Astyages*; to the *Persians* by *Cyrus*, as far as *Darius*; and to the *Greeks* by *Alexander the Great*. The *Parthians* established there likewise a very flourishing empire, which ended under *Alexander Severus*, and passed to the *Persians*, till it was swallowed up by the *Turks* and *Saracens*.

Christianity, *Mahometanism*, and *Paganism*, are the three reigning religions in *Asia*.—*Christianity*, is divided into eleven sects, *viz* 1. Of the *Greeks*; 2. Of the *Russians*; 3. Of the *Georgians*; 4. Of the *Syrians*; 5. Of the *Jacobites*; 6. Of the *Armenians*; 7. Of the *Nestorians*; 8. Of the *Cophts*, or *Egyptians*; 9. Of the *Abyssines*, or *Abyssinians*; 10. Of the *Maronites*; and 11. Of St. *Thomas*: These two last acknowledge, at present, the *Roman* church.—The *Greek* is the religion of the natives of part of *Turky* in *Asia*, whose patriarch is that of *Constantinople*.—The *Russian* is professed in the dependencies of that empire, whose patriarch resides at *Moscow*.—The *Georgian* is the religion of the people of *Mingrelia*, who have their own patriarch.—The *Syrian*, extends in *Syria*, or *Seristan*, which is a province of *Turky* in *Asia*, whose patriarch is that of *Antioch*, residing at *Damascus*.—That of the *Jacobites* is in the *Diarbeck*, or *Mesopotamia*, and in the *Holy Land*, under two patriarchs; one residing at *Caraemid*, who stiles himself patriarch of *Antioch*; and the other at *Jerusalem*, for the *Holy Land*.—That of the *Armenians*, is professed in both *Armenia's*, under two patriarchs, one for the *great*, and the other for the *little Armenia*.—That of the *Cophts*, is in *Egypt*, whose patriarch is that of *Alexandria*, residing at *Cairo*.—That of the *Abyssines*, is that of the dependencies of the empire of the same name.—That of the *Nestorians*, extends in the *Erzerum*, or *Assyria*, in the *Diarbeck*, the *Gerack*, or antient *Chaldæa*, and in some provinces of *Persia*, under the patriarch of *Mosul*, which is the antient *Niniveh*; this sect was once the most extended. Among all these schismatical sects, there are but the *Russian*, *Abyssinian*, and *Georgian*, which are professed by sovereign princes; the others being most of them subject to the *Mahometan* princes, in whose dominions they are professed.

The *Mahometanism* in *Asia*, is almost the sole religion of *Arabia*; and is the reigning one of *Turky* in *Asia*, of *Persia*, of the *Mogul*, of the western parts of the *great Tartary*, of the northern part of the peninsula of *India*, this side the river *Ganges*, of the *Maldivia Islands*, and of most of the *Isles of Sunda*, and of the *Molucca's*.

Among the *Pagan* sects, that of the *Parsis*; was antiently the reigning religion of *Persia*; but ever since *Mahometanism* has gained the ascendancy, there are but few of the natives who profess it, some of whom have settled on the coasts of the *Mogul*, near *Persia*, and in some places of the peninsula of *India*, this side the river *Ganges*.—The religion of the *Brachmans*, was once the only one of all *Indostan*, and of the peninsula, this side the river *Ganges*; and since *Mahometanism* has been established in those countries, it is yet the most followed religion, and most general of the natives of the dominions of the *Mogul*, and of the *Mahometan* states of the peninsula of *India*, this side the *Ganges*; is the reigning one in other dominions of the same peninsula, and those of the *Rayas* of *Indostan*, who have maintained themselves against the *Mogul*.—The religion of *Jukaio*. is the particular religion of men of letters in *China*, and that of the court.—The religion of the *Laura*, is also professed no where but in *China*.—That of the *Lamas*, which has some remains of christianity, is the religion of all the regions of *Tartary*, near *China*, as of the *Thibet*, of *Tangu*, *Kin*, and has been introduced in *China* by the conquest the *Tartars* have made of that country.—*Judaism* is also professed throughout all *Asia*, but is subject to the three others above-metioned.

Asia has six *general languages*, and *five particular ones*.

Among the *general languages*, three are natural to it, *viz*. the *Arabic*, *Tartarian*, and *Chinese*; and three foreign, which it borrows from *Europe*, *viz*. the *Greek*, *Latin*, and *Teutonic*.

The five *particular languages* are the *Japanese*, the *Armenian*, the *Guzarate*, *Malabar*, and *Malayan*.—The *Japanese* is the only one of the inhabitants of *Japan*, without any mixture of foreign languages.—The *Armenian* is very much in use for the commerce in *Turky*, and *Persia*.—The *Guzarate*, *Malabar*, and *Malayan*, have their course on the coasts of *India*, and in the neighbouring islands; particularly the *Malayan*, which is esteemed the most beautiful and elegant of the *East-India*.

Asia is situate between the equator and 72 degrees north latitude, and between 25 and 148 degrees of east longitude, being 4800 miles in length from east to west, and 4300 in breadth, from north to south, comprehending,

1. The empire of *China*, and *Chinesian Tartary*, *Tibet*, and independent *Tartary*, with *Japan* and the other oriental islands in the east. 2. *India*, *Usbeck Tartary*, *Calmuck Tartary*, and *Siberia* in the middle. 3 The kingdom of *Persia*, *Arabia*, *Astracan*, *Circassian Tartary*, and *Turky* in *Asia* on the west; and is bounded by the frozen ocean on the north, by the pacific ocean on the east, by the *Indian* Ocean on the south, by the Red sea, which separates it from *Africa*, on the south-west, and by *Europe* on the north-west.

China, comprehending *Chinesian Tartary*, is situate between 95 and 139 degrees of eastern longitude, and between 21 and 25 degrees north latitude,

tude, being about 2000 miles in length from north to south, and 1000 miles in breadth, from east to west; bounded by *Russian Tartary* on the north, by the pacific ocean on the east and south, and by *Tonquin Tibet*, and the territories of *Russia* on the west.

The chief towns in *China* are.

1. *Peking*, the capital of the province of *Peking*, and of the whole empire

2. *Nanking*, the capital of the province of *Nanking*, situate near the mouth of the river *Kiam* and the *Kang* sea.

3. *Canton*, the capital of the province of *Canton*, situate on the river *Ta*.

The chief rivers are the *Croceeus* or *Hoombo*, and the *Kiam*; and there are two considerable islands on the coast of *China*, subject to that empire, *viz*. *Hainan*, in the south of *China*, and *Formosa*, on the south-west of *China*.

Tibet and independent *Tartary* lie between 30 and 35 degrees of north latitude, and between 75 and 85 degrees of eastern longitude, having *Siberia* on the north, *China* on the east *India* on the south, and the *Usbeck* and *Calmuck Tartars*, and another part of *Siberia* on the west.

The islands of *Japan* are situated between 30 and 40 degrees north latitude, and between 130 and 140 degrees of east longitude, of which there are great numbers, but the three chief are those of 1. *Japan Proper* or *Niphon*. 2. *Sacock*, and 3. *Tonsa*.

1. *Japan Proper*, the most northerly of these islands, is about 600 miles in length from north to south, and from 100 to 150 miles broad.

2. *Sacock*, is about 500 miles in circumference.

3. *Tonsa*, is 400 miles in circumference.

The chief towns are, 1. *Jeddo* or *Yedo*, the capital of the empire.

2. *Saccai*, *Bongo*, and *Nangasaque*.

The other islands comprehended under the name of the oriental islands, are all the islands south of *China*, and the farther *India* may properly be called the oriental islands, particularly, 1. The *Philippine* islands. 2. *Gilolo* with the *Moluccas* or clove islands. 3. *Ceram* with *Amboyna*, *Banda*, and the rest of the nutmeg islands 4. *Celebes* or *Macassar*. 5. *Borneo*. 6. *Java*, with the islands of *Bally* and *Florin*, and the rest of the islands east of *Java*, And 7. The island of *Sumatra*.

The *Phillipine* islands are very numerous, and lie between 5 and 19 degrees north latitude, and between 114 and 127 degrees of east longitude, whereof the islands of *Manilla* or *Luconia*, and *Mindanao* are the chief.

1. That of *Manilla* or *Luconia* is 400 miles long and 200 broad. The chief town *Manilla*.

The island of *Mindanao*, is situate between 5 and 10 degrees of north latitude, and between 120 and 126 degrees of east longitude. The chief town *Mindanao*.

2. *Gilolo* with the *Molucca* or clove islands, are situate between 1 degree of south latitude, and 2 degrees north latitude. The chief of the clove islands is *Ternate*, situate in 1 degree 15 minutes north latitude, and 12 degrees of east longitude, scarce 30 miles in circumference. This with the rest of the clove islands was usurped by the *Dutch* in the reign of king *James* I. and the cloves are now eradicated and planted only in the island of *Amboyna*, which is situate in 3 degrees 40 minutes south latitude, and 126 degrees of east longitude. It was here that the *Dutch* tortured and massacred several of the *English* factors and merchants, and then drove the rest out of the clove islands.

3. *Ceram* and the islands of *Banda*, which only produce nutmegs, are situate between 3 and 4 degrees of south latitude, and between 125 and 129 degrees of east longitude. Here the *Dutch* destroyed both the *English* and the natives in the reign of king *James* I. usurped the dominion of these islands also, and have kept possession of them ever since.

4 The island of *Celebes* or *Macassar*, is situate between 2 degrees north and 6 degrees south latitude, and between 116 and 124 degrees of east longitude, being 500 miles long, and 200 broad, The chief town *Macassar*.

5. *Borneo*, the largest island in the known world, situate between 7 degrees 30 minutes north latitude, and 4 degrees of south latitude, and between 107 and 117 degrees of eastern longitude. It is fruitful in the best pepper. The chief town *Borneo*.

6. The island of *Java*, situate between 5 and 8 degrees of south latitude, and between 102 and 113 degrees of east longitude. The capital city *Batavia*. The capital of all the *Dutch* settlements in *Asia*, and the east coast of *Africa*.

7. The island of *Sumatra*, situate between 5 degrees south, and 5 degrees north latitude, and between 91 and 105 degrees of east longitude. The capital city *Achen*, situate at the north end of the island.

The two last are usually called the *Sunda* islands, from the straights of *Sunda*, which lie near them between *Java* and *Sumatra*.

India is usually divided into two parts, the one beyond the river *Ganges*, contiguous to *China*, and the other on this side the *Ganges*, next to *Persia*.

India beyond the *Ganges* comprehends, 1. *Tonquin*. 2. *Cochin China*. 3. *Laos* 4. *Cambodia*. 5. *Siam* and *Malacca*. 6. *Pegu*, *Ava*, and *Acham*.

1. Ton-

1. *Tonquin* is ſituate between 17 and 26 degrees of north latitude, and between 101 and 108 degrees of eaſt longitude, bounded by *China* on the north and eaſt, by *Cochin China* on the ſouth, and by the kingdom of *Laos* on the weſt. The capital city *Cachao* or *Keccio*.

2. *Cochin China*, ſituate between 104 and 109 degrees of eaſt longitude, and between 10 and 17 degrees of north latitude, bounded by *Tonquin* on the north, by the *Indian* ocean on the eaſt and ſouth, and by *Cambodia* on the weſt.

3. *Laos* is bounded by *China* on the north, by *Tonquin* on the eaſt, by *Siam* and *Cambodia* on the ſouth, and by *Ava* and *Pegu* on the weſt.

4. *Cambodia*, ſituate between 8 and 15 degrees of north latitude, bounded by *Laos* on the north, by *Cochin China* on the eaſt, by the *Indian* ocean on the ſouth, and by the bay of *Siam* on the weſt. The chief town *Cambodia*.

5. *Siam* including *Malacca*, is ſituate between the equator and 18 degrees of north latitude, and between 92 and 102 degrees of eaſt longitude. The chief towns *Siam* and *Malacca*.

Malacca, the capital of the territory of *Malacca*, is ſituate on the ſtraight between *Malacca* and *Sumatra*, to which it gives name, and with the adjacent country is ſubject to the *Dutch*, who being maſters of this ſtraight, and that of *Sunda*, have it in their power to exclude all nations from trading to *China* and the oriental iſlands on the eaſt.

6. *Pegu*, including *Ava* and *Acham*. Theſe countries are ſituate on the eaſt ſide of the bay of *Bengal*, between 15 and 25 degrees of north latitude, and between 91 and 100 degrees of eaſtern longitude. The capital city is *Pegu*.

Beſides the iſlands already mentioned, are thoſe of the *Ladrones*, ſituate in the pacific ocean, in 140 degrees of eaſt longitude, and between 12 and 28 degrees of north latitude. Alſo the *Andaman* and *Nicobar* iſlands, near the coaſt of *Siam*, on the eaſt ſide of the bay of *Bengal*.

India on this ſide the *Ganges*, or the hither *India*, moſt properly called *India*, or *Indoſtan*, is ſituate between 7 and 40 degrees of north latitude, and between 66 and 92 degrees of eaſt longitude, being about 2000 miles in length from north to ſouth, and from 300 to 1500 in breadth from eaſt to weſt, bounded by *Uſbeck Tartary* and *Tibet* on the north, by another part of *Tibet*, the kingdoms of *Acham*, *Ava*, and *Pegu* on the eaſt, by the bay of *Bengal*, and the *Indian* ocean on the ſouth, and by the ſame ocean and the kingdom of *Perſia* on the weſt. The chief towns *Agra*, *Delly*, *Lahor*, and *Surat*.

The chief rivers are thoſe of *Ganges*, *Indus*, and *Attock*.

The chief mountains are thoſe of *Balegate*, which run through the middle of *India* from north to ſouth, and thoſe which divide *India* from *Tartary* called *Balch* and *Bember*, ſaid to be branches of *Mount Caucaſus*.

Uſbeck Tartary, and *Mogul* or *Mogul Tartary* are the ſame; this being the country of *Tamerlane*, the firſt great *Mogul*, who was not only ſovereign of theſe countries, but of *Perſia* and *India*, and from whom the *Moguls* of *India* are deſcended.

The preſent country denominated *Uſbeck Tartary* is ſituate between 35 and 45 degrees of north latitude, and between 64 and 77 degrees of eaſt longitude, having the *Calmuck Tartars* on the north, independent *Tartary* on the eaſt, *India* and *Perſia* on the ſouth, and a deſert which lies between this country and the *Caſpian* ſea on the weſt.

Their chief towns are *Bochara* and *Samarcand*.

The *Calmuck Tartars* lie north of *Uſbeck Tartary*, and the *Caſpian* ſea, and have no towns or ſettled habitation, but have lately put themſelves under the protection of *Ruſſia*, and therefore may now well be eſteemed a part of *Siberia*.

Siberia, if we include *Calmuck Tartary*, is ſituate between 44 and 72 degrees north latitude, and between 60 and 100 degrees of eaſt longitude, bounded by the frozen ocean on the north, by the pacific ocean, *China*, and independent *Tartary* on the eaſt, by another part of independent *Tartary* and *Uſbeck Tartary* on the ſouth, and *European Ruſſia*, and *Aſtracan* on the weſt. The chief town *Toboliski*.

Perſia is ſituate between 25 and 45 degrees of north latitude, and between 45 and 67 degrees of eaſt longitude, being 1200 miles long, and almoſt as many broad, bounded by *Circaſſian Tartary*, the *Caſpian* ſea and the river *Oxus*, which ſeparates it from *Uſbeck Tartary* on the north; by *India* on the eaſt, by the *Indian* ocean, the gulphs of *Ormus* and *Boſſora* on the ſouth, and by the *Turkiſh* empire on the weſt. The chief towns are, *Iſpahan*, *Schiras*, *Gombron*, *Meſched*, *Aſterabat*, and *Tauris*.

The chief rivers in *Perſia*, are the *Kur* or *Cyrus*, *Arras* or *Araxes*, *Oxus*, and *Herat*.

The chief mountains, *Caucaſus*; of which *Ararat* is a part, ſituate between the *Euxine* and *Perſian* ſeas; and mount *Taurus*, which runs croſs *Perſia* from *Turky* to *India*; the branches whereof very much incumber this kingdom, it being one of the mountainous countries in *Aſia*, and has at the ſame time ſcarce one navigable river.

Arabia is ſituate between 11 and 30 degrees of north latitude, and between 35 and 60 degrees of eaſt longitude, being upwards of 1200 miles in length and 900 in breadth, bounded by *Turky* on the north, the kingdom and gulph of *Perſia* or *Boſſora* on the eaſt, the *Indian* ocean on the ſouth,

and

and the *Red-sea* which separates it from *Africa* on the west: the north-west part of it, between *Egypt* and *Palestine*, is denominated *Arabia Petræa*, the middle of it *Arabia Deserta*, and the south *Arabia Felix*; but the limits of any of them have never been exactly described

The chief towns are *Medina*, *Mecca*, *Mocho*, *Aden*, *Muscat*, and *Bossora*.

Medina is remarkable for *Mahomet*'s tomb, situate in 24 degrees.

Mecca is celebrated for the *Kaaba* or *Holy-House* to which the *Mahometan* nations go in pilgrimage, and for being the place of *Mahomet*'s nativity.

There are no navigable rivers in *Arabia* but the *Euphrates* and *Tigris*, which unite their streams in the province of *Iraca Arabia*, and fall into the gulph of *Persia*, or *Bossora*, a little below the City of *Bossora* in 30 degrees north latitude.

There are several mountains, among which those of *Mount Sinai* and *Mount Horeb* in *Arabia Petræa*, are the most remarkable.

Turkey in *Asia* is situate between 30 and 44 degrees of north latitude, and between 26 and 45 degrees of east longitude, comprehending the counties of 1. *Diarbeck*, the ancient *Mesopotamia*. 2. *Curdestan*, part of the ancient *Assyria*. 3 *Turcomania*, the ancient *Armenia*. 4. Part of *Georgia*, *Mengrelia*, and *Circassia*. 5. *Syria* and *Palestine*; and 6. *Natolia* or *Asia Minor*.

The chief towns of *Turkey* in *Asia* are,

1. *Erzerum*, the capital of the province of *Turcomania* or *Armenia*.

2. *Diarbec*, the capital of the province of *Diarbec* or *Mesopotamia*.

3. *Aleppo*, the capital of the *Beglerbelic* of *Aleppo*.

4. *Jerusalem*, the capital of *Palestine*.

5. *Damascus* or *Scham*, the capital of *Syria*.

6. *Smyrna*, a port town in the lesser *Asia*, situate on a bay of the *Archipelago*.

7. *Bursa* or *Prusa*, the capital of *Bythinia*.

8. *Tocat*, the capital of the province of *Amasia* in the lesser *Asia*.

9. *Trepisond* or *Trapesond*, a port town of *Amasia* in the lesser *Asia*, situate in the *Euxine* sea.

The chief rivers and mountains of *Turkey* in *Asia* are the *Tigris* and *Euphrates*.

The mountains are *Taurus*, *Anti-taurus*, *Caucasus*, *Ararat*, *Libanus*, mount *Zion*, the mountains about *Jerusalem*, and mount *Olympus* in *Bythinia*.

The kingdom of *Astracan* is part of the *Russian* dominions in *Asia*, and situate on the north side of the *Caspian* sea, between 45 and 50 degrees of north latitude, and between 51 and 57 degrees of east longitude.

Astracan city, the capital of the kingdom, is situate on the river *Wolga*, in 47 degrees north latitude, and 52 degrees of east longitude.

Africa. This part of the antient world is the most southern, and the greatest peninsula of the universe. *Josephus* assures us, that the word *Africa* comes from *Afer*, *Abraham*'s grandson.

It extends from 35 degrees of northern latitude, to 35 of southern latitude; and from 3 degrees of longitude, to 83; so that it may have 1600 leagues in length, at the altitude of the river *Niger*, about half under the equator, and always diminishing as one goes southward: it has very near 1400 leagues in breadth, towards the lake *Zaire*, and about 600 in *Guinea*: therefore it is believed to have more than 5000 leagues of coasts.

It confines northward with the *Mediterranean*; eastward with the isthmus of *Suez*, the *Red Sea*, and the eastern ocean; southward with the sea of *Ethiopia*; and westward with the *Atlantick*.

Its situation shews us, that the equator passes justly in the middle, and that two thirds thereof are in the torrid zone, which renders the climate extremely hot: add to this, that the middle of the country is full of shining sand, which reflects the rays of the sun with a burning and insupportable heat. All this sandy land is unculivated, very little inhabited, and abounds with ferocious beasts: among which are found the lion, the leopard, the panther, the elephant, the monkey, the wild horse and ass, the sea-ox and horse, the camel, &c. the sheep, oxen, &c. are very good, and extraordinary large and fat. The soil produces delicious fruit, and medicinal plants: it has in several places mines of gold and silver, and some of salt.

Its most considerable rivers are the *Nile* and the *Niger*; the first springs from the lake *Zaire*, or from a small river which enters into it in *Abyssinia*, which it traverses from south to north by east; as it does *Nubia* and *Egypt* from south to north. It disembogues into the *Mediterranean* through several mouths, after it has divided itself into several branches, which form a triangle, called the *Delta* of *Egypt*, because it has very near the form of that *Greek* letter. The *Niger* takes its source from a lake of the same name in *Abyssinia*, runs from south to north between that empire and the kingdom of *Congo*; then entering the kingdom of *Borno*, loses itself in the mountains; then appears again near the lake *Borno*, thro' which it passes, and traverses afterwards all *Nigritia* from east to west, forming the island which the *Arabs* call *Nub*, between *Gangara* and *Zanfara*, and the lake *Guarda*, in the kingdom of the *Agades*; then, before it disembogues into the ocean, it divides itself into several branches, the most considerable whereof are *Rio Grande* southward, *Gambia* in the middle, and *Senegal* northward: the most southern

southern point of the island, formed by these two last, is what we call the *Cape Verd*.

Africa may be divided into eight principal parts, which are *Egypt*, *Barbary*, the *Bildulgerid*, *Zaara*, or the *Desart*, *Nigritia*, *Guinea*, *Ethiopia*, and *Nubia*; to which may be added, for a ninth part, the isles depending thereon.

The *Africans* were always idolaters, and adored the stars, the fire, &c. The queen of *Sheba*, who visited *Solomon*, instructed them in the *Jewish* religion; and they received afterward the light of the gospel from the eunuch of queen *Candace*, who was baptized by the apostle St. *Philip*. At present there are found in it Mahometans, Idolaters, Castes, *Jews*, and three sorts of Christians, *viz.* the *Abyssinians* of the *Greek* Church; the subjects of the kings of *Spain* and *Portugal*, who are of the *Roman church*; and the subjects of *Great-Britain*, &c. who are of the *reformed church*.

Egypt. This kingdom extends from 60 degrees of longitude to 67, and from the 22 of latitude to 31, 30 min. so that it may have near 100 leagues of extent from east to west, and 180 from south to north.

It confines eastward with the *Red Sea*, and the isthmus of *Suæs*, northward with the *Mediterranean*; westward with *Barbary* and the desart of *Barca*; and southward with *Nubia* and the *Abyssinians*.

The climate of *Egypt* is unwholsome, because of the excessive heats, and the waters of the *Nile*; for the water which remains on the earth after the overflowing of that river, generates a prodigious quantity of insects of different species, which infect the air.

The isthmus of *Suæs*, which parts the *Red Sea* from the *Mediterranean*, is 30 or 35 leagues broad. Several kings of *Egypt* have attempted in vain to cut it, to join the two seas together.

Four leagues off *Cairo*, are seen the three famous pyramids, which have passed for one of the seven wonders of the world: the greatest of these pyramids has 86 fathoms, 4 feet in length; each side of its base has 113 fathoms, 4 feet; and each face of its pedestal is 270 fathoms, 5 feet long.

Egypt is divided into *higher*, *middle*, and *lower*, and more particularly into twelve *Calliwicks* or prefectures, which are found situated in the following manner.—First, between the *Nile* and the *Red Sea*, are inclosed the government of *Cairo*, and the *Calliwicks* of *Cossir* and *Cherstesse*, the country called *Said* extends southward, and contains westward the *Calliwick* of *Girgie*, and eastward that of *Minio*, those of *Monfelont*, *Benesuef*, *Fium*, and *Geza*, which are also westward of it. The government of *Alexandria*, the *Calliwicks*, of *Calliconbich*, of *Menousæ*, and of *Garbia*, are on the *Mediterranean*, taking up the whole extent of the *Delta*: lastly, that of *Mansoura* is on the isthmus of *Suæs*.

The city of *Alexandria* was the antient capital of *Egypt*; but *Cairo* possesses at present that advantage. This city is situated on the border of the *Nile*, over-against the ruins of the antient *Memphis*.

Barbary. It extends along the *Mediterranean*, from 9 degrees 30 minutes of longitude, to 60; and from 27 of latitude, to the 35, 30 minutes so that it may have very near 900 leagues in length, and only 80 in its greatest breadth.

It confines eastward with *Egypt*, northward with the *Mediterranean*, westward with the *Atlantick* ocean, and southward with the *Biledulgerid*.

The climate is temperate enough: the soil produces cotton, maiz, and excellent fruit. It feeds beautiful horses and cattle, whose leather is much esteemed; and a great quantity of coral is fished on the coasts.

It is divided at present into six kingdoms, called of *Barca*, of *Tripoli*, of *Tunis*, of *Algier*, of *Fez*, and of *Morocco*; which are found in this order going from east to west, on the coast of the *Mediterranean* except the last which is on the ocean, at the south by west of that of *Fez*.

The kingdom or country of *Barca*, is situated between *Egypt* and the great *Syrtes*, called *Seiches of Barbary*, and contains about 30 leagues of coasts, and 30 or 40 in breadth.

This country is very sterile and full of rocks: it is watered by the rivers *Nachel*, *Docra*, and *Melela*, which spring from the mount *Mayes* in the desert.

This kingdom depends on the grand seignor, who keeps a sangiack at *Barca*. The inhabitants are *Mahometans*.

The kingdom of *Tripoli* is situated between that of *Tunis*, and the country of *Barca*, extending about 250 leagues on the coast, from the mouth of the small river of the *Salins*, in the *great Syrtes*, or gulph of *Sidra*, as far as to that of the *Capes*, or *little Syrtes*: its breadth is very irregular, of 15, of 25, and of 40 leagues.

This country is divided in two by the river of *Tripoli*, on which is the city of the same name, which is the capital.

In the eastern part, which is almost deserted, except the coasts, are found these four rivers, *viz.* the *Tessura*, *Macer*, *Mistrata*, and that of *Salins*. In the western part, besides the of river *Tripoli*, are found those of *Rasamalbasa*, of *Portera*, and of *Casa-*

Cæsarnecara. These, as well as the first, spring from mount *Atlas.*

The kingdom of *Tunis*, is situated between that of *Algier* and the *little Syrtes*. Its greatest length from east to west is of about 70 leagues, and its greatest breadth 90.

The *Guadalbarbar* waters its most western part, springing from the *Biledulgerid*; after it has divided itself into two arms, the most western thereof runs so serpent-like, that in the extent of a strait line of about 25 leagues, one could make more than 90, if one would follow its shore. The other arm is called *Magrida*. The other rivers are *Magerada*, *Capallia*, &c. which spring from it.

The city of *Tunis*, capital of this kingdom, is a port advantageously situated, at the bottom of a gulph. Its entrance, which is narrow, is defended by the fort *La Goulette*. It is also governed in form of a republic, under the protection of the grand seignior,

The isles *Galata*, *Fanthalarea*, *Lampedusa*, *Limosa*, *Chercbara*, *Gamelera*, and some others, are dependencies of this kingdom.

The kingdom of ALGIER is situated between that of *Tunis*, and that of *Fez*. Its greatest length is of about 220 leagues, and its breadth of 80 or 90.

This country is full of high mountains, particularly southward, where it is confined by a part of mount *Atlas*.

Among its rivers are found the great one, which springs from the lake *Mezzal*, and traverses mount *Atlas*; the others which comes from that mount, are the *Titnes*, *Seslisas*, *Miromus*, *Sefay*, &c.

This kingdom is divided into five provinces: first, that of *Algier* is in the middle; that of *Bugiek* eastward of it; that of *Constantine* is likewise eastward of this; that of *Tenese* is westward of *Algier*; and that of *Tremesin*, or *Tellensin*, is the most eastern.

The city of *Algier*, which is the capital, is also governed in form of a republic, under the protection of the grand seignior, who has not the least authority in it. It serves for a retreat to pyrates, among whom the famous *Barbarossa* alarmed the *Mediterranean* during the reign of the emperor *Charles* V.

The other cities are situated on the coasts, except *Tremesin*, which is 6 or 7 leagues more advanced in the country, and *Constantine*, which is an island made by a river towards the middle of its province. The king of *Spain* keeps *Marsalquivir*, and *Oran* on this coast.

The kingdom of FEZ, which is part of the antient *Tingitana Mauritania*, is situated between that of *Algier* and the ocean. Its greatest length is of about 120 leagues, and its breadth, as far as to the streight of *Gibraltar*, of 90.

It is separated from the kingdom of *Algier*, eastward, by the river *Mulvia*; at south by west the *Ommirabi* parts it from *Morocco*; and southward, mount *Atlas* divides it from the *Segelakesse*.

This country is the best cultivated, and most inhabited of all *Barbary*; and though it be full of mountains, several pretty large cities are found in it towards the middle.

This kingdom is divided into seven provinces, situated thus, first *Fez*, *Asgar*, and *Temesne*, are on the ocean; *Habat* on the straight; *Errif* and *Garet*, on the *Mediterranean*; and *Chaus*, which contains almost half the country, is farther in the land.

Fez is the capital, and is situated in the middle of the kingdom, on the small river *Union*, between *Suba*, and *Bunasar*. This city passes for one of the fairest of the whole world, and for the ornament of all *Africa*.

This kingdom is governed by a prince, who stiles himself emperor of *Africa*, king of *Morocco*, *Fez*, *Sus*, and *Tafilet*, lord of *Gago*, *Dare* and *Guinea*, grand xerif of *Mahomet*, &c.

The king of *Spain* keeps some places on this coasts; as *Ceuta*, *Pennon de Velez*. The *Portuguese* are masters of *Cazar*, *Ezaghir*.

The kingdom of *Morocco*, which is the other part of the *Tangitana Mauritania*, is situated at the south by west of that of *Fez*, between *Segelmesse* and the *Atlantiek ocean*.

Its greatest length is of about 120 leagues, from cape *Non* to the mountains, which part it from the *Segelmeke*; and its greatest breadth is of about 110, along the coasts of the ocean, from the same cape to the mouth of the *Ommirabi*.

Its rivers are the *Ommirabi*, *Tensif*, *Sus*, *Guadelhabi*, which disembogue into the *Ommirabi*, and the *Assimeal*, which runs to the *Tensif*.

The soil is fertile in corn, fruit, oil, and sugar; delicious grapes, each of which is as big as a pigeon's egg, are found in some of its mountains; and it has mines of gold, silver, and copper.

This kingdom is divided into seven principal provinces, which are *Morocco*, *Hascora*, *Tedles*, *Ducalia*, *Hea*, *Sus*, and *Guzalu*.

The city of *Morocco*, situated near the river *Tensif*, is the capital of this kingdom.

The kings, princes, and people of *Barbary*, are all *Mahometans*.

The *Biledulgerid*. This country, which contains very near the antient *Numidia*, is called *Biledulgerid* by the *Arabs*, because of the great number of dates it produces.

if the desart of *Barca* be included in it, it extends from the 5 degree of longitude to the 60, and from the 22 of latitude to the 32, so that its greatest extent is about 1000 leagues; and its breadth, which is very irregular, is from 30 to 160 in some places.

It confines eastward with *Egypt*, northward with *Barbary*, westward with the ocean, and southward with the *Zaara*, or desart.

The climate is very hot, and notwithstanding very wholsome. The soil is sandy, uncultivated, and very little inhabited in several places: in other places it produces barley and anis-seed, and a little wheat; but its fertility consists in the great quantity of dates it produces, and in its camels.

Among the rivers, which run through it, the most remarkable are the great river, that of *Salina*, the *Quadilbarbar*, the *Tegorarin*, *Ghiz*, *Ziz*, and others: which all spring from some lake or fountain.

It is divided into eight principal provinces, reckoning the desart of *Barca*.

This country is inhabited by the natives, and the *Arabs*: the first are brutish, lascivious and very great thieves; the others have more humanity: but in general all these people are violent, and it is dangerous falling into their hands.

It is in part governed by some petty kings or lords, who are most of them tributary to the *Turks* of *Algier*, of *Tunis*, or of *Tripoli*, in part by some republics; and in some places those people live without laws or policy; as some bands of *Arabs*, who live in the desarts, and put several cities under contribution.

All those princes and the people are *Mahometans*. The rest follow the *Jewish* religion, and have their synagogues in most of the greatest cities, where they are all merchants.

The *Zaara*, or *Desart*. This country is called *Zaara* by the *Arabs*, i. e. *Desart*, because so little inhabited.

It is situated under the tropic of Cancer, between the 12 and 27 degree of latitude, and extends from the 4 of longitude to the 56; so that it may have more than 950 leagues in length, and 40, 60, 100, even as as far as 250 in breadth, according to the different places.

It confines northward with the *Biledulgerid*, eastward with *Nubia*, southward with *Nigritia*, and westward with the ocean.

It enjoys a very wholsome climate, though very hot. All its riches consist in camels.

There are but three considerale rivers found in it, *viz.* that of *Nubia*, which after it has passed the desarts of *Lempta*, and *Borno*, hides itself under ground, for the space of seven or eight leagues, then appears anew in *Nubia*; that of *Ghir*, and that of the *Horses*.

This country is divided into several principal provinces or desarts, which bear the name of some of their most considerable cities. *Borno*, *Garga*, *Berdoa*, *Lempta*, *Targa*, *Zuenziga*, and *Zanhaga*.

The inhabitants are brutish, wild, and great thieves. Part of them live in cities with a little more humanity; but the others are vagabonds in the fields, where they keep their flocks or seek fortunes; and those have neither laws nor policy.

They have kings, or particular lords, whom they call *Zeques*.

Several follow the doctrine of *Mahomet*; the others have neither faith nor religion.

Nigritia. This part of *Africa*, borrowed its name from the river *Niger*, receives its name from the country; and that of the country comes from the colour or hue of its inhabitants.

It extends between the 8 and 23 degree of latitude, from the 3 degree of longitude to the 44; and may have 800 leagues in length, near 300 in its greatest breadth, and 140 in its lesser.

It confines northward and eastward with the *Zaara*; southward with *Guinea*; and westward with the *Atlantic ocean*.

The climate is very hot, but so wholesome, that of itself it cures maladies. The soil produces rice, flax, and cotton. It has mines of gold, and copper; ambergrease, and some fruit-trees. The soil in this country is more fertile than in any other part of *Africa*.

The principal rivers are the *Niger*, and its branches, which all have different names, as *Senegal*, *Gambia*, *Rio San Domingo*, and *Rio Grande*.

This country is divided into sixteen principal kingdoms, found along the *Niger*, re ascending towards its source in the following order. First, northward of this river, *Genehoa*, and *Galate*, which are on the ocean; then *Tanbut*, *Agades*, *Cano*, *Casseua*, and *Gangara*, in which the *Niger* forms an island, 100 leagues long, and 50 broad. Between the rivers *Senegal* and *Gambia*, are inclosed the kingdoms of the same name, the people whereof are called *Jaloffi*; between *Gambia* and *Rio San Domingo*, are the kingdoms of the *Cassangas*; between *San Domingo* and *Rio Grande*, those of the *Bijagos*; southward of the great river, are found following one another, the kingdoms of the *Biaffari*, *Melli*, *Sousos*, *Mandiga*, *Guber*, *Gago*, *Zegazeg*, and *Zanfara*, which ends at the lake *Borno*. Most of these kingdoms are subdivided into several others lesser, which have all their capical cities of the same name; that of *Tanbut* being more

more confiderable and larger, than thofe of *Mandigues* and *Cano*.

The negroes are lefs wild than the people of *Barbary*, and of the *Biledulgerid*; but they are not lefs brutifh in their amours. Moft of them carry on the commerce of flaves, whom they take from their neighbours, and even fell their wives, children, fathers, and mothers to the *Europeans*.

The kings of this country are very abfolute in their refpective dominions.

They are all *Mahometans*, or idolaters, and great enemies of the *Jews*. Thofe of the defarts live without religion.

GUINEA. It extends between the 4 and 12 degree of latitude, from the 9 of longitude, to the 38; fo that it may have 550 leagues in length, 140 in its greateft breadth, and about 60 in its leffer, at the mouth of the river *Benin*.

It confines eaftward with the kingdom of *Biafara*; northward with *Nigritia*; weftward with *Sierra Leona*; and fouthward with the fea of the fame name.

The climate is exceffively hot. The land is low, fat, and very fertile, watered by feveral fmall brooks, and frequent rains. The foil produces pepper, fugar-canes, cotton, rice, millet, barley, and feveral other forts of corn, and fruit. It has feveral golden mines, and feeds a vaft number of elephants, peacocks, monkeys, tygers, leopards, &c. and the inhabitants carry on a great commerce of ivory. A great quantity of excellent fifh is taken on the coafts, among which are the *Dorade*, the *Bonite*, &c.

The moft remarkable of its rivers are the *Sweira da Cofta*, thofe of *Da volta*, *Lago*, *Calabri*, *Del Rey*, *Benin*, and *Dos Camarones*, which parts it from *Biafara*.

Guinea is divided into three principal parts: which are the particular kingdom of *Guinea*, fituated in the middle; eaftward of this, the kingdom of *Benin*; and the province of *Malaguette*, or *Maniguate*, weftward Thefe kingdoms, and this province, is again fubdivided into feveral others very confiderable, as *Sabou*, *Fatu*, *Accaria*, *Arda*, &c. but as we have very little knowledge of them, I will content myfelf with faying that the particular coaft of *Guinea* is diftinguifhed by three different names.

The moft extended and moft eaftern, is called the *Golden Coaft*; becaufe of the quantity of gold carried away from thence: The moft weftern is called the *Ivory Coaft*, for the fame reafon: and this is again fubdivided into two parts, the moft eaftern whereof is called the coafts of *Good People*; and the moft weftern the coaft of *Bad People*.

The people of *Guinea* are witty, dextrous, and underftand commerce very well.

Guinea is governed by feveral kings, among whom that called emperor of *Guinea* is moft powerful, having feveral other kings and princes for tributaries, and fubjects. That of *Benin* is likewife very powerful, having feveral kingdoms in his dominions. The province of *Malaguette* is poffeffed by a great number of princes and people towards the mountains. Some place it in the kingdom of *Sierra Leona*: The *Englifh*, *Dutch*, *Portuguefe*, &c. have each their factories on the coafts of *Guinea*.

The people are ftill idolaters.

ETHIOPIA. All the reft of the continent of *Africa*, is commonly known under the name of *Ethiopia*, which is divided into *inward* and *outward*.

The *inward Ethiopia*, contains *Abyffinia*, or the empire of the *Abyffinians*, and *Nubia*, northward of it.

The *outward*, or *exterior Ethiopia*, contains the kingdoms of *Biafara*, and of *Congo*; the coafts or country of the *Cafres*; the empire of *Monomotapa*, and of *Monoemogi*; the coafts of *Zanguebar*, *Ajan*, and *Abex*, which are properly of *Abyffinia*, though they be at prefent in the power of the *Turks*.

Abyffinia extends from 48 degree of longitude to about the 74; and from the 20 degree of northern latitude, to the 14 of fouthern latitude; fo that it may have very near 700 leagues in its greateft extent from north to fouth, and about 500 from eaft to weft.

It confines northward with *Nubia*; eaftward with the coafts of *Abex*, *Ajan* and *Zanguebar*; fouthward with the empire of *Moncemogi*; and weftward with the people fubjects of *Congo*, and of *Biafara*, and the *Gales*, who are very powerful.

The climate is very temperate, with regard to its fituation, particularly on the mountains, and in the flat country, but in the valleys, it is exceffively hot. It is very fertile in barley, millet, maiz, and feveral other forts of corn unknown to us, as the *Tefet*, or *Tafo*, *Agoufla*, and *Machella*, of which they make bread and beer. It produces all forts of gums, ginger, fugar, honey, and wax, which ferves to make candles, cotton, &c. Mines of gold, filver, tin, copper, iron, and fulphur are found in that empire almoft every where. There are feen in it elephants, tygers, lions, panthers, rhinocero's, giraffi, monkeys, wild-bears, harts, deers, hares, civets, goats, wild oxen, camels, horfes, affes, cows and fheep; in a word, all forts of game and fowls we have in *Europe*, and feveral others unknown to us. There are alfo found in the rivers, crocodiles, and wild horfes.

The moft confiderable rivers, which water this vaft country are, the *Nile*, the rivers *Abanhi*, and *Tacaffi*, the river *Niger*, with its lake, the lakes *Zaire* from fouth to north, about 80 leagues in breadth, and

and more than 350 in circuit. The lake *Zaflan* has more than 300 leagues in circuit. There are in this lake ſeveral iſles of 30, 40, and 50 leagues round. The lake *Niger* is about 160 leagues in circuit.

Abyſſinia is governed by a prince called *Artiklabaſſi* by the *Arabs*, and *Negus* by the *Abyſſinians*; we call him *Preſter John*: this emperor pretends to be deſcended from the race of *David*. The greateſt part of the coaſt of *Abex* are in the power of the grand ſeignior.

The *Abyſſinians* pretend to be deſcended from the firſt chriſtians, and to have been firſt inſtructed in the *Jewiſh* religion by the queen of *Sheba*, who went to viſit king *Solomon*; by whom, they ſay, ſhe had a ſon called *Melilech*, who governed them after his mother's death, and that they received the light of the goſpel by means of queen *Candace*, whoſe eunuch was baptized by *St. Philip*, and afterwards by *St. Thomas*, *St. Matthew*, and *St. Bartholomew*. Ever ſince that time they have preſerved the name of *Chriſtians*, but they have been corrupted by the errors of *Eutyches* and *Dioſcorus*: They have a patriarch whom they call *Abuna*, inferior to that of the *Cophti*, who reſides at *Alexandria* in *Egypt*, by whom he muſt be confirmed. They circumciſe their children, afterwards baptize them, *viz.* the males forty days after their birth, and the females ſixty; which is always done on *Saturday* and *Sunday*.

Nubia. It is ſituated in ſuch a manner between the 10 and 23 degree of latitude, and extending from the 48 of longitude, to the 65 degree 30 minutes, that it may have about 370 leagues in its greateſt extent from ſouth by weſt to north by eaſt, and 190 in its greateſt breadth.

It confines northward with the deſart of *Barca*, and *Egypt*; eaſtward with the kingdom of *Barnagas*, and the iſland *Guegere*; ſouthward with the *Deſarts*, which are of the empire of the *Abyſſinians*; and weſtward with the deſarts of *Borno* and *Gaoga*.

The climate is exceſſive hot every where; the ſoil produces a great quantity of ſugar-canes, but the inhabitants have not the ſecret of purifying it, who leave the ſugar in its blackneſs: It has beſides mines of gold, ſanders-wood, civet, and abundance of ivory: Eaſtward the land is uncultivated, and deſart

The natives are courageous and cunning; they apply themſelves to commerce and huſbandry: They are extremely black, and cloath themſelves with cotton cloth.

Some authors pretend, that the *Nubians* are neither *Chriſtians*, *Jews*, *Mahometans*, nor idolaters; and ſay, that having wanted biſhops and prieſts, the religion is almoſt entirely deſtroyed, with their churches, which they have neglected.

This country is ſituated between the 34 and 48 degree of longitude, and extends from the 13 degree of northern latitude to the 2 of the ſouthern: So that it takes up near 300 leagues in its greateſt extent, from north to ſouth, and 280 from eaſt to weſt.

It confines eaſtward with the river and lake *Niger*, and ſome mountains which part it from *Abyſſinia*, and the *Glaqui*, people of *Congo*; northward with the kingdoms of *Congo*, and *Zanfara*; weſtward with that of *Benin*, and the ocean; and ſouthward with the territories of *Congo*.

The climate is extremely hot at all times: winter is not diſtinguiſhed but by long and violent rains, which fall from the month of *April* to that of *Auguſt*; their ſummer begins in *September*.

The inhabitants are wild cheats, and thieves: They are guilty of the moſt infamous actions, laying together without diſtinction, the father and the daughter, the mother and the ſon, brothers and ſiſters, all things being in common among them; they paint their bodies with various colours, and adorn it with ſmall toys, as rings, little ſhells, *&c.* The kings rub their faces and hands with chalk to appear more beautiful.

They are all idolaters, adore the devil, ſun, moon, the trees, and the earth, for which they have ſo great a reſpect, that they will not permit one ſhould ſpit upon it, becauſe it produces the things neceſſary for their ſubſiſtence.

Congo. This country is ſituated on the weſtern coaſt of *Æthiopia*, between 10 and 20 degrees of longitude eaſt, and between the equator and 18 degrees of ſouth latitude, ſo that it has very near 300 leagues in its greateſt extent from north to ſouth, and 260 in breadth.

It confines northward with the kingdoms of *Gabon* and *Macoco*, whoſe king is called by ſome, prince or king of the *Anzicans*, eaſtward with the kingdom of *Damut*, and the lake *Zair*; ſouthward with the kingdoms of *Malemba* and *Mataman*, and weſtward with the ocean, called the ſea of *Congo*.

The climate is exceſſive hot, the great rains which fall during the months of *April*, *May*, *June*, *July*, *Auguſt*, and make their winter, cauſe the inundations of the *Nile*, of the *Niger*, of the *Zair*, and of other rivers, which water the ſoil, and render it fertile in all things neceſſary for life. It produces abundance of rice, maize, white millet, and another ſmall ſort of corn, called *Luco* by the inhabitants, and of which they make very good bread: There are ſeen in it fruit-trees of ſeveral ſpecies, as orange-trees, lemon-trees, and palm-trees of

three,

three ſorts. It feeds oxen, cows, hogs, goats, and ſheep, which bear three or four times a year; and alſo elephants, tygers, monkeys, civets, and other animals unknown to us, as the *zebra*, which reſembles a mule; the *daut*, and the *empalariga* which have almoſt the figure of a heifer. Pelicans, peacocks, pheaſants, partridges, and ſeveral other ſpecies of volatiles: There are found in it large ſerpents, and very venomous vipers. It has mines of ſilver, copper, and cryſtal.

Beſides the river *Zair*, which flows from the lake of the ſame name, and traverſes the whole country, are found in it the *Loango*, *Lelunda*, *Loanza*, and ſeveral others, which flow from the lake *Aquilanda*.

This country is divided into ſeveral kingdoms, and different people, the moſt remarkable of which are the kingdom of *Congo* in the middle; that of *Loango*, with the people of *Anzican*, northward; that of *Angola*, ſouthward; and eaſtward the people called *Giaqui*, who inhabit the mountains of the ſun towards the dominions of the *Grand Negus*.

The city of *Congo* was once called *Baza* by the natives; at preſent the *Portugueſe* call it *St. Salvador*.

The capital of *Loango* bears the ſame name.

The capital of *Angola* is *Longo*, or *Engaze*.

The king of *Congo* is the moſt powerful; and his people have ſo great a veneration for him, that they never ſpeak to him but kneeling. The kingdom is hereditary in his family, and only the male children can pretend to the crown, with the excluſion of the female. The governor of *Batta* is the moſt conſiderable of the kingdom, and his court is very little leſs numerous than that of the king.

The king of *Loango* is alſo very much reſpected by his ſubjects: That of *Angola* is almoſt as powerful as that of *Congo*, though he pays a ſort of tribute to him; the governors he keeps in each province are called *Sobas*.

Empire of *Monomotapa*. This country called by ſome the empire of *Monomotapa*, by others *Benomotapa*, and *Benomotaxa*, extends from the 13th degree 30 minutes of northern latitude to the 31ſt; and from the 43 degree 30 minutes of longitude, to 57 degree 30 minutes, ſo that it muſt have 350 leagues in its greateſt extent from north to ſouth, and 150 in its greateſt breadth.

It confines northward with the *mountains of the moon*, which part it from the empire of the *Monoemugi*, and from the kingdom of *Malemba*; on the three other ſides it is environed with the *Cafrery*.

The climate is temperate; the ſoil very fat, and fertile in rice, ſugar-canes, fruit-trees, and meadows. A great quantity of gold is found in it; in which metal, and ivory, conſiſts the commerce of the country.

The moſt conſiderable of its rivers are the *Zair*, the *Rio de Spiritu Santo*, and the river *Cumiſſa*.

The people are witty enough, and very courageous, but inconſtant, and ſubject to revolts:

This country is under the dominion of an emperor, commonly called *Monomotapa*, to whom all the other kings or princes are ſubject or tributary.

Empire of the *Monoemugi*. This empire confines northward with *Abyſſinia*, eaſtward with the coaſts of *Zanguebar*, ſouthward with *Monomotapa*, and weſtward with the kingdom of *Malemba*, and the lake *Zambre*.

It has very near the qualities of the empire of *Monomotapa*, except that it is fuller of *mountains*, including thoſe of the *moon*: The river *Cuama*, of *Zambre*, traverſes it from eaſt to weſt; by means whereof a commerce is carried on with thoſe of *Quiloa*.

The country is in the power of a king, called *Monvemugi*, to whom all the other petty kings are ſubject, or tributary: Part of the *Giaqui* are under his dominion. And idolatry ſtill reigns in this empire.

The countries, or coaſts of the *Cafres*, extends along the coaſt from *Angra de Negro*, on the weſtern ſhore of *Ethiopia*, under the 14 degree 30 minutes of ſouthern latitude, to *Punto do Sal*, on the eaſtern ſhore, about the 18 degree of the ſame latitude, including the famous cape of *Good Hope*: So that its coaſt tread more than 1000 leagues: Its breadth is very irregular; in ſome places it is more than 100 leagues broad, and in others not 50.

It confines, outward with the ocean; and inward with the *mountains of the moon*; and with *Montes Fragoſos*, which part it from *Monomotapa*.

Cattle are numerous but lean, and the ſheep are clothed with hairs inſtead of wool.

The moſt conſiderable rivers are the *Zambre*, *de Spiritu Santo*, *Cumiſſa*, *St. Blaiſe*, *St. Ambroſe*, the *Green River*, and *St. Mary's*.

The city of *Sophala* is very advantageouſly ſituated in an iſland, which is in the middle of a little gulph, into which falls a little river called *Sophola*; it is ſituated on the eaſtern coaſt, about the 20 degree of latitude, near the coaſt of *Zanguebar*.

The *Cafres*, are wild, brutiſh and cruel: they live in mountains and caves like beaſts; thoſe who inhabit the temperate zone are leſs black than the others; they eat rice, fleſh and fiſh. There is very little commerce carried on in this country, except

except at *Sophola*, where the people are more tractable. This commerce consists in gold and ivory, which the natives change for stuffs, *&c.*

As to the government: this country is in part subject to *Monomotapa*, and in part to the king of *Matamun*, the third part is under the dominion of the king of *Sophola*, tributary of the *Portuguese*, who are masters of the capital.

Coasts of *Zanguebar*, called by the antients *Barbaria Regia*; contain the kingdoms of *Mongalle* or *Angoshe*, of *Mozambick*, of *Quiloa*, of *Mombaze*, of *Melinde*, and the territories of some petty kings, as *Lamon*, *Pata*, &c. situated in this order ascending from south to north.

This country extends from the equator, to the 18 degree of southern latitude, may have 450 leagues of coasts, and 60, 80, or 100 in breadth: And confines northward with the coasts of *Agan*; eastward with the ocean; southward with the *Cafrery*; westward with the territories of *Prester John*.

The climate in general is unwholsome, and particularly in the kingdom of *Quiloa*. The land is low and mashy, and does not produce sufficiently what is necessary for life: it produces millet, rice, pulses, oranges, and lemons: It feeds oxen, goats, and sheep, which are so big and so fat, that one of their tails weighs full thirty pounds: there are found in it wild beasts, fowls, and a vast number of elephants; and it has mines of gold, silver, and other metals. There is a great commerce of gold and silver.

The river *Quilmanca* is the most considerable; the others are those of *Melind*, of *Mombaze*, of *Quiloa*, *Del Gado*, of *Mozambick*, and of *Cuama*.

The people of this country are much more tractable than the *Cafres*, they are black, and feed themselves with the flesh of wild beasts, milk, pulses, and wild fruits.

The natives are either *Idolaters* or *Mahometans*, according to the doctrine of a certain zaid, *Haly*'s nephew; so that the *Turks* believe them hereticks in their faith.

The king of *Angoscia*, or *Mongalle*, is supposed tributary of the *Monamagi* and a *Mahometan*. He resides in the city of *Angai*, capital of his dominions.

The king of *Mozambick* is also a *Mahometan*; but several petty kings and lords live in that kingdom without religion, The *Portuguese* are masters of the capital, and of the island in which it is built.

The king of *Monbaze* is extremely dreaded, and respected by his subjects.

The king of *Melinde* is so much respected by his subjects, that when he appears in public, the ladies sing his praises before him, and make a kind of simphony in striking brass basons with ivory sticks. He is a very great friend of the *Portuguese*, with whom his subjects trade in all liberty, and with a great deal of honesty. He resides at *Melinde*, capital of his kingdom, and situated on the sea shore, with a very fine port, where the *Portuguese* have built a fortress which commands it entirely, and eighteen or twenty churches in the city.

Coasts of *Ajan* extend from the equator to the 12 degrees of latitude, between the 63 and 70 of longitude; so that it may have 300 leagues of coasts on the ocean, as far as cape *Gardafuy*; and 140 from that cape to the streight of *Bebelmandel*. Its greatest breadth is of about 150 leagues, and its lesser of 60.

It confines northward with the kingdom of *Dancali*, and the streight of *Bebelmandel*; eastward with the ocean; southward with the river *Quilmanca*, which parts it from *Zanguebar*; and westward with the dominions of *Prester John*.

It is fertile in wheat, millet, barley, and various sorts of fruits, and pastures; and therefore feeds a great quantity of cattle, as horses, cows, goats, and sheep. It also produces honey, wax, gold, and ivory.

Among its rivers the most remarkable are the *Quilmanca*, *Magadoxo*, and *Zeila*: westward of the city *Magadoxo* is found the lake of the monks, with an island, and a city in the middle of it, which bears the same name.

This country is divided into four principal states, *viz.* the kingdom of *Adel*, which is the largest, and the most northern; that of *Adea*, which is in the middle; and that of *Magadoxo*, with the republick of *Brava*, which is the most southern.

The inhabitants of this country are of three sorts: Some are white towards the coasts: some black towards *Abyssinia*, and others called *Beduini*, of *Arabian* extraction, who are vagabonds, live without laws, without care, and are all thieves.

The republick of *Brava* is the only one known in *Africa*. The city which is situated on the coast, between *Baraboa* and *Magadoxo*, is governed by twelve Xequi, chosen among the most antient of the families of the seven brothers, by whom it was founded. It is tributary to the *Portuguese*, and the inhabitants carry on a great commerce of gold, silver, ivory, ambergrease, wax, *&c.*

Coasts of *Abex*. This country extends from the streight of *Bebelmandel* to the mountains, which part it from *Egypt*, about the 22 degree of latitude; so that it takes up more than 350 leagues of coasts on the Red sea; and has not 50 in its greatest breadth, and

and 20 in its leffer. It is almoft all defart and uncultivated, becaufe of its exceffive heat and want of water. The climate is burning and unwholfome; the foil fandy, and fterile, particularly northward.

The northern part is in the power of the grand feignior, who keeps a Beglierbeg in the city of *Suaquen*, fituated on the coaft of the Red fea; he is called at the porte, the *Beglierbeg Bafhaw of Abaffia*.

The city of *Ercoco*, on the fame coaft, and the ifland *Mafua* over-againft it, are of this government. All the inhabitants follow the doctrine of *Mahomet*.

Eaftward of cape *Gard-fay*, is found, under the 86 degree of longitude, the ifland *Zocotra*, which may have 45, or 50 leagues of circuit.

The climate is very hot, the foil dry and pretty fterile, having nothing recommendable but aloes, called of its name *Zocotrina*, and *Sanguis Draconis*, which it produces in abundance.

This ifland is in the power of the king of *Fartach*, in *Arabia*, who keeps in it a *Xequi*, or governor. The inhabitants are idolaters, and adore the moon.

The ifland *Madagafcar*. This ifland is one of the greateft and richeft of the whole world. The natives give it the name *Madagafcar*, i. e. the *Ifland of the Moon*. That of *St. Laurence* was given to it, becaufe difcovered on that faint's day; and the *French* call it *Ifle Dauphine*.

It is fituated eaftward of the coafts of *Zanguebar*, and of the *Cafrery*, between the 12 and 26 degree of fouthern latitude; and extends from the 43 degree of eaft longitude, to the 51: fo that it may have about 350 leagues in its greateft extent from north to fouth, *i. e.* from cape *Natal*, to cape *St. Mary*; 100 in its greateft breadth; and 900 of circuit.

The climate is wholefome enough and temperate: The foil very fertile in fruits, as oranges, lemons, &c. and in pulfes. It produces rice, cotton, fugar, ginger, faffron, the igname, and other very good roots; and alfo wax and honey. It has mines of gold and filver; and feveral trees grow there which are very rare among us, as ebony, brazil-wood, red, yellow, and white fanders. Lions, elephants, camels, and feveral other animals are fo common in it, that fometimes a fheep has been given for a fheet of paper, and four cows for a poor jacket.

The middle of this ifland is full of forefts and mountains, from which flow feveral rivers, the greateft of which are, *Janibarov*, *Marsucou*, and *Macabarou*.

It has feveral very commodious ports, *viz. Antongil*, *Vingagora*, *St. Andrew*, *St. Auguftin*, *Antipera*, the port of the galeons, &c.

Thofe who inhabit the middle of the ifland are brutifh, wild, and without faith, like the *Cafres*; they go quite naked, and dwell in very low huts. Thofe towards the coafts are a little more tractable, and all love pleafure to excefs: They are witty enough, ftrong and courageous.

Some are idolaters, or without the leaft fhadow of religion, and thofe towards the coafts *Mahometans*.

Between the weftern coaft of *Madagafcar*, and thofe of *Zanguebar*, are found the ifles of *Comorra* and feveral others lefs confiderable, as thofe of *Querimba*, *Anifa*, *Jan*, *Nueva*, which will be found in my particular defcription.

The ifles of *Comorra* are fituated between the 11 and 13 degree of latitude, towards the 72 and 73 of longitude.

They produce rice, banana's, cocoa-nuts, oranges, lemons; and feed cows, goats, fheep, pigeons, hens, &c.

The inhabitants of thefe ifles are tractable enough, and trade freely with the *Portuguefe* of *Mofambique*

They have each a king, which every fhip at its arrival, is obliged to acknowledge with a prefent. And none but the king wears cloaths and fhoes, all his fubjects going naked, except that they hide what modefty forbids to expofe to publick view.

Towards the coafts of *Zanguebar*, is found under the 6 degree of fouthern latitude, the ifland *Zanzibar*, from which the whole country has borrowed its name. It may have about 90 leagues of circuit. The ifland *Pemba*, fituated under the 4 degree, has more than 110 leagues of circuit; that of *Monfia* has 50.

Thefe ifles produce rice, millet, lemons, oranges, and fugar-canes, but the inhabitants have not the wit to purify the fugar. They feed a great quantity of cattle, in which confifts their commerce with thofe of the main land.

Each of thefe ifles has its particular king, who are made tributary to the king of *Portugal*. Thefe kings, and their fubjects, are all *Mahometans*.

The natives of thefe ifles are lean, puny, enemies of war, applying themfelves to agriculture and commerce. Their women love to be adorned with chains, bracelets, ear rings, and other jewels.

At 50 leagues diftance from the main land of the kingdom of *Biafara*, is found the ifland *St. Thomas* which has given name to the gulph in which it is fituated under the equator.

Its

Its figure is almost round, and some say that it may have 45, and others 60 leagues of circuit.

The climate is unwholsome for foreigners, but not for the natives: The soil produces all that is necessary for the life of the negroes, but not of the *Europeans*; for it has neither corn nor wine, but maize, palm-trees, potatoes, and a great quantity of sugar.

The *Dutch* conquered this island from the *Portugueze*, who retook it afterwards, and keep a governor in the city *Pavoasan*, which is the capital. The inhabitants are most of them catholicks, and there is even a bishop in the capital city.

The *Island of the Prince*, was thus called by the *Portuguese*, because the prince of *Portugal* had the revenue thereof.

It is situated at the north by east of that of *St. Thomas*, under the 2 degree of latitude, and the 32° 30 minutes of longitude; and has about 25 leagues of circuit.

The climate is wholsome, and the soil very near like that of the island *St. Thomas*. It is in the power of the *Portuguese*, and the inhabitants are christians.

The *island of Fernando Poo*, is situated still further into the gulph of *St. Thomas*, between that of the *Prince*, and the mouth of the *Rio des Camarones*, in the main land, it is very near as big as that of *St. Thomas*.

Its climate and soil is like that of *the island of the Prince*, and its government and religion likewise the same.

The *island Annobon*, was thus called because discovered the first day of the year.

It is situated under the 28 degree of longitude; and 2°. 30 minutes of southern latitude.

Its extent, soil, government, and religion, is very little different from that of *Fernando Poo*.

Isles of CAPE-VERD. Some authors pretend that there are twenty of them, but we reckon but ten principal; *St. Anthony*, *St. Vincent*, *St. Lucia*, *St. Nicolas*, the *island of Salt*, of *Bona vista*, of *May*, *St. James*, *Del Fuego*, and *Bravo*.

They are situated westward of *Nigritia*, between the 353 and the 357 degree of longitude, extending from the 13 degree 30 minutes of latitude, to the 19.

The *Island St. James*, is the greatest of them all, and may have 45 leagues in its greatest length from south by east, to north by west, 10 in its greatest breadth, and 95 of circuit.

The climate of these isles is generally hot, and unwholsome. The soil is stony yet they produce rice, maize, ignana's, banana's, lemons, oranges, cocoa-nuts, pomegranates, wine, and cotton: And these fruits are gathered twice a year. They feed a great number of cattle and fowls.

These isles were discovered by a *Genoese*; they are now subject to the king of *Portugal* who keeps a governor in the city of *St. James*, situate in the island of the same name. This city is not only capital of the isles, but likewise of all the places, which the *Portuguese* possess on the coast of the *Higher Guinea*. It is an episcopal see, suffragan of *Lisbon*.

The CANARY isles are ten or twelve in number, among which there are seven principal, *viz.* the *Lancelotte*, *Forteventura*, *Canary*, *Teneriff*, *Gomer*, the island *Del Ferro*, and that of *Palma*.

They extend from the first degree of longitude, to beyond the 28 or 29, if we will speak of the four small ones, which are northward of *Lancelotte*.

The climate of these isles is very good, though a little hot. The soil is very fertile in all things, and produces wheat, barley, millet, and delicious wines, which are exported throughout all *Europe*; and likewise all sorts of excellent fruits, as figs, oranges, lemons, pomegranates, sugar, &c. It feeds a great quantity of goats and wild asses.

In the island *Teneriff*, there is towards the middle a high mountain, by the *Spaniards* called *El Pico*, which rises like a sugar loaf, and passes for the highest of the whole world.

The inhabitants of these isles are almost all *Spaniards*. The natives are great epicures.

They are subjects of the king of *Spain*, who keeps a viceroy, or governor, in the city of *Canary*, situated in the island of the same name. There is in that capital a royal audience, a bishop, and an inquisition.

The island MADERA, is situated under the first degree 30 minutes of longitude, and under the 32 degree 30 minutes of latitude: 20 leagues in length, 8 in its greatest breadth, and 40 of circumference.

The climate is much more temperate than in the *Canaries*, and the soil still more fertile in corn, wine, sugar, and fruits: it is watered with five or six rivers. When it was discovered by the *Portuguese* in 1420, it was all covered with wood; whence it takes its name: for *Madera* in *Portuguese* signifies *timber* or *wood*.

The king of *Portugal*'s governor resides at *Fonzal*, the capital of *Madera*, an episcopal see, suffragan of *Lisbon*.

The isles AZORES may be ranked among those *Africa*, though very distant from it.

They are found between the 36 and 40 degree of latitude, and between the 346 and the 354 of of our longitude: but the *Dutch* make their first meridian to pass at the island *Terceira*, which is the most considerable of all.

The climate is very wholsome, and the soil very fertile in corn, wine, and fruits.

These isles are nine in number, and the most considerable of all is the island *Terceira*, it having 15 or 16 leagues of circumference; and its capital is *Augere*, which is an episcopal see.

These isles began to be inhabited by the *Portuguese* about the year 1449; and ever since that time they have remained in their power, except during the usurpation of the kings of *Spain*.

Having travelled through the different parts, which compose the antient world, I will pass to the *other continent*; so called, because on the surface of the globe it is separated from our continent by the sea; *new*, because it was not known 300 years ago; *inferior*, because in the vulgar's opinion it should be under ours; *western*, because it is described westward of the first meridian, in the map of the terrestrial globe; *America*, from the name of one of the first navigators who discovered it; and lastly, the vulgar gives it the name of *West-Indies*. *Indies*, because its riches equal those of the true *Indies*; and *west*, because they are westward of *Europe*.

AMERICA, extends from the 63 degree of northern latitude, at the straight of *Hudson*, to that of *Magellan*, under the 54 of the southern; and from *Agubeza del Gato*, below the island of *California*, under the 240 degree of longitude, to the most advanced point of the *Brazil*, under the 348.

Northward it confines with the sea, which parts it from *Greenland*, by the *Straight of Hudson*, &c. Eastward with the *Atlantick Ocean*; southward with the *Straight of Magellan*, which parts it from *Terra del Fuego*; and westward with the *Pacifick Ocean*, or *South-Sea*.

This quarter of the world consists of *continent* or main land, and of a number of islands; and is divided amongst various proprietors or states in *Europe*; whose claim to their respective provinces and islands is founded upon preoccupancy or their first discovery and possession: or upon conquest. Therefore we shall divide our survey thereof,

First, into *north* and *south* AMERICA.

Secondly, into *continent* and *islands*.

Thirdly, into their respective *governments* or connections with the powers in *Europe*.

First, SOUTH AMERICA is a great peninsula, which extends between 292 and the 348 degree of lougitnde; from cape *Coquibocoa*, under the 12 degree 30 minutes of northern latitude, to the straight of *Magellan*, under 54 of the southern: so that it may have 1330 leagues in its greatest extent from north to south, and 1140 in its greatest breadth from east to west, and very near 5000 of circuit.

It is chiefly under the dominion of *Spain*, and contains *Terra Firma*, *Peru*, *Chili*, *La Plata*, or *Paraguay*.

TERRA FIRMA, formerly known by the name of *Castilla de Oro*, is the northernmost province of *South America*, and extends between the 12 degree 30 minutes of northern latitude, from the isthmus of *Panama*, under the 293 of longitude, to the 328 degree 30 minutes, having southward the country of the *Amazons*, with *Peru*; and northward, the *northern sea*.

The climate is extremely hot, and, notwithstanding, very wholsome, except towards the isthmus of *Panama*, where the land is very marshy, and the heat would be insupportable, if not a little temperated by the northern winds. The soil produces but little corn, but a great quantity of maize, except in the places where it is traversed with marshes and mountains; it is fertile enough in pasture, and abounds in cattle, as cows, sheep, hogs, and others. It produces several fruits unknown to us, as ananas, *Indian* figs, *&c.* but not equally every where. There is found in it a great quantity of gold, silver, copper, and azure; rocks of emeralds, and some other precious stones.

The most remarkable of its rivers are that of *Oronoque*, which springs from it, and traverses it through all its course; those of the *Magdelen*, *Rio Grande*, and *St. Martha*, which join together between the governments of *Carthagena* and of *St. Martha*: it has likewise the lake *Parime* under the equator, at 319 degree of longitude, all environed with mountains, 120 leagues long, 40 or 50 broad, and which may have 300 of circuit. A little higher the lake *Cassipa*, under the 4 degree of latitude, and which is more than 100 leagues round; and another 30 leagues distant from the lake *Parime*, eastward, and which may have 90 of circuit.

This province is divided into eleven governments; seven of which are on the northern sea, going from east to west, viz. *Castilla de Oro*, or *Terra Firme*, *Carthagena*, *Santa Martha*, *Rio de la Hacha*, *Venezuela*, *Neuva Andalusia*, and *Caribana*. The four others are found southward of these, returning from east to west, in this order, *Guiana*, *Paria*, *Neuva Granada*, and *Popayana*, in part; the other part is in the government of *Peru*.

The capital city is *Santa Fe de Begotta*, situated in the province of *Neuva Granada*; it is an archiepiſcopal ſee, the ſeat of a governor, and of the royal audience of all the *Terra Firma*.

The natives are well ſhaped, and of a braſs colour; they go naked to the waiſt.

PERU is ſituated between the 292 and 316 degree of longitude; exending on the *South-Sea*, from the 5 degree of northern latitude including the country of *Popayana*, to the 26 degree of the ſouthern; ſo that it may have 660 leagues of coaſts, 260 in its greateſt breadth from eaſt to weſt, and 140 in its leſſer.

It confines eaſtward with *Paraguay*, and the country of the *Amazons*, from which it is ſeparated by its river, and that of *Maragnan*, which ſprings from it; northward with the *main-land*; ſouthward with *Paraguay*, *Tucumano*, and *Chili*.

The climate is various. It is very hot at all times in the vallies, becauſe it never rains there, and a very great cold is ſometimes felt on the mountains, becauſe of the frequent and violent winds: there are very few rivers in it, and it has neither fountains nor wells.

The ſoil, though very dry, is fertile enough, particularly towards the rivers, where grows wheat, maize, ſugar-canes, cotton, and excellent wine in ſome places. In the valleys is found a plant of ſingular virtue, called cocoa, whoſe leaf being put into the mouth, nouriſhes and is a preſervative againſt hunger and thirſt.

Peru is divided into three principal governments, or provinces, which are *Peru*, *Los Charcas*, and *Quito*: the firſt is in the middle, the ſecond is ſouthward, where is found the rich mine of *Potoſi*; and the third is northward, ſubdivided into three ſmall provinces, which are *Quito*, weſtward; *Los Quixos*, and *Pacamores*, eaſtward; one at the north, the other at the ſouth.

Lima, or *Los Reyes*, ſituated on the coaſt, is the capital of the whole province, and the reſidence of the viceroy of *South America*: it is honoured with an archiepiſcopal ſee, a royal audience, and an univerſity; but curſed with an inquiſition.

Cuſco, was antiently the place where the *Incas*, or kings of *Peru* kept their court; and is, at preſent, an epiſcopal ſee. *Plata*, in the province of *Los Charcas*, is adorned with an archiepiſcopal ſee.

The natives of *Peru* are inconſtant and without faith; thoſe who inhabit the mountains, and near the equator, are more ingenious: theſe people are whiter than the *Spaniards*, though they inhabit the torrid zone.

TUCUMANO. It extends between the 303 and 317 degree of longitude, from the 23 to 37 of latitude: ſo that it has about 280 leagues in its greateſt extent from ſouth to north; and more than 200 from eaſt to weſt.

It confines eaſtward with *Paraguay*, ſouthward with the *Patagons*, weſtward with *Chili* and *Peru*, and northward with the ſame province, *&c.*

The climate is temperate; the ſoil fertile in paſture, produces very fine cotton, and feeds a vaſt number of ſheep; but it has no mines of metals.

The moſt remarkable of its rivers are thoſe of *Plata*, *Deſaguadero*, *Barbaranna*, and *Rio Vermejo*, or *Salado*.

The people are not ſo wild here, as in the other provinces; they love working; they are vindictive when they have been offended.

Part of this province is yet in the poſſeſſion of the natives, who chuſe from among themſelves *Caciques*, or commanders to govern them, and lead them to war. The other part which the *Spaniards* have conquered, is in the power of the catholic king, who keeps a governor in the city of *Jago del S. Eſtero*. This city, which was called *Varco*, is ſituated on the river *Plata*, is the capital of the province, and the ſeat of a governor, and of a biſhop.

CHILI. This country is called *Chili* by the natives, *i. e. cold*, in their language, becauſe the climate is extremely cold by its ſituation, which is between the 296 and 308 degree of longitude, extending along the coaſts from the 26 of latitude to the 47: ſo that it has about 420 leagues in length from north to ſouth, 150 in its greateſt breadth, and 90 in its leſſer.

It confines northward with *Peru*; eaſtward with, *Tucumano*, and *Magellanick land*, from which it is ſeparated by a long ridge of mountains, called by the *Spaniards*, *Sierra Nuevada de los Andes*; ſouthward with the *Patagons*.

The climate is very near the ſame as in *Spain*; except in the winter, which is ſometimes ſo exceſſively cold, that it kills men and beaſts, particularly on the mountains; which, notwithſtanding, the ſoil is fertile enough in corn and maiz. It produces wine like that of *France*, and a great quantity of all ſorts of *European* and *American* fruits. It has mines of gold, and the meadows are covered with a great number of ſheep, almoſt as big as camels.

It has ſeveral rivers which freeze during the night, and thaw in the day time, but they are not conſiderable.

This province is divided into three other ſmall ones, which are *Chili*, *Imperial*, and *Chicuito*. The two firſt are on the coaſts, one northward, the other ſouthward; and the laſt is eaſtward, ſeparated

rated from the two others by a ridge of mountains, called *Cordeleras*.

The *city of Conception*, was once the capital of *Chili*, and the feat of a royal audience, which was afterwards transferred to *Peru*; but at prefent *St. Jago* has that advantage, being the feat of a governor, and of a bifhop.

The *Chilians* are ambitious, impatient, bold, and very brave. They bear eafily all forts of incommodities, are ftrong, tall, and well proportioned. They exercife their children to run, hunt, and to ufe arms, the moft confiderable among them are thofe of the valleys of *Arauco*, *Tucapel*, and *Puren*, which the *Spaniards* could never conquer. They are commonly covered with fkins of beafts.

The province of *Chili* depends in part on the viceroyalty of *Peru*, under the direction of a governor, fent thither by the king of *Spain*, and in part is in the power of the favages, who chufe from among them caciques, or captains to lead them to war, to adminifter juftice, and the publick affairs.

The greateft part of the natives are yet idolaters, and adore the devil, whom they call *Eponamon*, i. e. powerful.

MAGELLANICK LAND or PATAGONIA. This province, which the natives call *Chiffa*, is called *Magellanick Land*, from the name of the perfon, who difcovered it. Some call it, *Country of the Patagons*, from the name of its inhabitants.

It is more advanced towards the fouth, than all the other provinces of *America*, and extends like a point into the fea, called alfo *Magellanick*, between the 296 and 322 degrees 30 minutes from the 36 degree of fouthern latitude, to the *Streight of Magellan*, under the 54; fo that it may have about 400 leagues in its greateft extent from eaft to weft, and 360 from north to fouth.

The *Paraguay*, *Tucumano*, and *Chili*, confine it northward; and the ftreight fouthward.

The climate of this country is very cold, and the foil not very fertile, except in paftures and forefts.

Its rivers are the *Defaguedero*, which comes from *Chili*, and paffes in the *Tucumano*, and the *Rio de los Camarones*, which are pretty confiderable.

The *Patagons* are ftrong, bold, and very fwift, love hunting, and dancing, live without care, paint their faces, cut their hair fhort, and cover themfelves with fkins of beafts.

We know nothing of their government, nor of their religion. They only fay that they fear a great horned devil, which they call *etebos*.

PARAGUAY. This province, which the moderns call *Paraguay*, from the name of a river, which waters it, is called by *Herrera*, *Rio de la Plata*, from the name of another river more confiderable than the firft.

It extends between the 309 and the 338 degree of longitude, from the 21 of fouthern latitude, to the 37; fo that it may have about 500 leagues in length and breadth.

It confines eaftward with the northern fea; northward with *Brafil*, and the country of the *Amazons*; weftward with *Peru*, *Tucumao*, and the *Magellanick Lands* and fouthward with the ocean.

The climate is very temperate and wholfome. The foil very fertile in corn, fruits, and cotton; has beautiful meadows round its rivers, which are in great number, and marfhes full of fugar-canes. A great quantity of filver is found at the bottom of *Rio de la Plata*, from which its name has been formed.

In the great number of its rivers, there are fix principal ones, *viz.* *Rio de la Plata*, *Paraguay*, *Parana*, *Uraguay*, *Rio Bianco*, and *Rio Vermejo*; the firft receive the waters of five others.

The *Spaniards* divide this whole country into fix principal parts or provinces, three of which are fouthward, *viz.* *Rio de la Plata*, *Parana*, and *Uraguay*. The three others, *Paraguay*, *Chaco*, and *Guayra*, are northward.

The king of *Spain* is almoft entire mafter of the whole country; and there are but very few people who are not fubject or tributary to him. He keeps a governor there, who anfwers to the viceroy of *Peru*, and refides in the *City of the Affumption*, capital of the whole country, fituated on the river *Paraguay*; this city is adorned with a royal audience, and is an epifcopal fee, as well as *Buenos Ayres*, and *Paraguay*, whofe bifhops are fuffragan of the archbifhop of *La Plata*.

The *Jefuits* claim the fovereignty of the whole country between the river *Paraguay* and *Brazil*; a moft defirable fituation both for the climate and foil, it being allowed to be one of the moft fruitful countries in the world.

The *Portuguefe* have very extenfive dominions on this continent of *South America*, and have given them the name of BRAZIL.

BRAZIL. This country was difcovered in 1501, by *Alvarez Cabral*, a *Portuguefe*, and is the moft eaftern of all *America*, extending between the 322, and the 349 degree of longitude, from the firft degree of fouthern latitude, to the tropick of Capricorn, being 2500 miles in length and 700 miles broad.

It confines northward and eaftward with the northern fea; fouthward with the *Paraguay*; and weftward weſtward with the ſame country, and that of the *Amazons*.

The climate is hot, but very wholſome, and agreeable; the ſoil is very fertile in paſtures: It bears ſeveral ſorts of fruits, as oranges, and lemons, anana's, acajou's, aradrou's, potatoes, and ſeveral others unknown to us, as the *ayri*, and *mainoc*, of which they make bread and pap. Its greateſt fertility is in ſugar: it produces alſo tobacco, and trees, commonly called brazil-wood, of which there are whole foreſts. It abounds with gold and diamonds.

The moſt remarkable among the rivers which all ſpring from, and roll their waters in that country, are the *Miary*, *Pinara*, *Tabucourou*, *Siope*, that of *S. Francis*, and ſeveral others.

The *Brazilians* are cruel, vindictive, and very violent; but they are very patient and abſtemious. They are bold, and even raſh on occaſions.

The middle of the country is inhabited by ſeveral different people, among which the *Topinambas*, the *Marjagas*, the *Oüitaſe*, the *Paraibas*, and the *Tapouyis*, are the moſt conſiderable. The one are governed by a chief, whom they chuſe among the moſt notable: the others, *viz.* the *Maramonins*, *Coriges*, &c. live without law, and without conductor.

The *Portugueſe* are maſters of all the coaſts; and of about 150 or 160 leagues further into the inland. This part is divided into fourteen *Capitaneries*, eleven of which are found on the eaſtern coaſt, aſcending from ſouth to north in the following order: firſt, *San Vincente*, *Rio Janeiro*, *Spiritu Santo*. *Port Seguro*, *Itheos*, *Bahia*, *Seregippe*, *Pernambuco*, *Tamaraca*, *Paraiba*, and *Rio Grande*. The three others are ſituated on the northern coaſt, alſo in order, going from eaſt to weſt, and are *Siara*, *Maragnan*, and *Para*. There is a governor in each capitanate, all of them under the direction of the viceroy of the whole country, who reſides at *St. Salvador*, capital of the whole province, and ſituated in the *Bay of all Saints*, on the eaſtern coaſt; it is alſo an epiſcopal ſee.

Country of the AMAZONS. I call by this name, not only the *Guiana* of the antients, but likewiſe, the whole extent of the country which is in the neighbourhood of the great river of the *Amazons*, between the 300 and the 328 degree of longitude, and extending from the ſecond of northern latitude to the 16 of the ſouthern; ſo that it may have near 560 leagues in length, and near 300 in breadth.

This country confines eaſtward with *Brazil*; northward with *Terra Firma*, weſtward with *Peru*; and ſouthward with the *Paraguay*.

The climate is hotter here than in any other part of *America*. The ſoil is fertile in meadows, but we know very little elſe of the country, except that it muſt have mines of gold, becauſe the natives change that metal for *European* commodities.

The river of *Amazons* traverſes all this vaſt country, from weſt to eaſt, rolling its waters in an extent of more than 700 leagues, forming ſeveral iſles in its courſe, as towards *Peru*, that inhabited by the *Homagui*; the iſland of the *Tapinabous*, and ſeveral others at its mouth, which is 50 or 60 leagues broad. This river receives ſeveral other great rivers, ſouthward, as *Maragnon*, *Amarumaye*, *Tapy Catua*, *Cuſignares*, *Cayana*, and *Topayſa*, the leſſer whereof is more than 200 leagues long; and northward the *Rio Negro* which is a branch of *Oronoque*.

Several different people inhabit this country, the principal provinces whereof are *Caribana*, *Aparia*, *Apanta*, and *Coropos*, northward of the great river; *Cayana*, *Mataya*, *Paranayba*, &c ſouthward of it.

Theſe people are wild, cruel, and go quite naked, men and women without ſhame. They have always their bodies painted of different colours, and covered with ſeveral little ſtones, thruſt into the ſkin from their infancy.

Every one lives as he pleaſes, for they have neither chief, nor conductor; doing themſelves juſtice for the wrongs they have received.

NORTH-AMERICA. The northern continent of the new world is divided amongſt other ſovereigns.

This *ſecond part* of the NEW WORLD is, in the opinion of ſome, a great peninſula, whoſe extent and limits, weſtward and northward, are not certainly known, towards which, ſome *Geographers* imagine, that it is joined to the *Arctick land*.

The *Dutch* make it to extend from the *Streight of Anian*, under the 195 degree of longitude of the firſt meridian of the *Azores*, i. e. about the 187 of the iſland *Del Ferro*, to the 330; and from the *iſthmus* of *Panama*, under the 7 degree and 50 minutes of latitude, to beyond the 63.

GREAT BRITAIN claims all that tract of land, which is bounded by the *Frozen* ocean, on the north; by the *Atlantic* ocean, on the eaſt: by *Florida*, on the ſouth, and by unknown lands on the weſt.

Within theſe bounds are ſituate *New Britain* or *Eſkimaux*, *Britiſh Canada*, *Nova Scotia*, *New England*, *New York*, the *Jerſeys*, *Penſilvania*, *Maryland*, *Virginia*, *North* and *South Carolina* and *Georgia*.

NEW-BRITAIN. This country called alſo *Eſkimaux*, including *Britiſh Canady*, and *Hudſon's* bay,

bay, contains 1600 miles in length, and 1200 miles in breadth; bounded by unknown lands, about the pole on the north; by the *Atlantic* and *Baffin*'s bay on the east; by the bay and river of *St. Laurence*, and *French Canada* on the south; and by unknown lands on the west.

It is watered with the *Black* river, *Rupert* river, *Albany* or *Chickewan* river, *Moose* river, *Severn* river, *Nelson* river, *Berray* river, *Mercour* river, and *Merrick*'s river.

Within this region we have divers seas, bays, straights and capes, which take their names from the discoverers.

The SEAS that border on these countries are the *Atlantic* ocean and the extensive sea, called *Hudson*'s bay; in which are many lesser bays, as *James*'s bay, *Buttons*'s bay, *Baffin*'s bay, Sir *Thomas Roe*'s welcome, *Brig*'s bay, *Cumberland*'s bay; and the ports or bays of *Rupert*, *Albany*, *Nelson*, and *Churchill*.

The BAYS in *New-Britain* are *Eskimaux*, *Hold-with-Hope*, and *Phillipeaux*.

The STRAITS are *Hudson*, *Davis*, and *Bellisle*.

The CAPES are Cape *Charles* on the straights of *Bellisle*; Cape *Desire* at the entrance of *Hudson*'s straight, Cape *Henry*, Cape *James*, and Cape *Worsenham* near the entrance of *Hudson*'s bay; Cape *Henrietta* and *Maria* on the south west part of the bay, and Cape *Comfort*, and Cape *Assumption* on the north part of the bay.

This country is full of lakes, bogs, morasses, which being covered with ice and snow great part of the year, makes the air excessive cold.

The natives are savage heathens: but the *English* have settlements on the west side of *Hudson*'s bay, called fort *Churchill*, *Nelson*, *New Severn*, and fort *Albany*, subject to the direction of the *Hudson* bay company, who claim by charter an exclusive right, to the trade and country within the limits of the northernmost seas and continent; on condition of their making a search for, and attempting to discover a passage through those seas to the *East-Indies* and *China*. But how far their diligence in this grand attempt is to be commended, is too well known by their discouragement of every project for carrying it into execution, and by their abandoning *Fort Charles* and *Fort Rupert*, and several more situate at the bottom of the bay, to the *French*, rather than be at the charge of maintaining them against those competitors for trade.

The north part of the *Eskimaux* is generally known by the name of *Terra de Labrador*.

Their animals are the mouse deer or elk, stags, rein deer, bears, tygers, buffaloes, wolves, foxes, beavers, otters, lynk's, martins, squirrels, ermins, wild cats, and hares.

Of the feathered kind they have geese, bustards, ducks, partridges, and all manner of wild fowl.

Of fish, there are whales, morses, seals, cod fish, and a white fish preferable to herrings; and in their rivers and fresh waters, pike, perch, carp, and trout. Their foxes, hares, and partridges turn white in the winter; their partridges are as large as hens. There have been taken at port *Nelson*, in one season, 90,000 partridges, and 25,000 hares.

The food of the *Indians* is chiefly what they take in hunting or fishing.

The *English* kill beef, pork, mutton, and venison, at the beginning of the winter. These are preserved by the frost six or seven months free from putrefaction: also geese, partridges, and other fowls, killed at the same time, are hung up with their feathers on, and their guts in, and hold good all the winter. In lakes and standing waters, which are not ten feet deep, the water is frozen to the bottom, and the fish killed; but in waters of greater depth, and rivers near the sea, the fish are caught all the winter, by cutting holes in the ice, to which they come for air.

As soon as they are taken out of the water, they are immediately frozen and stiff, but may be thaw'd again by being immersed in cold water.

And thus it is that people thaw and freshen their salt provision here: they let down the meat through a hole in the ice into the water, and in a little time it becomes soft and pliable, as if it never was frozen, and eats very well; whereas, if you roast or boil it while it is frozen, it will be spoiled, and eat as if it was rotten.

There is no want of food in *Hudson*'s bay, at any time of the year. In *April* come the geese, bustards, and ducks, of which they kill as many as they please. About the same time they take great numbers of rein deer, and those do not return to the north till *July* or *August*. In the summer also they take pike, trout and carp, and a white fish like a herring; and in the beginning of winter, all manner of wild fowl return again.

There come down usually to port *Nelson*, every season to trade with the *English*, a thousand men, and some *Indian* women in about 600 canoes. They come from far distant countries, and are much delayed in their voyages, by being obliged to go on shore every day to hunt for provisions; for their canoes are so small holding only two men and a pack of a hundred beaver skins, that they cannot carry much provision with them; and they are so discouraged by the high price the company sets upon the *European* goods, that if it were not for the necessity they are under of having guns, powder, and shot, hatchets, and other iron tools for hunting,

hunting, with tobacco, brandy, and paint, they would not go down to the factory at all.

When the *Indians* came to the factory in *June* 1742, they could get but a pound of gunpowder for four beaver ſkins, a pound of ſhot for one beaver, an ell of coarſe cloth for fifteen, a blanket for twelve, two fiſh-hooks or three flints for one, a gun for 25 ſkins, a piſtol for ten, a hat with a white lace for ſeven, an ax for four, a hedging bill for one, a gallon of brandy for four, a check'd ſhirt for ſeven: all which were ſold at that monſtrous profit of 2000 *per cent.* Notwithſtanding which diſcouragement, the *Indians* brought down to port *Nelſon* that ſeaſon 50,000 beaver ſkins, and 9000 martins, theſe beaver ſkins being worth 5 or 6*s.* a pound; whereas thoſe the *Engliſh* purchaſe at *New York* are not worth above 3*s.* and 6*d.* a pound.

Beſides theſe ſkins, the *Indians*, the ſame year 1742, brought to the factory at *Churchill* 20,000 beaver ſkins.

As to the trade on the eaſtern and ſouthern ſhores, the company have in a manner abandoned it, and ſuffer the *French* to run away with it, though this country was confirmed to *Great-Britain* by the peace of *Utrecht*, *Anno* 1714. If the trade was laid open, and the ſouthern and eaſtern countries ſettled, we might regain that trade, and vaſtly increaſe it, by furniſhing the natives with woollen goods, iron tools, guns, *&c.* at reaſonable rates. The number of hunters would increaſe, and we ſhould bring home four times as many furrs, and other valuable ſkins, as we do now. By increaſing our ſettlements to the ſouthward, in the bottom of the bay, we ſhould make the natives our friends; being able to afford our goods cheaper than the *French* can, we might force the *French* out of the trade upon the eaſt main, and the countries north of the *Huron* lake, and the other lakes of *Canada*. The company have no other place of ſtrength than *York* fort, with 25 men, and the prince of *Wales*'s fort at *Churchill*, in which they keep but 28 men, though there are 40 guns mounted.

This company which does not conſiſt of above nine or ten merchants, exclude all the reſt of the *Britiſh* ſubjects from this trade, by virtue of a patent, extremely to the prejudice of their native country: for if the reſt of the king's ſubjects had been ſuffered to ſend colonies thither, and traffic with the *Indians*, they would have underſold the *French*, and conſequently beat them out of that trade, and out of thoſe countries which were yielded to *Britain* by the peace of *Utrecht*.

The eaſtern ſhores of this country were firſt diſcovered by *Sebaſtian Cabot* for *Henry* VII. king of *England*, in the year 1498: they were afterwards viſited by *Davis* and other *Britiſh* mariners. Mr. *Hudſon* made four voyages thither, between the years 1607 and 1611; in the laſt of which his men forced him and eight more of their officers into a boat, and left them to ſtarve in the bottom of the bay, and they were never heard of more; but the ſhip and the reſt of the men returned home.

Sir *Thomas Button* perſued the diſcovery in 1612, and Capt. *James* in 1631, in hopes of finding a north-weſt paſſage to *China*: Capt. *Gilham* ſailed to the bottom of the bay in 1667, and at his return his owners procured a patent for planting this country, *Anno* 1670. The firſt *Engliſh* governor, who went thither, was *Charles Batley*, Eſq; who built a fort on *Rupert* river, calling it *Charles* fort, and ſoon after ſettled another factory at *Nelſon*. In the Year 1684, the chief *Engliſh* factory was at *Albany*, and a fort erected for its defence,

The *French* invaded our ſettlements, and took fort *Rupert* and *Albany* in *July* 1686, though we were then at peace with *France*. In king *William*'s war, *Anno* 1693, the *Engliſh* recovered their ſettlements again.

During the war in queen *Ann*'s reign, the *French* reduced all our ſettlements except *Albany*, but were obliged to reſtore them at the peace of *Utrecht*, *Anno* 1714, when the *French* king having ſeized ſome *Engliſh* ſettlements in theſe countries, he was obliged by the treaty of *Utrecht* in the year 1713, to reſtore to *Great Britain* the bay and ſtraights of *Hudſon*, with all the lands, ſeas, ſea-coaſts, rivers, and places, ſituate on the ſaid bay and ſtraights, (which comprehend all *New-Britain* and *Britiſh Canada*, or *Nova-Scotia*) and it was agreed, that commiſſioners, on the part of *Great-Britain* and *France*, ſhould determine, within the ſpace of a year, the limits between the dominions of *Great-Britain* and *France* on that ſide; which limits the ſubjects of *Great-Britain* and *France*, were not to paſs over to each other by ſea or land; but theſe limits were never ſettled, which delay brought on at laſt the preſent war.

By the 12th article of the ſame treaty, *Nova Scotia*, with the fortreſs of *Annapolis*, and all the lands and dependencies thereunto belonging, were yielded to *Great-Britain*; and the ſubjects of *France* were entirely excluded from all kinds of fiſheries in the ſeas of *Nova Scotia*, eſpecially thoſe which lie towards the eaſt, and within thirty leagues thereof, beginning at the iſland of Cape *Sable*, and extending from thence to the north eaſt.

Nova Scotia is bounded by the river of St. *Lawrence*, on the north; by the bay of St. *Lawrence*, and the *Atlantic* ocean, eaſt; by the ſame ocean and *New England*, ſouth; and by *French Canada*, weſt; extending 500 miles in length, and 400 in breadth.

The

The chief towns are, 1. *Annapolis Royal*, 2. *Halifax*. 3. *Minnes*. 4. *Chenigto*, all in the southern peninsula; 5. *Canseau*, upon an island at the east end of the peninsula, near the straight which divides *Nova Scotia* from *Cape Breton*.

Here are several good rivers. The river of St. *Lawrence*, which forms the northern boundary. The rivers *Risgouche* and *Nipisiguit* run from west to east, and fall into the bay of St. *Lawrence*. The rivers of St. *John*, *Passamagnadi Penobscot*, and St. *Croix*, which run from north to south, fall into *Fundi* bay, or the sea a little to the eastward of it.

The seas adjoining to it are, the bay of St. *Lawrence*; the *Atlantic* ocean, and *Fundi* bay. The lesser bays are, *Chenigto*, and *Green* bay upon the isthmus, which joins the north part of *Nova Scotia* to the south; the bays of *Gaspe* and *Chaleurs* on the north east; the bay of *Chebucto* on the south east; the bay of the *Islands*. The ports of *Bart*, *Chebucto*, *Prosper*, St. *Margaret*, *La Heve*, port *Maltois*, port *Rosignol*, port *Vert* and port *Joly*, on the south; port *La Tour* on the south east; port St. *Mary Annapolis*, and *Minnes* on the south side of *Fundi* bay.

The chief capes are, *Rosser* and *Gaspe* on the north east. The capes *Portage*, *Ecoumenac*, *Tourmentin*, cape *Port* and *Epis*, on the east. Cape *Fogeri*, and cape *Canseau*, on the south east. Cape *Bianco*, cape *Vert*, cape *Theodore*, cape *Dore*, cape *Le Heve*, and cape *Negro*, on the south. Cape *Sable* and cape *Fourche*, on the south west.

This country is a great forest: where it has been cleared and cultivated, it affords good corn and pasture. The timber is fit for building, and will produce pitch and tar; and the soil is proper for hemp and flax; so that all manner of naval stores might be had there.

It abounds in deer, wild fowl, and all manner of game; and there is one of the finest cod-fisheries in the world on the coast

No provision was made to plant the rest of *Nova Scotia*, until the year 1749, when about three thousand *English* families, under the command of governor *Cornwallis*, were sent thither, and erected the town of *Halifax* in *Chebucto* bay.

The dispute between *Great-Britain* and *France*, is not whether *Nova Scotia* was yielded to *Great-Britain* by the treaty of *Utrecht*, but what were the *Bounds* of *Nova Scotia*: which the *British* commissaries demonstrated extended to the river of St. *Lawrence*, on the north, by several treaties between the two nations; whereas the *French* insisted that only a small part of the peninsula was ceded to *Britain*.

The *French* also encroached upon *Virginia* on the side of the *Ohio*, near the lake of *Erie*; made several of the subjects of *Great-Britain* prisoners, and erected forts on the lake and on the river *Ohio*, to defend their encroachments on that side. Whereupon some forces under the command of general *Bradock* were sent to dislodge them, who fell into an ambuscade, near fort *Duquesne*, and were defeated, and the general, and many of the officers were killed.

In the mean time general *Johnson* marched with a body of troops from *Albany* in *New-York*, and obtained a victory over the *French*, near the lake of *Champlain*, and erected some forts to restrain the incursions of the enemy from fort *Frederic* or *Crown Point*; other detachments of the *English* keep possession of the forts on the isthmus, which unite the peninsula to the continent of *Nova Scotia*; and of those the *French* had erected on the north side of the bay of *Fundi*, since the treaty of *Aix-la-Chapelle*. Since then we have reduced *Cape Breton*, and the island of St. *John*, fort *Duquesne*, and fort *Frontenac*, &c. and are upon an expedition against *Crown Point* and *Quebec*.

The island of *Cape-Breton*, called by the *French* *Isle Royal*, is situated between the 45th and 47th degree of north latitude, and forms, together with the island of *Newfoundland*, from which it is distant only 15 or 16 leagues, the entry of the gulph of St. *Lawrence*. The streight, which separates it from *Acadia* or *Nova Scotia*, is only five leagues in length, and one in breadth. The *French* call it the passage of *Fronsac*; but the *English* the streight of *Canso*.

The length of the island, from north-east to south-west, is not quite 50 leagues; and its greatest breadth, from east to west, is not above 33. It is of a very irregular figure, and almost intersected by lakes and rivers, so that the two principal parts join together only by an isthmus of about an hundred paces over, which separates the bottom of port *Toulouse* from several lakes, which are called *Labrador*. These lakes discharge themselves eastwards into the sea, by two channels, of unequal breadth, formed by the island *Verderonne*, or *la Boularderie*, which is seven leagues in length.

The climate of this island is nearly the same as that of *Quebec*; and, though fogs are here more frequent, the people do not complain of an unhealthy air. All the lands are not good, yet they produce trees of all sorts. Here are oaks of a prodigious magnitude, pines proper for masts, and all kinds of timber for carpenters work. The most common sorts, besides the oak, are the cedar, the ash, the maple, the plane, and aspin-tree. Fruits, especially apples; pulse, corn, and other grains necessary for life; as also hemp and flax, are in less abundance, but as good, in quality, as those of *Canada*. It has been observed, that the mountains here will bear cultivation up to the top, and that the

the beſt lands are upon their ſouthern declivities, which are defended from the north and north-weſt winds, by the hills which bound them on the ſide of St. *Laurence*'s river.

All domeſtic animals, as horſes, black cattle, hogs, ſheep, goats, and poultry, find here proviſions in abundance. The chace and the fiſhery are ſufficient to nouriſh the inhabitants a good part of the year. Here are a great plenty of excellent mines of pit-coal. As theſe mines are in the mountains, there is no occaſion for digging deep under ground, or to be at the expence of making drains to carry off the water, as in ſome other countries. Lime-ſtone is alſo found here. The cod fiſhery is here carried on with perhaps, better ſucceſs than in any other part of the world; nor can greater conveniencies be found for drying fiſh. Formerly this iſland was full of wild beaſts, but at preſent they are very rare, eſpecially elks. The partridges here are almoſt as large as pheaſants, and feathered very much like them. In ſhort, fiſheries of ſeals, porpoiſes, and ſea cows, or grampuſes, might be conveniently carried on for the benefit of their oil, there being great plenty of them.

All the ports on the eaſt ſide round to the ſouth are open, for the ſpace of fifty-five leagues, beginning with port *Dauphin*, and proceeding to port *Touloſe*, which is almoſt at the entry of the ſtreight of *Canſo*, or paſſage of *Fronſac*. Every where elſe it is difficult to find anchorage, even for ſmall veſſels, either in the bays or between the iſles. All the north coaſt is very high, and almoſt inacceſſible; nor is it more eaſy to go on ſhore on the weſt, till you come to the ſtreight of *Canſo*; upon leaving which, you fall again upon port *Toulouſe*, formerly called St. *Peter*'s.

This port lies properly between a kind of gulph, called *Little* St. *Peter*'s, and the iſle of St *Peter*, over-againſt the iſles of *Madame* or *Maurepas*. From thence advancing to the ſouth-eaſt, and paſſing ſeveral other bays, you come to that of *Gaborus*, or *Gaboron*, the entrance of which, about 20 leagues from the iſlands of St. *Peter*, is a league broad between iſles and rocks. This bay is two leagues deep, and affords very good anchorage. Here Admiral *Boſcawen* landed the forces that took *Louisbourg*, *&c.* in 1758.

The haven of *Louiſbourgh*, formerly called *Engliſh Haven*, is a league diſtant from the above bay. It is one of the fineſt of all *America*; it is near four leagues in circumference, and every where there are ſix or ſeven fathoms water. The anchorage is good, and you may, without danger, run a ſhip aſhore on the mud. The entrance is not above two hundred fathoms wide, and lies between two ſmall iſlands; and it may be known twelve leagues off at ſea, by the cape of *Lorembec*, which lies but a ſmall diſtance from it to the north eaſt.

Two leagues higher is *Port de la Baleine*, or *Whale Port*, the entry of which is difficult, becauſe of ſeveral rocks, which the ſea covers when it runs high. Ships of above 300 tons cannot enter here, but then they are quite ſafe when they are got in. From hence it is but two leagues to the bay of *Panadou*, or *Menadou*, the entrance of which is about a league broad, from whence it runs in about two leagues. Almoſt over-againſt it is the iſle of *Scatari*, formerly called *Little Cape Breton*, which is about two leagues long. The bay of *Mire* is ſeparated from it only by a very narrow neck of land. The entrance of this bay is two leagues over, and runs eight leagues into the country. It grows narrow the farther you go into it, and receives a great many rivulets and ſmall ſtreams. Large ſhips may run up it ſix leagues, and find very good anchorage, and be ſheltered from the winds by the hills.

Beſides the iſland of *Scatari* there are many other ſmall ones, and rocks, which the ſea never covers, and may be ſeen at a great diſtance. The largeſt of the rocks is called the *Forillon*.

The bay of *Morienne* is higher ſtill, and ſeparated from the bay of *Mire* by *Cape Bru'e* or *Cape Burnet*. A little higher is *Flat Iſle*, or *Gunſlint Iſle*, lying in 46 degrees 8 minutes of north latitude. There are good openings between all theſe iſlands and rocks, and they may be approached without danger.

Advancing from thence to the north weſt, we come to *Indiana*, which is a good haven for ſmall veſſels, but has not water enough for large. From *Indiana* to *Spaniards* Bay is two leagues, and the latter a very fine haven. The entrance is not a mile over, but enlarges, as we advance inwards, and at the diſtance of a league divides into two branches, which may be ſailed up for two leagues. They are both very good ports, and might be made better at a ſmall expence. From this bay to the leſſer entrance of *Labrador* is two leagues, and the iſland which ſeparates the leſſer entrance from the greater, is about the ſame breadth.

Labrador is a gulph, about twenty leagues long, and three or four over, where broadeſt. It is reckoned only a league and a half from the large entrance of this gulph to port *Dauphin* or St. *Anne*'s port, and you may anchor with ſafety, almoſt any where among the iſlands of *Cibou*. A ſlip of land, or kind of natural mole, almoſt entirely ſhuts up this port, and leaves room for the paſſage of only one ſhip at a time. The port is about two leagues in circumference, and ſhips hardly feel the wind there, by reaſon of the height of the mountains that ſurround it.

it. The ſhore is every where ſo bold, that you may ride as near to it, as you pleaſe.

New England is bounded by *New Scotland*, on the north; by the *Atlantic* ocean, on the eaſt and ſouth; and by *New York*, on the weſt, and is 300 miles long, and 200 broad, divided into four governments, *viz.* 1. *New Hampſhire*, or *Piſcataway*. 2. The *Maſſachuſets* colony. 3. The colony of *Rhode* iſland, *Providence* plantation; and 4. *Connecticut* colony.

It is divided into four provinces, *viz.* 1. *New-Hampſhire*. 2. *Maſſachuſets* colony. 3. *Rhode* iſland. 4. *Connecticut*. Whoſe chief towns are *Portſmouth*, *Boſton*, W. long. 71. N. lat. 42. *Newport*, *London*, and *Hertford*.

Here are the rivers, 1. *Connecticut*; 2. *Thames*; 3. *Patuxent*; 4. *Merimac*; 5. *Piſcataway*; 6. *Saco*; 7. *Caſco*; 8. *Kinebeque*; and, 9. *Penobſcot*, or *Pentagonet*.

The moſt remarkable bays and harbours are thoſe form'd by *Plymouth*, *Rhode* iſland, and *Providence* plantation; *Monument* bay; *Weſt* harbour, form'd by the bending of cape *Cod*; *Boſton* harbour; *Piſcataway*; and *Caſco* bay.

The chief capes are, cape *Cod*, *Marble Head*, cape *Anne*, cape *Entick*, cape *Porpus*, cape *Elizabeth*, and cape *Small Point*.

The climate is generally healthful, and agreeable to *Engliſh* conſtitutions.

The fruits of *Old England* come to great perfection here, and particularly peaches, which are all ſtandard-trees.

Engliſh wheat does not thrive here. They eat maize or *Indian* corn chiefly: one grain whereof frequently produces twelve hundred grains, and ſometimes two thouſand. Beſides the foreſt-trees of *Old England*, they have cedar, cypreſs, pine, and fir-trees Their fir-trees are of a prodigious bulk, and furniſh the royal navy of *England* with maſts and yards, and they draw from theſe, and other trees, pitch, tar and roſin, turpentine, gums, and balm; and the ſoil is proper for hemp and flax. A ſhip may be built and rigged out with the produce of the ſoil; ſo that ſhip-building is a conſiderable employment in this country.

The animals, which ſeem almoſt peculiar to *New England*, and the reſt of *North America*, are the *mooſe deer* and the *beaver*.

The *ſpermaceti* whale alſo is found upon this coaſt: of which, and other whales, the *New England* people take great numbers, and ſend ſome ſhips every year to fiſh for whales in *Greenland*. Beſides the whale-fiſhery, there is a very fine cod-fiſhery on the coaſt of *Nova Scotia*.

The *New-England* people have a great trade by ſea to the *Britiſh* ſugar colonies, and with the *Dutch* at *Surinam* and *Curaſſoa* near *Terra-Firma*: whither they ſend horſes, ſalt proviſions and lumber, that is deal-boards, pipe-ſtaves, hoops, and ſhingles.

The appointment of a governor, lieutenant governor, ſecretary, and all the offices of the admiralty, is veſted in the crown. The power of the militia is wholly in the hands of the governor, as captain general. All judges, juſtices, and ſheriffs, to whom the execution of the law is intruſted, are nominated by the governor, with the advice of the council; and the governor has a negative on the choice of councellors, peremptory and unlimited. All laws enacted by the general aſſembly are to be ſent to the court of *England*, for the royal approbation; and no laws, ordinances, elections (of magiſtrates, I preſume,) or acts of government whatſoever, are valid, without the governor's conſent in writing.

In one of the repreſentations of the board of trade, they inform the privy-council, that in the colony of the *Maſſachuſets* only, there were upwards of ninety-four thouſand ſouls, and that their militia conſiſted of ſix regiments of foot, and fifteen troops of horſe, of an hundred men in each troop. The ſame repreſentation ſhews, that they employed near five hundred ſail of ſhips, and four thouſand ſeamen, annually in their trade; and if this calculation be right, it muſt be allowed, that the reſt of the colonies north of *Virginia* and *Maryland*, viz. *Connecticut*, *Rhode Iſland*, *New York*, the *Jerſeys*, and *Pennſylvania*, can raiſe at leaſt as many more. All that ſeems wanting, in order to render theſe forces uſeful and capable of oppoſing an invaſion, is a generaliſſimo, impowered, on any exigencies, to oblige every colony to raiſe their reſpective quota's of ſupplies and troops, and to command them when aſſembled in the field; for theſe are particulars, which it is never to be expected the colonies ſhould agree on among themſelves, or at leaſt time enough to prevent the ravages of a potent enemy, as ſome late proceedings have convinced us.

New England was planted by the *Independents* a little before the commencement of the civil wars in *England*. Theſe people tranſported themſelves thither, rather than conform to the eſtabliſhed church. Though they complained of the government here, for not allowing a toleration, they permitted no other ſect or denomination of chriſtians, but themſelves, to have any ſhare in the governments they erected there, and were ſo far from allowing a toleration to thoſe that differed from them, that they hanged ſeveral quakers. It is but very lately they have ſuffered any member of the church of *England* to have a ſhare in the magiſtracy, or to be elected a member of the comm[illegible] houſe of repreſentatives; and there are not more than two or three admitted at this day into their councils.

New-York with the Jerseys. Theſe are bounded by *Canada*, on the north; by *New-England* caſt; by the *American* ſea ſouth; and by *De la War* river, which divides it from *Pennſylvania*, on the weſt: 200 miles long and 100 broad. It is divided into three provinces, *viz.* 1. *New-York*, 2. The *Jerſeys*, 3. *Long-Iſland*, and the reſt of the iſlands near *Hudſon*'s river; whoſe chief towns are, *New-York*, W. lon. 72--30. N lat. 41. *Albany*; *Burlington*; *Elizabeth*; *Southampton*.

The chief rivers, beſides thoſe of *Hudſon* and *De la War*, are the *Mohawk* river; *Onandago*, *Raritan*, and *Maurice* rivers.

The Capes are *Cape May*, on the eaſt entrance of *De la War* river; *Sandy point*, near the entrance of *Raritan* river; and *Montaug Point*, at the eaſt end of *Long-Iſland*.

There are very extenſive Lakes on the north-weſt, *viz.* the *lakes* of *Champlain*, *Ontario*, and *Erie*. The *Iroquois*, or five nations, lie upon the *lakes* of *Ontario* and *Erie*.

New York and the *Jerſeys* abound in cattle and a good breed of horſes, and have plenty of wheat and other grain, as well as fiſh. They ſupply the ſugar colonies with flour, ſalt beef, pork, and ſalt fiſh: and with timber, plank, and pipe-ſtaves; and as they are much employed in the fiſhery, they export a great deal of dried and ſalted fiſh to *Spain*, *Portugal*, *Italy*, and other countries of *Europe*. They traffick alſo with the logwood cutters in the bay of *Honduras*, and with the *Spaniſh* ſettlements, exchanging the manufactures of *Europe* for treaſure, which they ſend to *England* as merchandize. They bring over alſo whale oil and bone, and return with the manufactures of *Great Britain*.

The people of *New-England*, *New-York*, and our other northern colonies, of late, export a great deal of timber to *Portugal*, and other countries in *Europe*.

Every nation of the *Iroquois* is a diſtinct republic, governed by their ſachems or civil magiſtrates in time of peace, and by their warriors or captains in their wars; but their chiefs neither reſolve, nor execute any thing of importance, without conſulting the heads of their tribes.

The church of *England* is eſtabliſhed in this and all the royal governments in *Britiſh America*.

Pennsylvania, is bounded by the country of the *Iroquois*, or five nations, on the north; by *De la War* river, which divides it from the *Jerſeys*, on the eaſt; and by *Maryland* on the ſouth and weſt, 200 miles long and 200 broad. It is divided into north and ſouth, and thoſe diviſions ſubdivided into ſix counties, *viz. Buckingham*, *Philadelphia*, *Cheſhire*, *Newcaſtle*, *Kent*, *Suſſex*, whoſe chief towns are *Briſtol*, *Philadelphia*, W. long. 740. N. lat. 40. 50. *Cheſter*, *Newcaſtle*, *Dover*, and *Lewes*.

The coaſt near the ſea is flat, but riſes gradually, having the *Apalachian* mountains on the weſt.

The Rivers are, 1. The *De la War*. 2. *Saſquahanna*; and, 3. *Skoolkil*.

The merchandiſe conſiſts of horſes, pipe-ſtaves, pork, beaf, and fiſh, ſalted and barreled up; ſkins and furrs; all ſorts of grain, *viz.* wheat, rye, peaſe, oats, barley, buck-wheat, *Indian* corn, *Indian* peaſe, and beans, pot-aſhes, wax, &c.

They have ſome rice; and a little tobacco of the worſt ſort. The colonies of *Pennſylvania*, the *Jerſeys* and *New-York*, appear extremely proper to produce hemp and flax where they are cultivated. Their trade with the *Indians* conſiſts but in few articles; they receive of the natives chiefly ſkins and furrs of their wild beaſts, for which they give them cloathing, arms, ammunition, rum, and other ſpirits, in return.

Maryland, is bounded by *Pennſylvania*, on the north, by another part of *Pennſylvania*, and the *Atlantic* ocean, eaſt; by *Virginia*, ſouth; and by the *Apalachian* mountains weſt, extends 140 miles in length and 135 in breadth: and is divided into two parts by the bay of *Cheeſepeak*, *viz.* 1. The eaſtern; and, 2. The weſtern diviſion.

The eaſt diviſion contains four counties, 1. *Somerſet*, 2. *Dorcheſter*, 3. *Talbot*, county, 4. *Cecil* county. The weſt diviſion contains ſix counties, 1. *St. Mary*'s county, 2. *Charles* county, 3. *Prince George* county, 4. *Calvert* county, 5. *Anne Arundel* county, 6. *Baltimore* county; whoſe chief towns are *Somerſet*, *Dorcheſter*, *Oxford*, *St. Mary*'s *Briſtol*, *Maſterkout*, *Abingdon*, *Annapolis*, W. lon. 78. N. lat. 39-25. and *Baltimore*.

This country is watered with innumerable ſprings, which form a great many fine rivers, of which the chief are 1. *Potomack*. 2. The *Pocomoac*. 3. The *Patuxent*. 4. *Severn* 5. *Cheptonk*. 6. *Saſſafras*. 7. *Wicomoca*; and, 8. The river of *St. George*.

It is ſeparated from *Virginia*, on the ſouth, by the river *Patowmack*.

The air of this country is exceſſive hot ſome part of the ſummer, and equally cold in winter, when the north-weſt wind blows.

Tobacco is planted and cultivated here with much application, and their principal traffick with *England* is in this article; though the country produces moſt of the grain and fruits of *Europe* and *America*.

They

They are governed by the same laws as in *England*, only some acts of assembly they have relating to particular cases, not under the verge of the *English* laws, or where the laws of *England* do not aptly provide for some circumstances, under which their way of living hath put them. The church of *England* is established here; churches are built, and there is an annual stipend allowed for every minister by a perpetual law; every christian male sixteen years old, and negroes, male and female, above that age, pay 40 ℔. of tobacco to the minister, which is levied by the sheriff among other publick levies; which make the revenues of the ministers, one with another, about twenty thousand pounds of tobacco, or one hundred pounds sterling *per annum*.

VIRGINIA is bounded by the river *Patowmack*, which divides it from *Maryland*, on the north-east; by the *Atlantic* ocean, on the east; by *Carolina*, on the south; and by the *Apalachian* mountains, on the west: extending 240 miles in length and 200 miles in breadth; and may be divided into four parts, *viz.* 1. The north division. 2. The middle division. 3. The south division. And, 4. The east division.

The north division contains five counties; 1. *Northumberland*. 2. *Lancashire*. 3. *Westmoreland*. 4. *Richmond*. 5. *Stafford*. The middle division contains ten counties; 6. *Essex*. 7. *Middlesex*. 8. *Gloucester*. 9. *King* and *Queen* county. 10 *King William* county. 11. *New Kent*. 12. *Elizabeth* 13. *Warwick* county. 14. *York* county. 15. *Princess Anne* county. The south division contains eight counties. 16. *Norfolk* county. 17. *Nansamund* county. 18. *Isle of Wight* county. 19. *Surrey* county. 20. *Prince George* county. 21. *Charles* county. 22. *Henrico* county. 23. *James* county The eastern division between *Cheesepeak* bay and the ocean is only one county. 24. *Acomac* county. These counties are divided into parishes, *viz. Wincomoca* parish, *Christ-Church*, *St. Paul's*, *Farnham*, *Christ-Church*. *Abingdon*, *Stratton*, *St. John's*, *St. Peter's*, *Elizabeth*, *Denby*, *York*, *Lynhaven*, *Elizabeth*, *Chukatuk*, *Newport*, *Southwark*, *Wyanoke*, *Westover*, *Bristol*, *James Town*, *Williamsburg* and *Acomac*

Into the west side of *Cheesepeak* bay fall four great rivers, which rise in the *Apalachian* mountains, running from the north-west to the south-east; the most southerly of these is *James* river, the *Indian* name whereof was *Powhatan*, being generally about two miles over, and navigable at least fourscore miles. *York* river, whose *Indian* name was *Paamunky*, is a little to the northward of *James* river. North of *York* river is the river *Rappahanock*; north of *Rappahanock*, is the great river of *Patowmack*, which is navigable near two hundred miles; being nine miles broad in some places, but generally about seven.

The great bay of *Cheesepeak* runs up through *Virginia* and *Maryland*, almost due north, three hundred miles and upwards, being navigable most part of the way for large ships. We enter this bay between two promontories called *Cape Charles* and *Cape Henry*.

As we approach *Virginia* from the Ocean, it appears to be low land; and for an hundred miles up into the country, there is a scarce a hill or a stone to be met with. People travel with ease through these forests on horseback, and never want a fine shade to defend them from the summer heats.

Snow falls sometimes in pretty great quantities, but rarely continues there above a day or two; their spring is about a month earlier than in *England*; in *April* they have frequent rains; *May* and *June* the heat increases, and it is much like our summer, being mitigated with gentle breezes, that rise about nine of the clock, and decrease and increase as the sun rises and falls. *July* and *August* those breezes cease, and the air becomes stagnant; then the heat is violent and troublesome. In *September* the weather usually breaks suddenly, and there falls very considerable rains, when many fall sick, this being the time for cachexies, fluxes, scorbutic dropsies, gripes, or the like.

It is computed there are in *Virginia* upwards of an hundred thousand souls, besides servants and slaves, which are above twice that number.

No country produces greater quantities of excellent tobacco.

Of spontaneous flowers there are great variety; the finest crown-imperial in the world, the cardinal flower, so much extolled for its scarlet colour; and almost all the year round the plains and vallies are adorned with flowers of one kind or other.

There is also found the fine tulip-bearing laurel-tree, which has the pleasantest smell in the world, and keeps blossoming and seeding several months together.

The woods produce great variety of incense and sweet gums, which distil from several trees.

All sorts of naval stores may be produced there, as pitch, tar, rosin, turpentine, plank-timber, masts and yards, besides sails, cordage, and iron.

Horses, cows, sheep and hogs, run wild in their forests. Beef and pork are sold from one penny to two pence a pound. Their fattest pullets are sixpence a piece; chickens at three or four shillings a dozen; Geese at ten pence a-piece; a turkey for eighteen pence. Fish, oysters, and wild

wild fowl, are the cheapest food in this country in the season. And deer are sold from five shillings to ten shillings a-piece.

The government of the *English* is formed upon the *English* model; the governor acts as king; the council supplies the place of a house of lords, and the house of representatives the commons.

There are no other forces in *Virginia* but militia. Every freeman, (that is, all that are not servants) from sixteen to sixty years of age, are listed in the militia, and are mustered once a year at a general muster, and four times a year by troops and companies in their respective counties; and they are reckoned to be about twenty thousand men; the whole inhabitants, men, women and children, amounting to upwards of one hundred thousand, and slaves and servants to twice that number.

There is a college at *Williamsburgh*, situate between *James* and *York* rivers. King *William* and queen *Mary* gave two thousand pounds in 1692, towards its foundation, endowed it with twenty thousand acres of land, and a revenue of one penny in the pound on all tobacco exported. Hence this college is called *William* and *Mary* College, for a resident, six professors, and a hundred students. This college has acquired a very considerable donation also from the Hon. Mr. *Boyle*, for the education of *Indian* children.

Carolina, comprehending *North Carolina*, *South Carolina*, and *Georgia*, is situated between 75 and 86 degrees west longitude, and between 33 and 36 degrees north latitude.

If we were to extend *Carolina* to the westward, as far as their charters would justify them, or as far as the country of the *Cherokee Indians* our allies extends, we might make the river *Mississippi* the western boundary, which falls into the gulph of *Mexico*, in 95 degrees of western longitude; but if we take in no more than is actually planted by the *English*, we must not extend it above two hundred miles west of the *Atlantick* ocean. As to the *French* settlements on the river *Mississippi*, they are but late intruders there, since the year 1720, for all to the east of that river properly belongs to the *English*; and all towards the west to the *Spaniards*; and the *Spaniards* actually destroyed some of the forts the *French* had erected on the west side of that river, though since the strict Union between the two kingdoms of *France* and *Spain*, the *Spaniards* wink at the *French* Incroachments.

I shall take the liberty, however, to give *Carolina* the bounds it ought to have, both against *French* and *Spanish Florida*, and bound *Carolina* by *Virginia* on the north; by the *Atlantick* ocean on the east; by the river of St. *John* on the south; and the river *Mississippi* on the west; and throw it into three divisions, viz. 1. *North Carolina*, 2. *South Carolina*, and 3. *Georgia*; extending five hundred miles in length, with an uncertain breadth.

North Carolina contains three counties, viz. *Albemarle*, *Bath* county, and *Clarendon* in part, which are divided into parishes, but have no towns.

The middle division, or *South Carolina*, contains five counties, viz. *Clarendon* in part, *Craven* county, *Berkeley* county, *Colleton* county, and *Granville* county; whose chief towns are *St. James*, *Christ-Church*, *Charles-Town*, west long. 79, north latitude 32. 30. and *Port-Royal*.

The South division contains only *Georgia*, whose chief towns are *Savannah*, *Frederica*, and *Purisburgh*.

The chief rivers are, 1. *Albemarle*. 2. *Pentague*. 3. *Neuse*. 4. Cape *Fear*, or *Clarendon* river. 5. *Wateree*. 6. *Santee*. 7. *Ashley*. 8. *Cooper*. 9. *Colleton*. 10. *Cambahee*. 11. *Savannah*. 12. *Alatamaha*; and 13. That noble river *St. John's*, which divides *Georgia* from *Spanish Florida*; all which rivers rise in the *Apalachian* mountains, and, running east, fall into the *Atlantic* ocean.

There has not yet been found one good harbour in *North Carolina*; the best are those of *Roanoak*, at the mouth of *Albemarle* river, and *Pimlico*. In *South Carolina* there are the harbours of *Winyaw*, or *George town*, *Charles-town*, and *Port-Royal*. In *Georgia*, the mouths of the rivers *Savannah*, and *Alatamaha*, form good harbours.

The most remarkable promontaries are Cape *Hatteras*, in 350° odd min. north latitude; Cape *Fear* to the south of it, and Cape *Carteret* still further South.

It has a low level coast; not a hill to be seen from *St. Augustin* to *Virginia*, and a great way beyond. The country rises into hills about 100 miles west of the coast, and continues to rise gradually to the *Apalachian* mountains, which are about 150 miles distant from the ocean.

Carolina is situate between the extremes of heat and cold; but the heat is more troublesome in summer, than the cold in winter.

The vegetables are innumerable, for all that grow in *Europe*, grow there, and many that cannot stand our winters thrive there.

This country hath produced, and would still produce, silk, wine, and oil, if it was properly cultivated; mulberry-trees and grapes grow spontaneously.

They ship off yearly from *Carolina* about 60,000 barrels of rice, each barrel containing 400 weight, and export 70,000 deer skins *per annum* at a *medium*, for ten years successively; also 20,000 barrels of pitch; and they have sent home 70,000 barrels of tar

tar in a year: whereby they reduced the price of *Norway* tar, from 50s. a barrel, to 12 s. and 15 s.

The *English* traffick with the natives for deer-skins, bear and buffaloe skins, for which they give them guns, powder, knives, sciffars, looking-glasses, beads, and some coarse-cloth, and duffils. The *English* chapmen carry these on pack horses 5 or 600 miles into the country, west of *Charles Town*; but most of the trade is confined within the limits of the *Creek* and *Cherokee* nations, which do not lie above 300 miles from the coast.

Georgia, the most southern province, is not a fruitful country; but having several fine rivers running through it, the banks of them are fortified, and make a very good barrier for the *Carolinas*, which were before exposed to the incursions and ravages of the *Spaniards* and their *Indian* allies.

On this same continent our most inveterate and natural enemies the *French* have got a strong footing, and were contriving means to ruin the *British* empire and trade in these parts, till by their encroachments we were provoked to maintain our right by the present war.

Their claim is to one tract of land measuring 1800 miles in length and 1260 in breadth, which they call FRENCH CANADA or NEW FRANCE; and to which they set the bounds of *New-Britain* and *British Canada* on the north; *New Scotland*, *New England* and *New York* on the east, and unknown lands on the west. To another tract, which they call LOUISIANA, extending 1400 miles in length and 900 in breadth, and bounding on the river and lake of *Illinois* on the north; by *Carolina* on the east; by the gulph of *Mexico* on the south, and by *New Mexico* on the west, and to a third province, which they name CAEN or EQUINOCTIAL FRANCE, bounded by *Surinam* on the north; by the *Atlantic* ocean, on the east; by the *Amazons* on the south, and by *Guiana* on the west, which extends 300 miles in length, and 240 miles in breadth.

But, we say that FRENCH CANADA or NEW FRANCE, stripped of the encroachments made upon the *British* discoveries and settlements, is but a small province, confined to the coast of the south and east sides of the river of *St. Laurence*. Its chief town is *Quebec*, about 110 leagues from the sea. It is an episcopal sea, and adorned with several convents and churches for *Jesuits*, religious of both sexes, and parochial. The whole extent of the place is covered by a regular fortification with a citadel and several redoubts, well furnished with artillery. This is the largest and strongest town in *New France*, and generally maintains a strong army, to over awe both their *Indian* and *British* neighbours: so that the reduction thereof must entirely destroy the power and interest of *France* on that continent.

Though *Canada* is situated in the midst of the temperate zone, yet the air of it is prodigiously sharp: so that their winter, which sets in about the middle of *November*, and lasts to the middle of *May*, is excessively severe, the greatest rivers being frozen over, and the snow two or three feet deep on the ground. But, notwithstanding this, the *French* boast very much of the fertility of this country; and, indeed, where it is cultivated, it yields *Indian* and other sorts of corn, peas, beans, and, in short, all kinds of herbs and vegetables in great plenty. There is likewise plenty of stags, elks, bears, foxes, martins, and other wild creatures in the woods, besides wild fowl and other game. The southern parts, in particular, breed great numbers of wild bulls, deer of a small size, divers sorts of roebucks, goats, wolves, and a great variety of other animals, both wild and tame.

The meadow grounds, which are all well watered, yield excellent grass, and breed great quantities of large and small cattle; and, where the arable land is well manured, it produces large and rich crops. The mountains abound with coal mines and some, we are told, with silver, and other metals; though we do not learn that any great advantage is made thereof. The marshy grounds, which are likewise very extensive, swarm with otters and beavers, and the rivers and lakes with fish of all sorts.

With regard to the product of this colony, it consists of furs, especially castors, which they purchase from the *Indians*; several kinds of hides or skins, which they likewise purchase from the natives; fish, and what we call lumber, that is, planks, pipe staves, and other things of that nature. The greatest part of the commerce of the country is carried on in light canoes, made of bark, proper for the navigating their lakes and rivers, incumbered with water falls, which render them unfit for other kinds of vessels. In winter they make use of a kind of sledges, which are drawn either by horses or by dogs, and are very proper for passing over vast tracts of snow and ice, and enable them to continue their commerce with the *Indians* all the winter: which, however, the *French* tell us, is attended with one great inconveniency.

The persons, who carry on this trade, must have licences granted by the governors, which are confined to a certain number every year; and, though this brings them in large sums, yet by hindering the resort of *Indians* to their fairs in summer, when every man is at liberty to make the most

moſt of his goods, this prejudiced the colony in general.

As for their modern claim to the vaſt tract of lands, to which the *French Geographers* give the pompous name of Louisiana, nothing can be more chimerical. The whole is an encroachment upon *British* property; whoſe prior diſcoveries give the *Engliſh* a right to the whole continent, that lies eaſt of the river *Miſſiſſippi*.

The *French* in 1687, formed ſchemes to conquer *New York*, which twice miſcarried, as did their deſign on *Boſton* in 1697.

The *Ohio* country was known early to the *Engliſh*, and thoroughly diſcovered beyond the *Miſſiſſippi* by colonel *Wood*, from 1654 to 1664, as alſo by captain *Bott* in 1670 In 1698 two ſhips ſent by Dr. *Cox* of *New Jerſey*, diſcovered the mouth of that river, and ſailing up 100 miles, took poſſeſſion, and called it *Carolana*. Next year the *French* firſt found and ſettled on it. From thence to *Illinois* river, in 40° latitude they call it *Louiſiana*, (the trade of which was granted to M. *Croſat* in 1712.)

Since the peace of *Utrecht* they have daily encroached. In 1719, they began to diſpute our title to *Nova Scotia*. In 1726 they repoſſeſſed fort *Denonville*, near the falls of *Niaguara*, bordering weſt on the *Six Nations*. In 1731 they built fort *Frederick* at *Crown Point*, 120 miles ſouth of *St Laurence* river. In 1750 they ſeized two parts in three of *Nova Scotia*, by erecting forts at *Shegnikto*, *Bay Verte*, and at the mouth of *St John*'s river in 1752 and 54; two more on lake *Erie*, in 1752 and 53.

In 1754, they, by force, took our two forts on the *Ohio* and in the *Great Meadows*; drove our people out of their back ſettlements; and, as it were, kept *Virginia* beſieged; all this *they have* done in time of peace. About 1716, they built a fort on the *Alabama* river, in the country of the *Creek Indians*, to curb and ſtraiten *South Carolina*; thus they hemm'd in our colonies with forts, and cut off our trade and alliance with the *Indians*.

To the two *French* colonies there are only two inlets, the rivers *St. Laurence* and *Miſſiſſippi*, whoſe mouths are above 1000 leagues aſunder, and both their entrances of difficult acceſs; the firſt being full of rocks; the ſecond ſhoaly.

Canada in 1753 had not more than 45000 inhabitants, of which 15000 were fighting men; *Quebec* had 15000 inhabitants and 500 ſoldiers, or more than at both *Trois Rivieres* and *Montreal*, their other two ſettlements. *Louiſiana* has not one twelfth the number of men as in *Canada*, whereas our colonies contain between 900,000 and a million of *Engliſh*, out of whom 90 or 100,000 men for defence, may be raiſed; but a few united, are an overmatch for divided numbers.

The *French* are intruders into *Canada*, part of *Cabot*'s diſcovery, and have no right but by treaties, as appears from their claiming under *Verrozani*'s diſcovery 1524, though twenty ſeven years after *Cabot*'s.

The Dutch have one ſettlement upon this continent called *Surinam* of the extent of 300 miles in length and 100 miles in breadth; bounded on the north and eaſt by the *Atlantic* ocean; and on the ſouth and weſt by *Caen*, and the other parts of *Guiana* or *Caribbiana*.

The native *Indians* are ſtill in poſſeſſion of many regions in *America*; as 1. The countries north-weſt of *Mexico*. 2. The country of the *Amazons*, and the greateſt part of *Caribbiana* or *Guiana*; and, *laſtly*, the ſouth part of *South America*, viz. *Patagonia* and *Terra del Fuego*. Theſe are generally barren deſart countries, which no *Europeans* have thought it worth their while to plant.

Amazonia extends from *Peru* to *Brazil*, lying upon or near the equator, having *Terra Firma* on the north, and *La Plata* on the ſouth.

Guiana or *Caribbiana*, is bounded by the northern or *Atlantic* ocean, on the north and eaſt; by the country of the *Amazons*, on the ſouth; and by the provinces of *Granada* and *New Andaluſia*, on the weſt. It extends from the equator to the 8th degree of north latitude, and lies between 50 and 63 degrees of weſtern longitude, extending 1200 miles and upwards along the *Atlantic* ocean, *viz.* from the mouth of the river *Oronoque* to the mouth of the river *Amazon*; ſome divide it into two parts, calling that on the ſea coaſt *Caribbiana*, and the inland country *Guiana*.

For though ſeveral *European* powers, have ſettlements on or near the ſea coaſts of this country, particularly the *Spaniards*, the *French*, and *Dutch*; yet the natives are poſſeſſed of much the greateſt part of the inland country.

There are abundance of conſiderable rivers. (beſides thoſe of *Oronoque* and the river *Amazon*) and theſe having their ſources in the mountains, on the ſouth weſt, generally run towards the north-eaſt, and fall into the *Atlantic* ocean.

The ſea coaſt of this country is low, and ſubject to inundations in the rainy ſeaſon; the air is exceſſive hot and unhealthful, eſpecially in ſuch parts of the country as are not cleared of the woods.

The *Engliſh* had formerly ſeveral ſettlements on the coaſt of *Surinam*, which were yielded to the *Dutch* by the treaty of *Breda*, in the year 1667; and

and the *Dutch* and *French* have ſtill a great many forts and ſettlements here.

There is a good extent of country near the mouths of the rivers, which furniſh them with ſugar, tobacco, cotton, flax, ſkins, or peltry, dying woods, and ſeveral other conſiderable articles.

We ſhall cloſe this treatiſe, on GEOGRAPHY, with a deſcription of the AMERICAN ISLANDS; obſerving the ſame method of placing them under their reſpective ſovereigns.

SPANISH ISLANDS in AMERICA.

I. CUBA is ſituate in the *Atlantic* or *American* ocean, between 74 and 87 degrees W. long. and between 20 and 23 degrees N. Lat. upwards of 800 miles long from E. to W. and 70 miles broad.

A chain of hills run through the middle of the iſland, but the land near the coaſt is generally a level champaign country, well watered with rivulets and flooded in the rainy ſeaſon, when the ſun is vertical; but there are ſcarce any navigable rivers, as they run ſo ſhort a courſe from the hills into the ſea. There are ſeveral good harbours in the iſland, the chief whereof are thoſe of St. *Jago*, towards the eaſt end of the iſland; *Cumberland* harbour further eaſt; and the *Havanna*, at the N. W. part of the iſland.

The chief towns are, 1. St. *Jago*, W. Lon, 77. Lat. 20, ſtrongly ſituated and well fortified, the capital of the iſland.

2. The *Havanna*, W. long. 83. lat. 23. a ſecure capacious harbour of difficult acceſs, where the galleons from *Carthagena* and *Vera Cruz* rendezvous on their return to *Spain*.

3. *Baraccoa*, ſituate on the N. E. coaſt of the iſland, has a good harbour for ſmall veſſels.

4. *Porto del Principe*, ſituate alſo on the N. coaſt, 300 miles eaſt of the *Havanna*.

5. *Santa Cruz*, ſituate on the N. coaſt, 30 miles eaſt of the *Havanna*.

This iſland produces the ſame animals as the continent, under the ſame parallel; the hills are pretty well planted with timber.

The ſoil produces maize, caſſavi-root, tobacco, ſugar, hides, cotton, indigo, ginger, aloes, and long-pepper: but *European* wheat, hemp, or flax, do not thrive here any more than vines.

II. HISPANIOLA, or St. DOMINGO is ſituate in the *Atlantic* or *Americ* ocean, between 67 and 74 degrees W. long. and between 18 and 20 degrees N. lat. upwards of 400 miles long, and 120 broad; 50 miles eaſt of *Cuba*, and 70 E. of *Jamaica*, and 300 miles N. of *Terra-firma*; ſometimes called *St. Domingo*, from its capital.

In the middle of the country are mountains well planted with foreſt-trees, and other mountainous, barren rocks.

The reſt of the country conſiſts of fine fruitful plains, which produce ſugar, cotton, indigo, tobacco, maize, and caſſavi-root; and the *European* cattle are ſo multiplied, that they run wild in the woods, and are hunted for their hides and tallow.

This iſland is now divided between the *Spaniards* and the *French*; the *Spaniards* poſſeſſing moſt of the ſouthern ſhores, and the *French* the north and weſt.

The chief towns are, 1. St. *Domingo*, capital of the *Spaniſh* ſettlements, ſituate on a ſpacious harbour on the ſouth ſide of the iſland, W. long. 70 degrees, N. lat. 18, the moſt ancient royal audience in *N. America*, and ſeat of the governor; the inhabitants a mixture of *Europeans*, *Creols*, *Mulatto's*, *Meſtees*, and *Negroes*; not a ſixth part *Spaniards*, founded by *Bartholomew Columbus*, brother to the admiral, in 1504.

2. *Conception de la Vega*, 25 leagues north of St. *Domingo*, founded by *Columbus*, from whence he had the title of *Duke De la Vega*.

The chief towns belonging to the *French* in *Hiſpaniola*, are,

1. *Petit Guava's*, W. long. 73 degrees, N. lat. 16. a port town, ſituate on a bay at the weſt end of the iſland.

2. *Logane*, another port town, ſituate on the ſame bay.

3. *Port Lewis*, a good harbour on the ſouth-weſt part of the iſland

4. Cape *Francis*, the moſt eaſterly ſettlement of the *French* on the north ſhore.

III. PORTO RICO, is ſituate between 64 and 67 degrees W. long. and in 18 N. lat. about 120 miles long, and 60 broad. This iſland conſiſts of little fruitful hills and vallies, and produces the ſame fruits as the former iſlands, and is equally unhealthful in the rainy ſeaſon.

The town of *Porto Rico*, or St. *John*, is ſituate in 65 degrees W. long. 18 N. lat. in a little iſland on the north ſide of the main iſland, forming a capacious harbour, and joined to the chief iſland by a cauſey, and defended by forts and batteries, which render the town inacceſſible.

IV. The VIRGIN ISLANDS, ſituate at the eaſt end of *Porto Rico*, are exceeding ſmall.

V. The iſland of TRINIDAD is ſituate in the *Atlantic* ocean, between 60 and 62 degrees W. long. and between 10 and 11 N. lat. 90 miles long, and 60 broad; ſeparated from the continent of *Andaluſia*, in *Terra-firma*, by the narrow ſtraight of *Boco del Drago*, 80 miles N. W. of the river *Oronoque*; an unhealthful, but fruitful ſoil, producing ſugar, tobacco, indigo, cotton, ginger, and *Indian* corn.

VI.

VI. MARGARETTA is ſituate in 65 degrees W. long. and 11—30 N. lat. 60 miles N. of the continent of *Terra-firma*, and 200 W. of *Trinity*, being 50 miles long, and 24 broad; there is very little wood or water in this iſland.

The principal iſlands belonging to *Spain*, in the *Pacific* ocean, are, *Chiloe*, on the coaſt of *Chili*, and thoſe in the bay of *Panama*, called the *Kings*, or *Pearl* iſlands; *Juan Fernandes*, ſituate in the *Pacific* ocean, 300 miles weſt of *Chili* in *America*, W. long. 83. South lat. 33 degrees.

Gallipago's iſlands ſituate in the *Pacific* ocean, under the equator, 400 miles W. of *Peru*, between 85 and 90 degrees W. long.

Golden iſland, iſle of *Pines*, *Samballas* iſlands, and *Baſtimentos* near *Porto Bello*, in *Terra-firma*.

The PORTEGUEZE have only three ſmall iſlands at preſent, which lie on the coaſt of *Brazil*, where ſhips touch ſometimes for proviſions in their voyage to the *South-Seas*; particularly, 1. *Fernandes*, in 3 degrees S. lat. 2. St *Barbara*, in 18 degrees S. lat. and, 3. St. *Catherine*'s, in 28 degrees S. lat.

AMERICAN ISLANDS under the BRITISH dominion.

1. JAMAICA meaſures 140 miles in length, and 60 miles in breadth. It lies in the *American* ſea, about 100 miles ſouth of *Cuba*, and 70 weſt of *Hiſpaniola*.

There are near 100 ſmall rivers in the iſland, but none navigable.

Their well-water, near the ſea, is brackiſh and unwholſome.

The bays and capes are, 1, The port of point *Morant*, at the eaſt end of the iſland. 2. The harbour of *Port Royal*. 3. The port of old *Harbour*. 4. The harbour and point of cape *Negril*. 5. *Bienfield* bay. 6. Port *Pedro*; and 7. *Black* point; all on the ſouth ſide of the iſland; and there are ſome others on the north.

In *May* and *October*, it rains violently night and day for a fortnight.

There is a ridge of hills runs from eaſt to weſt through the iſland. Theſe hills conſiſt either of rock, or ſtrong clay, and are covered with wood.

The vallies or *Savannahs* are exceeding level. and without ſtones, fit for paſture, when cleared of wood, the moſt fruitful lying on the ſouth ſide of the iſland.

The iſland is divided into 14 pariſhes or precincts; they have very few towns; the chief are, 1. St. *Jago de la Vega*, or *Spaniſh-town*. 2. *Kingſton*. 3. *Port Paſſage*; and 4. that of *Port-Royal*.

St. *Jago de la Vega*, or *Spaniſh-town*, is pleaſantly ſituated in a fine plain, upon the river *Cobre*, which falls into a bay of the ſea that forms the harbour of *Port-Royal*, about 7 miles below; it conſiſts of 800 or 1000 houſes.

Kingſton is a port town, ſituate on the north ſide of the bay of *Port-Royal*, 10 or 12 miles ſouth-eaſt of St. *Jago*, and, ſince the repeated misfortunes of the town of *Port-Royal*, is become a large and populace place, much frequented by merchants and ſeafaring men.

Port-Paſſage is a ſea-port town, ſituated at the mouth of the river *Cobre*, ſeven miles ſouth-eaſt of St. *Jago*, and obtained its name from being the greateſt thorough-fare in the iſland.

Port-Royal, before it was deſtroyed by an earthquake in the year 1692, was ſituated in the ſouth-eaſt part of the iſland, at the extremity of a long ſlip or point of land, running weſterly about 12 miles from the main iſland, having the ocean on the ſouth, and a fine bay of the ſea, which forms the harbour, on the north, well defended by ſeveral forts and platforms of guns; the harbour is about three leagues broad in moſt places, and ſo deep that a ſhip of 700 tons may lay her ſide on the ſhore, and load and unload at pleaſure; nor does there want good anchorage in any part of it.

The principal vegetables and produce of this iſland are, ſugar-canes, cocoa, of which chocolate is made; oranges, lemons, citrons, palms, coco-trees, cotton, indigo, tobacco, the prickle pear, woods for dying, ſalt, ginger, cod-pepper, or *Piemento*, drugs, ſuch as guaiacum, *China* root, ſarſaparilla, caſſia-fiſtula, tamarinds, venella's, gums and roots, uſed in medicines and ſurgery.

Here grows the manchineel tree, which bears a beautiful, but poiſonous apple, and the mahogany, and animals; and they have the like foreſt-trees as are found in the continent of *America*, in the ſame climate.

There are in the *Savannahs* great plenty of cattle, but they cannot keep beef many days, tho' it be ſalted, and freſh beef is ready to corrupt in four or five hours. Butchers always kill in the morning, therefore, juſt before day, and by ſeven o'clock the markets for freſh meat are over.

This and all the other governments in the *Britiſh American* iſlands are royal governments. The king appoints the governor and council, and the repreſentatives are choſen by the freemen; and theſe aſſemblies make laws, but they muſt be confirmed by the court of *England*.

The principal part of the revenue, accruing to the crown of *Great Britain* from *Jamaica*, is the duty ariſing from ſugar, rum, and moloſſes, imported from thence which is very conſiderable.

The inhabitants are either *Engliſh*, or of *Engliſh* extraction born in the iſland; *Indians*, *Negroes*, *Mulatto*'s, *Mulatto*'s, or *Mestize*, or the descendants of them. The *English*, and those of *English* extraction, may be 40,000. The *Indians* are but few, most of the natives having been destroyed by the *Spaniards*. The negroes on the island are about one hundred thousand.

The religion of the church of *England* is also the established religion in all the *British* islands; but there are no bishops; the bishop of *London*'s commissary is the principal ecclesiastick in these islands.

Jamaica was discovered by *Columbus* for the *Spaniards*, in his second voyage to *America*, *Anno* 1493.

In the year 1596, Sir *Anthony Shirley*, with a single man of war, made a descent on this island, and took their capital town St. *Jago de la Vega*, (now *Spanish Town*) consisting of about 2000 houses, and plundered it. It was taken and plundered again by Colonel *Jackson*, who landed 500 men here, about the year 1638, and the *Spaniards* were compelled to raise him a very considerable sum to ransom it from burning.

In the year 1656, Admiral *Penn* and *Venables* were commanded by *Cromwell* to invade *Hispaniola*; and not succeeding there, they made a descent on *Jamaica*, and reduced the whole island; which conquest was confirmed to *Great Britain* by a subsequent treaty.

II. Newfoundland. *Newfoundland* is situate in the *Atlantic* ocean, between 47 and 52 degrees of north latitude, and between 55 and 60 degrees of west longitude; separated from *New Britain* by the straights of *Bellisle*, and from *Canada* by the bay of St. *Lawrence*, being 350 miles long, and 200 broad. It is a barren mountainous country, covered with snow great part of the year; but has several commodious harbours, and the greatest cod-fishery in the world upon its coast. The chief towns are, *Placentia*, *Bonavista*, and St *John*'s.

Several hundred ships are loaded with fish upon these banks every year, and carried to *Europe*.

There do not above a thousand families remain here in winter. The *French* were permitted to settle here in the reign of king *Charles* II. but were obliged to quit the island by the peace of *Utrecht*, *Anno* 1713, only they were left at liberty to dry their nets on the northern shores of the island.

It was the first *American* island discovered for *England*, by *Sebastian Cabot*, in the reign of *Henry* VII.

III. Barbadoes. The island of *Barbadoes* is situate in the *Atlantic* ocean, in 59 degrees of west longitude, and 13 degrees of north latitude; being the most easterly of all the *Caribbee* islands; 90 miles south-east of *Martinico*, and 70 miles east of St. *Vincent*; 25 miles long, and 15 broad; generally a level country, with some small hills, and but little wood, corn, or grass.

It produces sugar, rum, molosses, cotton, indigo, ginger, pine apples, guava's, plantains, oranges, citrons, and other tropical fruits.

The chief town is *Bridge-Town*, on the south-west coast of the island.

A college is erected here with a revenue for professors in the several sciences: Colonel *Codrington* was the principal benefactor.

The number of white inhabitants are computed to be 20,000, and of their negroe slaves 100,000.

They get their corn, flour, cattle, flesh, and salted fish, from *Pennsilvania*, and other *British* northern colonies, or from *Ireland*; and their furniture and cloathing from *Old England*.

This island was first resorted to by the *English* in the reign of King *James* I.

The adventurers applied themselves at first to the planting of *Tobacco*, which not thriving as they expected, they planted cotton and indigo, which yielded a considerable profit: but they made little sugar till 1647, when Colonel *Midford*, Colonel *Drax*, and Colonel *Walrond*, and other cavaliers, living uneasy under the usurpation, converted their estates into money, and transported themselves to *Barbadoes*, where they erected sugar-works, and acquired very great estates.

King *Charles* II. purchased the property of this island of the proprietors in the year 1661, ever since which *Barbadoes* has been a royal government, and the colony granted a duty of 4 and a half *per Cent.* on their sugars, for maintaining the forces and fortifications in the island, which amounts to 10 000*l.* *per Ann.* *De Ruyter*, the *Dutch* admiral, treacherously attempted to surprise this island in 1664, in a time of peace, but was bravely repulsed.

IV. St. Christopher's. The island of St. *Christopher*'s is situate in 62 degrees west longitude, and 17 north latitude. It is 20 miles long, and 7 or 8 broad: produces the greatest quantity of sugar, next to *Jamaica* and *Barbadoes*, and some years it produces full as much as *Barbadoes*. It produces also cotton, ginger, and the tropical fruits.

A mountain runs through the middle of it, from whence there issue several rivulets. The *French* were possessed of the south-side of the island till the peace of *Utrecht*, 171 , when they yielded it to *Great Britain*.

Christopher Columbus, in the service of *Spain*, discovered this island in 1493, and gave it his christian name: The *Spaniards* deserting it, the *English* and *French* arrived here in 1625, and divided it between them.

V. Antigua. The iſland of *Antigua* is ſituate in 61 degrees weſt long. and 17 deg. north lat. 60 miles eaſt of St. *Chriſtopher*'s; it is of a circular form, almoſt 20 miles over either way, and has a great many good harbours; the governor of the *Caribbee* iſlands uſually reſides at St. *John*'s, the chief town.

The produce is chiefly ſugar, ginger, cotton, pine-apples, plantain, and other tropical fruits; they have no other water but the rains, which fall in the ſpring and autumn; this they reſerve in ciſterns, and if the rains fail, they are in great diſtreſs, being forced to fetch their freſh water from the neighbouring iſlands. Some ſprings of freſh water have been lately found here.

VI. Nevis. *Nevis* is a little ſugar iſland on the eaſt of St. *Chriſtopher*'s, from which it is divided by a very narrow channel. The *Engliſh* ſent the firſt colony to *Nevis*, *Anno* 1628.

VII. Dominica. *Dominica* is a ſmall iſland, in 15 degrees north lat. 30 miles north of *Martinico*, but very little cultivated.

This was agreed to be a neutral iſland at the laſt treaty of *Aix la Chappelle*, though this, as well as the other three, *viz.* St. *Lucia*, St. *Vincent*, and *Tobago*, were in reality deemed part of the territories of *Great Britain* before this treaty, as appears by a commiſſion given by the late King *George*, to the late duke of *Montague*, to ſend colonies to the iſland of St. *Lucia*, in the year 1722.

VIII. Barbuda. *Barbuda* is ſituate in 18 deg. north lat. The inhabitants apply themſelves chiefly to the breeding of cattle, and raiſing proviſions, with which they ſupply the neighbouring iands.

This iſland is the property of the *Codrington* family, who have a great number of negroes here and in the iſland of *Barbadoes*.

IX. Anguilla. *Anguilla* is ſituate in 18 degrees odd minutes north latitude; 60 miles north-weſt of St. *Chriſtopher*'s; being about 30 miles long, and 10 broad.

The inhabitants apply themſelves chiefly to feeding of cattle, planting of *Indian* corn, and other parts of huſbandry.

X. Montserrat. *Montſerrat* is ſituate 30 miles ſouth-weſt of *Antigua*, and affords its proportion of ſugar.

XI. Tobago. *Tobago* is ſituate 11 deg. odd minutes north latitude, 120 miles ſouth of *Barbadoes*; a fruitful ſoil, capable of producing whatever the ſugar iſlands produce. King *Charles* II. granted it to the duke of *Courland*, by whoſe authority a colony of *Engliſh* and another of *Dutch* were ſettled here; but their plantations were ſo haraſſed and diſturbed by the *Caribbees* of the neighbouring continent, that they left the iſland; the *Engliſh* of *Barbadoes* only viſiting it ſometimes to cut wood here.

It was eſteemed however part of the territories of *Great Britain*, till denominated a neutral iſland by the treaty of *Aix la Chapelle*, *Anno* 1748. The *French* had no colour to claim it.

XII. St. Vincent. St. *Vincent* is ſituate 60 miles and upwards, weſt of *Barbadoes*, and is 20 miles long, and almoſt as many broad.

St. Lucia. St. *Lucia* is near 80 miles north-weſt of *Barbadoes*; the ſoil of theſe two laſt iſlands is as good as that of any of the *Caribbees*, and has the advantage of good wood.

To theſe we may add the conqueſt lately made by the *Britiſh* arms, of *Guadalupe* and *Marigalante*.

XIII. Guadalupe, ſo called by *Columbus*, from its hills reſembling thoſe of that name in *Spain*, is ſituate in 16 degrees north latitude, and 61 degrees weſtern longitude, about 30 leagues north of *Martinico*, and almoſt as much ſouth of *Antigua*; it is ſaid to be the largeſt of all the *Caribbee* iſlands, being 22 leagues in length, and half as much in breadth at each end; but almoſt cut in two by a deep gulph, or bay, on each ſide, ſo that the ends are joined together by a very narrow iſthmus. This, like *Martinico*, abounds in ſugar, cotton, indigo, ginger, *&c.*

The *French* began to ſend colonies to this iſland about the year 1632.

XIV. Marigalante is ſituate in 16 degrees N. lat. a little to the ſouth-eaſt of *Guadalupe*, and is about five leagues in length, and four in breadth; it was diſcovered by *Columbus* in his ſecond voyage to *America*, *Anno* 1493, and named by him *Marigalante*, or the *Gallant Mary*, after the name of his ſhip. The *French* began to ſend colonies thither about the year 1647. The produce is the ſame with the reſt of the *Caribbees*.

XV. Lucaya's or Bahama Islands are ſituate between 73 and 81 degrees weſt long. and 21 and 27 degrees north lat. are very numerous, and 12 of them pretty large. Theſe were the firſt lands diſcovered in *America*, by *Columbus*, *Anno* 1492.

The iſland of *Providence* is now planted and fortified by *Great-Britain*, being ſituate in 78 weſt long. 25. north lat. and is 200 miles eaſt of the continent of *Florida*: None of the other iſlands are inhabited, but the *Engliſh* have plantations on ſome of them.

XVI. Bermuda, or the Summer Islands. Theſe iſlands were ſo called from Sir *George Summer*, who

who loſt his ſhip on their rocks, *Anno* 1609; they are ſituate in the *Atlantic* ocean, W. long. 65 degrees, N. lat. 32 degrees 20 minutes, 700 or 800 miles eaſt of *Charles Town* in ſouth *Carolina*; being a cluſter of ſmall iſlands, in the ſhape of a ſhepherd's crook, containing 20,000 acres, walled round with rocks. No part of the world enjoys a purer air, or more temperate climate, or is more remarkable for health, and plenty of fleſh, fiſh, poultry, fruits, herbs, and roots. The chief town is St. *George*, in the north-weſt part of the iſland, containing 1000 houſes. There are fine groves of cedar, with which they built their houſes, and their ſwift ſailing ſloops, which they ſell to the ſugar iſlands, as well as proviſions.

The French Caribbee Islands, are *St. Martin*, *St. Bartholomew*, *Deſeada*, *Martinico*, *Granada*, Part of *Hiſpaniola*, and, *St. Croix*.

1. *St. Martin*'s an iſland of no great conſequence, ſituate a little to the north weſt of *St. Bartholomew's*.

2. *St. Bartholomew*'s, is a ſmall iſland about ten leagues north of *St. Chriſtopher's*, taken by the *Engliſh* under the command of Sir *Timothy Thornhill*, in the year 1689, but reſtored to the *French* at the peace of *Ryſwick*.

3. *Deſeada*, or *Deſiderada*, the *Deſirable iſland*, ſo called by *Columbus*, becauſe it was the firſt land he diſcovered in his ſecond voyage to *America*, *Anno* 1493; it is ſituate about ten leagues north-eaſt of *Guadalupe*.

4. *Martinico* is ſituate between 14 and 15 degrees of north latitude, and 61 degrees of weſtern longitude, lying about 40 leagues north-weſt of *Barbadoes*; it is 20 leagues in length, but of an unequal breadth. The inland part of it is hilly, and at a diſtance appears like three diſtinct mountains, being exceedingly well watered by numerous rivulets, which fall from the hills; and there are ſeveral commodious bays and harbours on the coaſt, ſome of them well fortified.

5. *Granada* is ſituate in 12 degrees north latitude, about 30 leagues ſouth-weſt of *Barbadoes*, and about the ſame diſtance north of *Caribbiana*, or *New Andaluſia*; this iſland is 25 leagues in circumference, and has ſeveral good bays and harbours, ſome of which are fortified: it is eſteemed a fruitful ſoil, and well watered, producing ſugar, and ſuch other plants that are found in the reſt of the *Caribbee* iſlands; there are abundance of very ſmall iſlands that lie at the north end of *Granada*, which are called the *Granadilla*'s.

6. *Hiſpaniola* has been already deſcribed amongſt the *Spaniſh* iſlands.

7. *St. Croix*, or *Sancta Cruz*, another ſmall iſland ſituate in 17 degrees 30 minutes north lat. about 20 leagues weſt of *St. Chriſtopher*'s.

The Dutch Islands are, 1. *Curaſſoa*. 2. *Bonaire*, 3. *Aruba*, near the coaſt of *Terra-Firma*. 4. *Euſtatia*; and, 5. *Saba*, among the *Caribbee* iſlands.

Nine or ten leagues from the continent of *Terra-Firma*, lies the iſland of *Curaſſoa*, or *Queriſſao*, the moſt northerly point of it, in 12 degrees 40 minutes north latitude; there is a good harbour on the ſouth eaſt part of the iſland, where the *Dutch* have a conſiderable town, defended by a ſtrong fort; the country is level, and feeds abundance of cattle; they have alſo ſome ſugar-farms, and ſmall plantations of fruits and roots; but this iſland is not ſo much eſteemed for its produce, as its ſituation for trade with the *Spaniſh Weſt-Indies*. Formerly the harbour was never without ſhips from *Carthagena* and *Porto Bello*; the *Spaniards* purchaſing 1000 or 1500 negroes at a time of them, beſides great quantities of *European* commodities; but part of this trade has of late fallen into the hands of the *Engliſh*. However, the *Dutch* have ſtill a very extenſive trade in the *Spaniſh Weſt-Indies*, ſending ſhips of good force from *Holland*, freighted with *European* goods, to this coaſt, from whence they make very profitable returns. Let the *Spaniſh* governors prohibit this ſmuggling trade never ſo ſeverely, the *Spaniards* ſtand ſo much in need of *European* commodities, that they run any hazards to deal with the *Dutch*; and, as it is their common intereſt to connive at this kind of traffick, the people cannot be very hearty in their endeavours to prevent it.

The *Dutch* iſlands of *Bonaire* and *Aruba* are conſiderable, chiefly for their ſituation near the coaſt of *Terra-Firma*, which gives the inhabitants an opportunity of carrying on a clandeſtine trade with the *Spaniſh* ſettlements in *Terra-Firma*.

The *Dutch* iſlands of *Saba* and *Euſtatia* produce ſugar, &c. as the reſt of the *Caribbee* iſlands do.

Danish America, conſiſts only of the iſland of St. *Thomas*, one of the *Caribbees*, producing ſugar, &c.

There are alſo certain Islands within the limits of *America*, which do not acknowledge the ſovereignty of any *European* power or ſtate, as the Island of California. Weſtward of *New-Mexico* is found, in the *South-Sea*, one of the greateſt iſles of the world, called *California*, which was thought, for a very conſiderable time, joined to the main land.

 This

This iſland is ſituated between the 23 and 46 degree of latitude, ſeparated from *New Mexico*, by the *Varmeille ſea*; ſo that it is ſuppoſed to have more than 450 leagues in its greateſt length from ſouth to north; 150 in its greateſt breadth, and about 1100 of circumference.

The climate is very wholſome, but cold with regard to its ſituation. Along the coaſts are found ſome iſles, as St. *Clement*, *Pararos*, *Ceintas*, and ſeveral others.

Arctick Lands. Theſe lands are called *Arctick*, becauſe of the pole of the ſame name, round which they are ſituated. They are almoſt all ſituated in the frigid zone.

They confine, in our ſuperior hemiſphere, with the *Glacial Sea*, which ſeparates them from *Muſcovy*, and *Tartary*; and in the other part with the *South Sea*, and part with the *Chriſtian Sea*, and the ſtreight of *Hudſon*, which parts them from *America*, *viz.* Spitzberg. This land, which is the moſt northern of the *Arcticks*, was thus call'd from the name of *Spitſberg*, a *Dutch* Captain who diſcover'd it; or becauſe of the great number of its ſharp mountains.

It is ſituated northward of *Laponia*, under the 60 degree of longitude, and the 78 of latitude; but we know nothing of its extent: ſome make an iſland of it, equally diſtant from the pole, and from the polar circle.

The climate is ſo cold, that thoſe ſent thither have had the ſame fate of others upon *Greenland*. The ſoil produces nothing at leaſt in the neighbourhood of the coaſts. The *Engliſh* and *Dutch* diſpute with one another the dominion of that country: they fiſh whales on the coaſt.

Nova Zembla. This land, which is the *Carambice* of the antients, was called *Nova Zembla* by the *Dutch*, ever ſince they ſearched a paſſage through it to the *Eaſt-Indies*

It is ſituated northward of *Muſcovy*, from which it is ſeparated by the ſtreight of *Weigatz*, or *Naſſau*, through which, it was imagined, that the ſea of *Muſcovy* had a communication with that of *Tartary*.

Land *of* Jesso. We ſcarcely know any thing of this country but the name, though it be of a vaſt extent: our relations ſpeak only of its coaſts; found about the 42 degree of latitude, and which is the moſt known.

It is ſituated between *Aſia* and *America*; eaſtward of the firſt, and weſtward of the other.

It ſeems to me, as if it was ſeparated from thoſe two regions, by two great arms of ſea; and ſome have imagined, that through its ſtreight the ſea of *China* had communication with the northern ocean, but others pretend, that there is an iſthmus which parts them. We know nothing particular of its quality.

The inhabitants of theſe coaſts live on fiſh and game; and cloath themſelves with ſkins of beaſts: they carry on a commerce with the *Japaneſe*, of fiſh, ſkins, tongues, and fat of whales.

Part of this country acknowledges the king of *Japan*; and the governor, who reſides in the city of *Matzumay*, carries him, every year, ſilver, feathers of various colours, and furrs. Does not this give encouragement to proſecute the long deſired diſcovery of a paſſage thro' this coaſt to *Japan*, &c.

New-Denmark, *New North-Wales*, and the iſles of *Cumberland*, &c. are ſituated northward of *America*, in the *Chriſtian*, or *Hudſon Sea*.

The End of the Firſt Volume.

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