LARKIN's

ELEMENTARY GEOMETRY,

BOTH

LINEAR, PLANE, AND SOLID.

PRICE ONE SHILLING.

ELEMENTARY GEOMETRY,

BOTH

LINEAR, PLANE, AND SOLID.

By N. I. LARKIN,

Teacher of Geometry, Author of the Rudiments of Geometry, and the Introduction to Solid Geometry.

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Fig. 3.

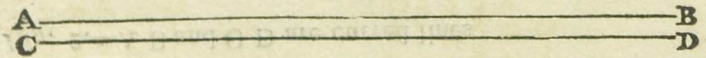


Fig. .

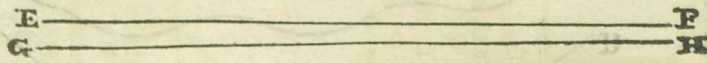


Fig. 3.—A B and C D are parallel straight lines; that is, they are equally distant from each other in every part.

Fig. 4.—E F and G H are diverging or converging straight lines; that is, they are not equally distant from each other in every part, but would meet in a point if produced in one direction, when they would form what is called an angle.

OF ANGLES.

Fig. 5.

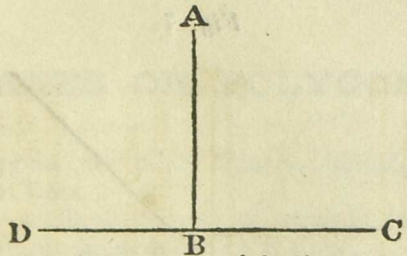


Fig. 5.—When a straight line A B meets another straight line D C, in such a manner as to make the corners A B C and A B D equal, those corners are called right angles, and the line A B is said to be a perpendicular to D C.

Fig. 6.

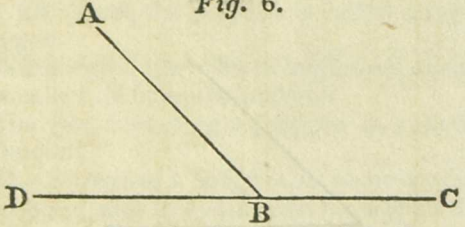


Fig. 6.—But should the straight line A B meet another straight D C, so as to make the corner A B C more open than the corner A B D, the corners are then called oblique angles; that A B C which is most open is likewise called an obtuse angle, and that A B D which is least open is called an acute angle

Fig. 7.

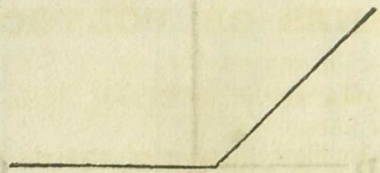


Fig. 7.—Is an obtuse angle.

Fig. 8.

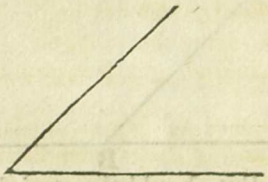


Fig. 8.—Is an acute angle.

OF

PLANES OR POLYGONS.

Polygons are plane figures, bounded by straight lines.

The smallest number of straight lines a polygon can be bounded by is three.

The number of the corners or angles is always equal to the number of its sides.

The sides of a polygon may be either equal or unequal; in like manner the angles

When the sides are all equal, and the angles are all equal, the polygon is called a regular polygon.

When either the sides or angles are unequal, it is called an irregular polygon.

The line bounding a polygon is called its perimeter.

The corners of a polygon, or plane are called its angles; and to distinguish them from those angles which are simply formed by the meeting of two lines, they are called plane angles, as being the angles of a plane.

Hence, a triangle is said to have three plane angles, a square four, &c.

Polygons are named from the number of their sides, or angles.

A triangle is so called because it has three angles; and in like manner a trigon, *tri* meaning three, and *gon* an angle.

An ISOSCELES TRIANGLE is a triangle which has only two of its sides equal.

A SCALENE TRIANGLE is a triangle having all its sides unequal.

All triangles must necessarily have two acute angles.

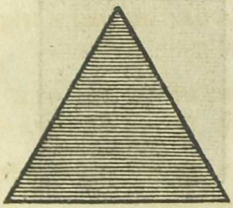
No triangle can have more than one right, or one obtuse angle.

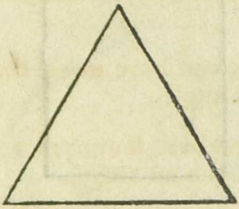
TETRAGONS have four angles; *Tetra* meaning four, and *gon* an angle.

Four-sided polygons are called quadrilaterals and also quadrangles.

REGULAR POLYGONS.

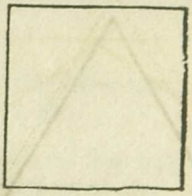
1. Equilateral Triangle.





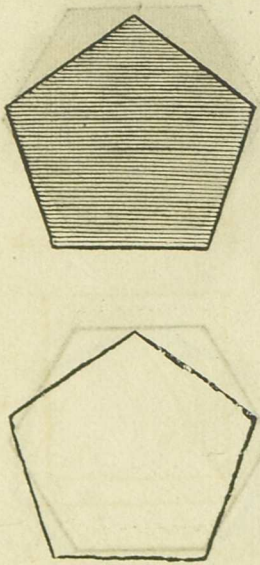
An Equilateral Triangle has all its sides and angles equal, and therefore is placed among the regular polygons.

2. Square.



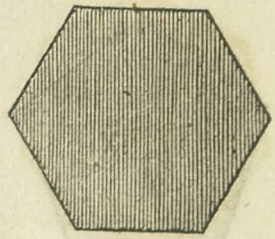
A Square is a regular tetragon, having all its sides and angles equal.

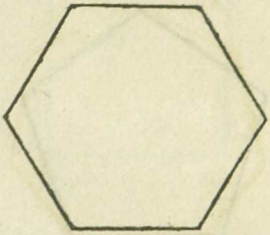
3. Pentagon.



A Regular Pentagon is a Polygon bounded by five equal sides and equal angles.

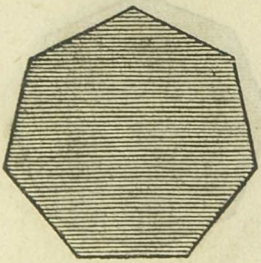
4. Hexagon.

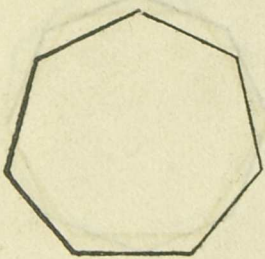




A Regular Hexagon is a Polygon bounded by six equal sides or equal angles.

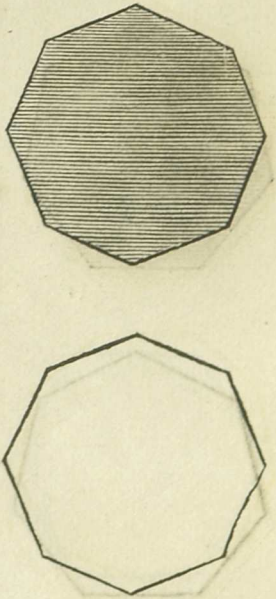
5. Heptagon.





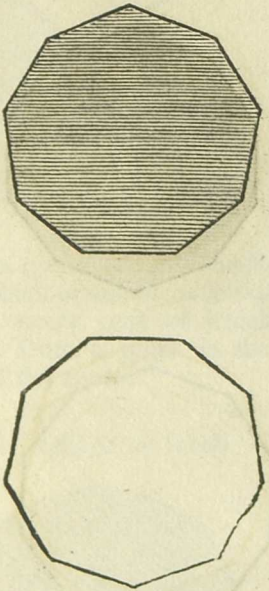
A Regular Heptagon is a Polygon bounded by seven equal sides and equal angles.

6. Octagon.



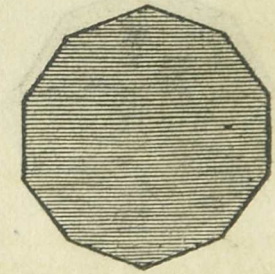
A Regular Octagon is a Polygon bounded by eight equal sides and equal angles.

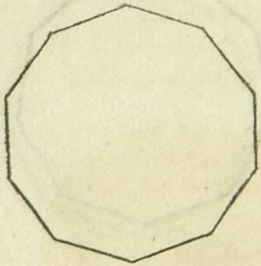
7. Nonagon.



A Regular Nonagon is a Polygon bounded by nine equal sides and equal angles.

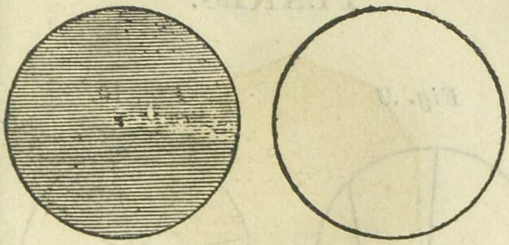
8. Decagon.





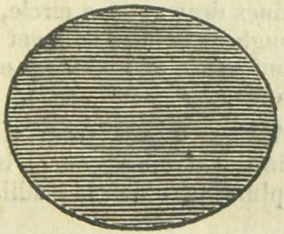
A Regular Decagon is a Polygon bounded by ten equal sides and equal angles.

9. Circle.



A Circle is a plane that is bounded by one curved line, which is called its circumference or periphery, every part of which line is equally distant from a point in the middle, which is called the centre.

10. Ellipse or Oval.



OF CERTAIN LINES OR PLANES.

Fig. .9

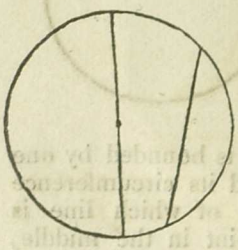


Fig. 10.

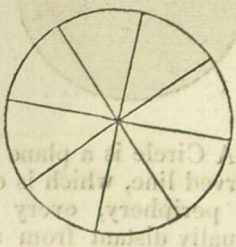


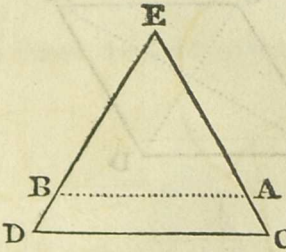
Fig. 9, a line drawn through the centre of a circle, cutting the circumference, is called the Diameter.

All other lines drawn on a circle, which do not pass through its centre, and yet touch or cut the circumference at both ends of the line, are called Chords.

Fig. 10, A line drawn from the centre, terminating in the circumference, is called a Radius, the plural of which is Radii.

Of the most remarkable lines drawn on Polygons.

Fig. 11.



Parallel lines are lines drawn parallel to one of the sides of the Polygon, as A B.

Fig. 12.

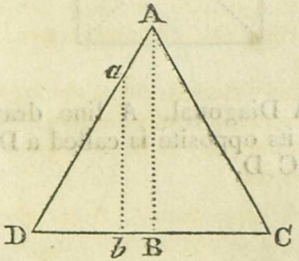


Fig. 12, a line drawn at right angles to the edge of a Polygon is called a Perpendicular, as A B, or *a b*.

Fig. 13.

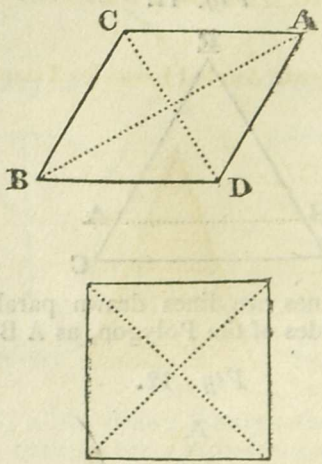
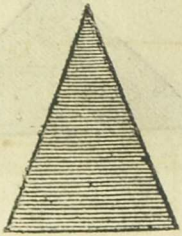
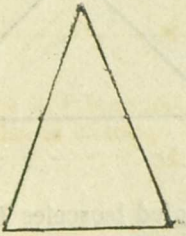


Fig. 13, A Diagonal. A line drawn from any angle to its opposite is called a Diagonal, as A B and C D.

IRREGULAR POLYGONS.

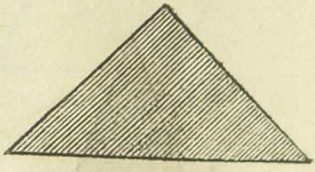
11. Acute Angled Isosceles Triangle.

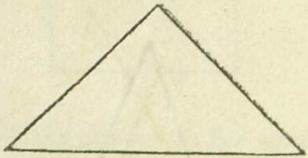




An Acute Angled Isosceles Triangle has all its angles acute.

12. Right Angled Isosceles Triangle.



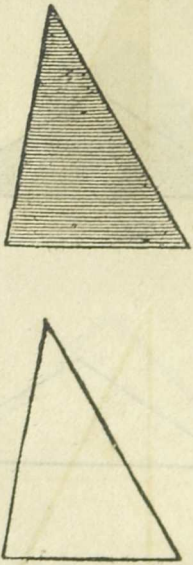


A Right Angled Isosceles Triangle has one right angle.

13. Obtuse Angled Isosceles Triangle.

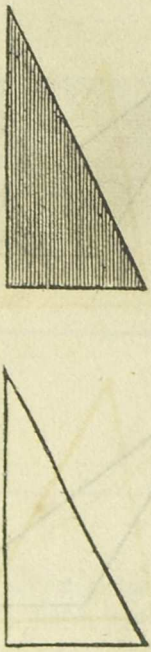
An Obtuse Angled Isosceles Triangle has one obtuse angle.

14. Acute Angled Scalene Triangle.



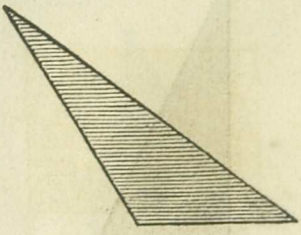
An Acute Angled Scalene Triangle has all its angles acute.

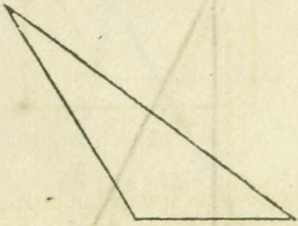
15. Right Angled Scalene Triangle.



A Right Angled Scalene Triangle has one right angle.

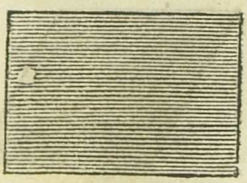
16. Obtuse Angled Scalene Triangle.

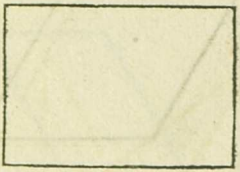




An Obtuse Angled Scalene Triangle has one obtuse angle.

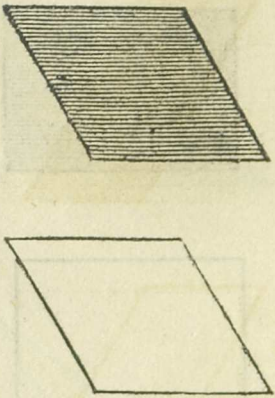
17. Rectangle





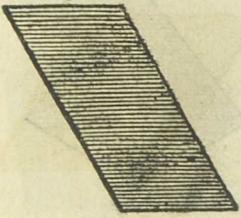
A Rectangle is an irregular tetragon, having only its opposite sides equal; its angles are all equal.

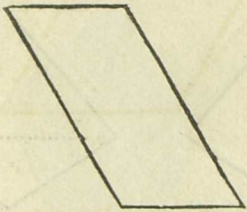
18. Rhomb.



A Rhomb is an irregular tetragon, having only its opposite angles equal; its sides are all equal.

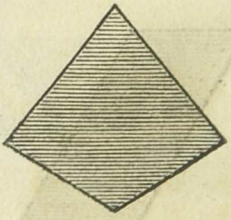
19. Rhomboid.

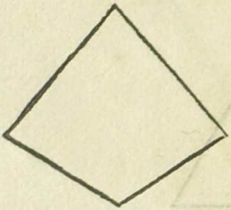


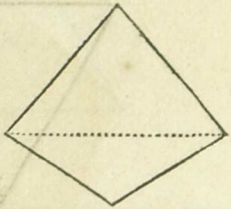


A Rhomboid is an irregular tetragon, having only its opposite sides and opposite angles equal.

20. Trapezoid.

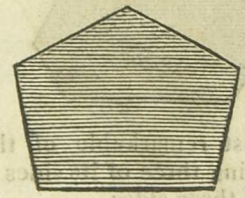


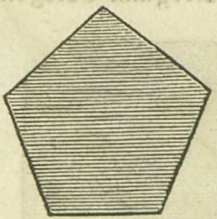




A Trapezoid is an irregular tetragon, having only two of its angles equal, which are opposite each other; a line drawn from one to the other, will divide the tetragon into two unequal isosceles triangles.

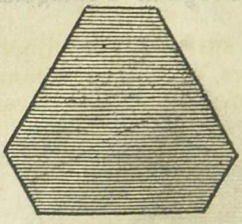
21. Irregular Pentagons.





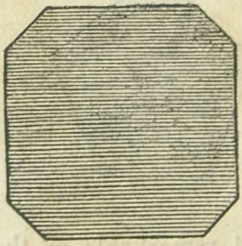
21, the most remarkable of the irregular pentagons, having four of the sides equal, the fifth side being either longer or shorter than the other four.

22. Irregular Hexagon.



22, the most remarkable of the irregular hexagons, having three of its sides longer than the remaining three sides.

23. Irregular Octagon.



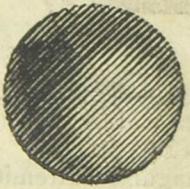
23, the most remarkable of the irregular octagons, having four of its sides longer than the remainin four.

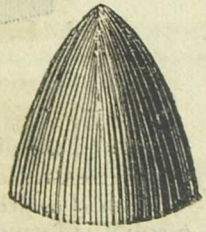
OF SOLIDS.

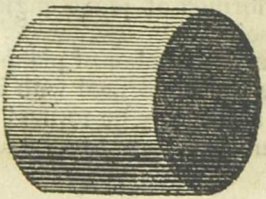
As planes or surfaces are either bounded by a line or lines, so solids are bounded by a surface or surfaces, which are likewise called the faces of the solid.

Solids are denominated curved or angular, from their faces.

CURVED SOLIDS are bounded by curved faces, A curved solid has, at least, one curved surface, and may be either represented by a ball, a sugar loaf, or a roller, as







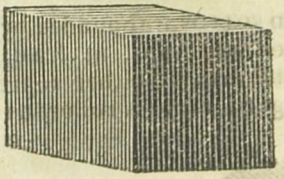
The ball has only one surface, which is curved.

A sugar loaf has two surfaces, one curved and one flat.

A roller has three surfaces, one curved and two flat.

ANGULAR SOLIDS are bounded by flat faces which are polygons of some kind or other.

An angular solid may be represented by a square block of wood, or brick, as



The six sides will represent the faces of the solid, and the eight corners will represent its angular extremeties, or its solid angles.

A solid angle, or the angular extremity of a solid, is formed of plane angles meeting in the same point.

The smallest number of plane angles, that a solid angle can be formed with is three.

A solid angle may be formed of any number of plane angles, not less than three.

If the six sides or faces of the block of wood be all equal squares, it will represent a cube.

Angular solids are either *regular* or *irregular*.

The *regular solids* are formed of, or bounded by, regular polygons, which are all equal and similar.

These must be either equilateral triangles, squares, or regular pentagons; no other polygons will form a solid by themselves.

Hence, there are but five solids which are called regular, viz. the Tetrahedron, Hexahedron or Cube, Octahedron, Dodecahedron, and Icosahedron.

They are likewise called Platonic bodies, because Plato discovered and described many properties belonging to them.

A cube may be represented by six square pieces of card, or thin wood, made all equal, and united together by their edges.

In a similar manner other solids may be represented.

The least number of faces that an angular solid can possibly have is four.

An angular solid may have any number of faces not less than four.

The regular solids may be divided into natural and artificial, which give rise to two series, denominated the natural and artificial series.

The natural series is so called, because they are to be found in great abundance among the productions of nature, viz. minerals.

The natural series consists of the Tetrahedron, Hexahedron or Cube, Octahedron, Rhomboidal Dodecahedron, Trapezohedron.

The artificial series is so called, because they have never been found among the productions of nature.

The artificial series consists of the Pentahedron, Dodecahedron, Icosahedron, Triacontrahedron, and Hexacontrahedron.

Angular solids are divided into simple and compound.

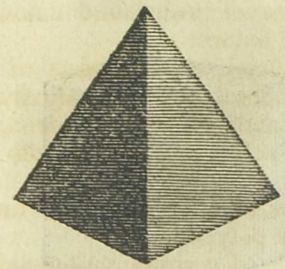
The faces of a simple solid are all equal and similar polygons.

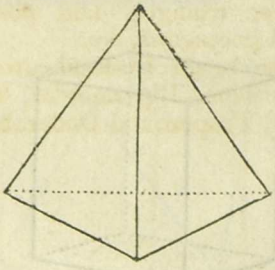
The faces of a compound solid consist of two or more kinds of polygons, as triangles and squares, triangles and pentagons, or squares and pentagons, &c.

There are seven Dodecahedrons, viz. the Regular, Scalene, Bipyramidal, Tetra, Pentagonal, and Trapezoidal Dodecahedrons.

NATURAL SERIES.

1. Tetrahedron.

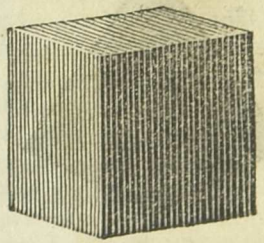


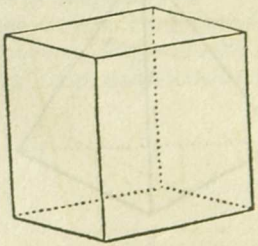


A Tetrahedron has four faces, which are equilateral triangles, six edges, and four solid angles.

NATURAL SERIES.

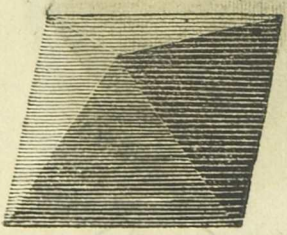
2. Hexahedron, or Cube.

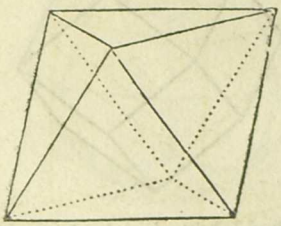




The Hexahedron or Cube has six faces which are squares, eight angular extremities or solid angles, and twelve edges.

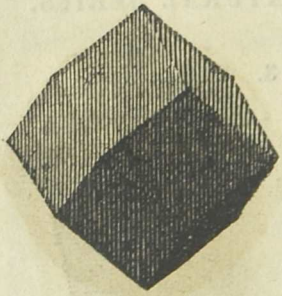
3. Octahedron.

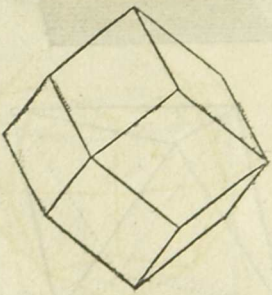




The Octahedron has eight faces which are equilateral triangles, six angular extremities or solid angles, and twelve edges.

4. Rhomboidal Dodecahedron.

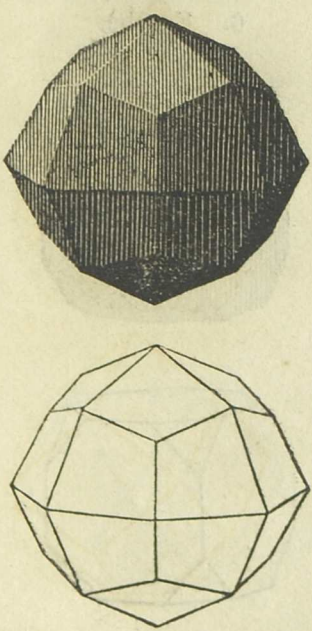




The Rhomboidal Dodecahedron has twelve faces which are rhombs, fourteen angular extremities, eight of which are obtuse and six acute, and twenty-four edges.

NATURAL SERIES.

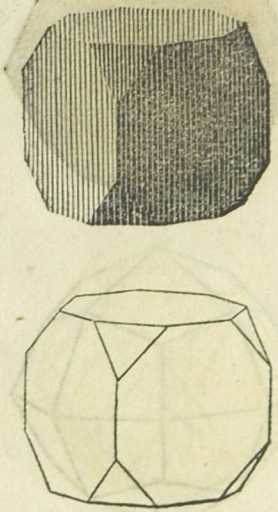
5. Trapezohedron.



The Trapezohedron has twenty-four faces which are trapezoids, twenty-six angular extremities, six of which are acute, eight obtuse, and twelve intermediate, and forty-eight edges.

COMPOUND SOLIDS.

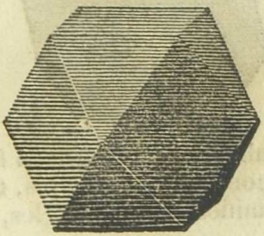
6. Excube.

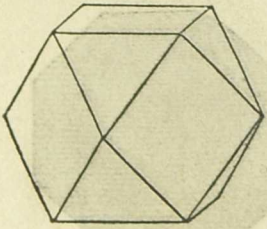


The Excube has fourteen faces, six of which are regular octagons, and eight are equilateral triangles, twenty-four angular extremities, and thirty-six edges.

COMPOUND SOLIDS.

7. Cuboctahedron.

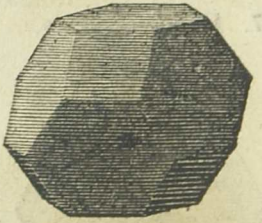




The Cuboctahedron has fourteen faces, eight of which are equilateral triangles and six squares, twelve angular extremities or solid angles, and twenty-four edges.

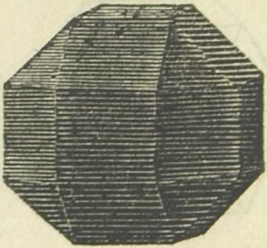
COMPOUND SOLIDS.

8. Exoctahedron.



The Exoctahedron has fourteen faces, eight regular hexagons and six squares, twenty-four angular extremities or solid angles, and thirty-six edges.

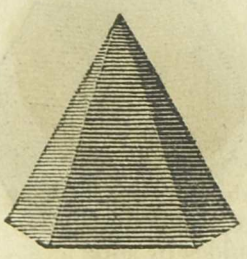
9. Triexoctahedron.

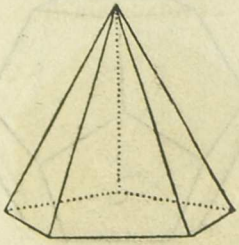


The Triexoctahedron has twenty-six faces, eight of which are equilateral triangles and eighteen squares, twenty-four angular extremities or solid angles, and forty-six edges.

ARTIFICIAL SERIES.

10. Pentahedron.

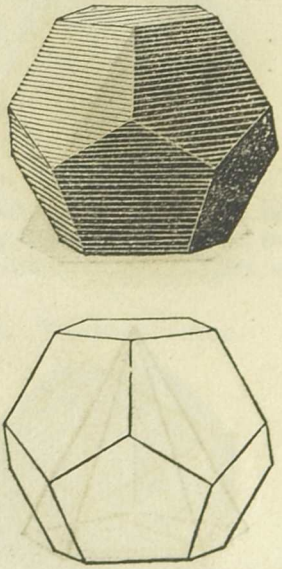




The Pentahedron has six faces, five of which are isosceles triangles and one regular pentagon, six angular extremities or solid angles, and ten edges.

ARTIFICIAL SERIES.

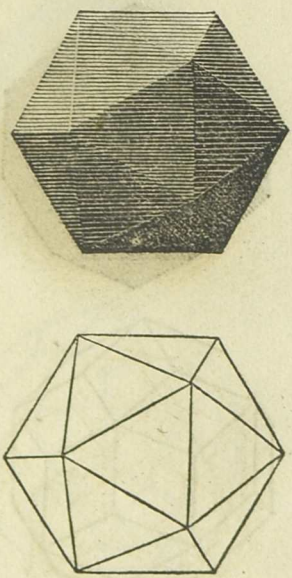
11. Regular Dodecahedron.



The Dodecahedron has twelve faces which are regular pentagons, twenty angular extremities or solid angles, and thirty edges.

ARTIFICIAL SERIES.

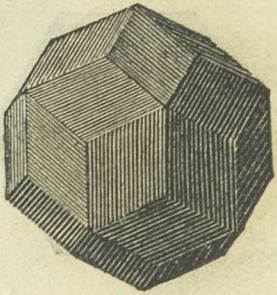
12. Icosahedron.

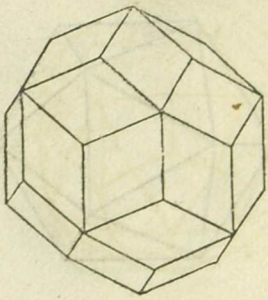


The Icosahedron has twenty faces which are equilateral triangles, twelve angular extremities or solid angles, and thirty edges.

ARTIFICIAL SERIES.

13. Triacontahedron.

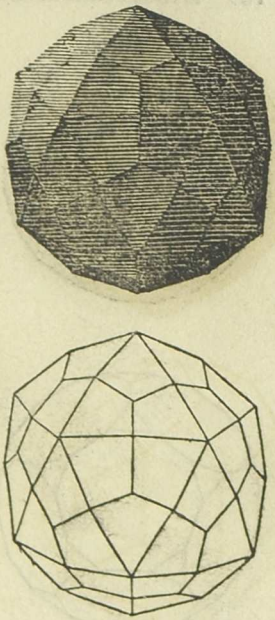




The Triacontahedron has thirty faces which are rhombs, thirty-two angular extremities or solid angles, twelve acute, and twenty obtuse and sixty edges.

ARTIFICIAL SERIES.

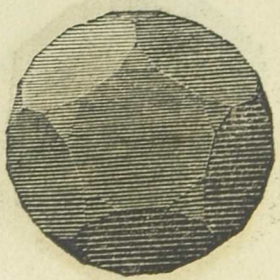
14. Hexacontahedron.

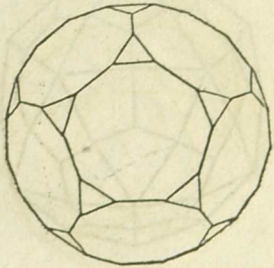


The Hexacontahedron has sixty faces which are trapezoids, sixty-two angular extremities or solid angles, twelve acute, twenty obtuse, and thirty intermediary, and one hundred and twenty edges.

COMPOUND SOLIDS.

15. Exdodecahedron.

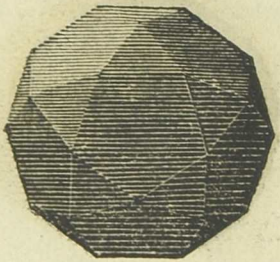


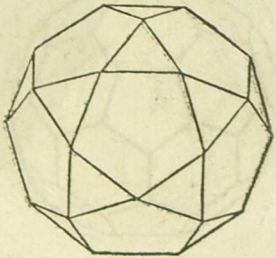


The Exdodecahedron has thirty-two faces, twelve of which are regular decagons, and twenty equilateral triangles, sixty angular extremities, and ninety edges.

COMPOUND SOLIDS.

16. Icosadodecahedron.

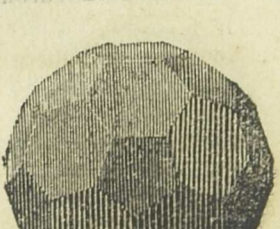


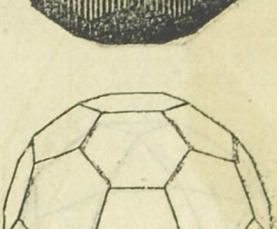


The Icosadodecahedron has thirty-two faces, twelve of which are regular pentagons, and twenty equilateral triangles, thirty angular extremities or solid angles, and sixty edges.

COMPOUND SOLIDS.

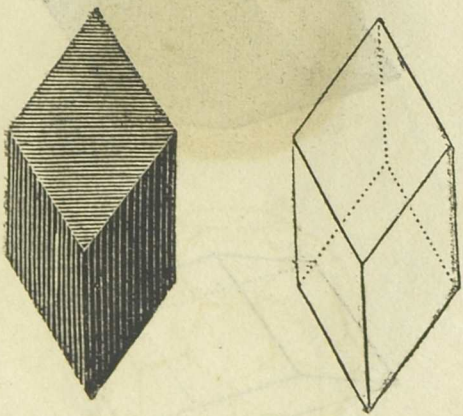
17. Exicosahedron.





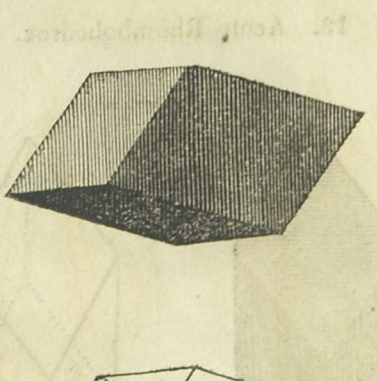
The Exicosahedron has thirty-two faces, twelve of which are regular pentagons and twenty regular hexagons, sixty angular extremities, and ninety edges.

18. Acute Rhombohedron.



The Acute Rhombohedron has six faces, which are rhombs.

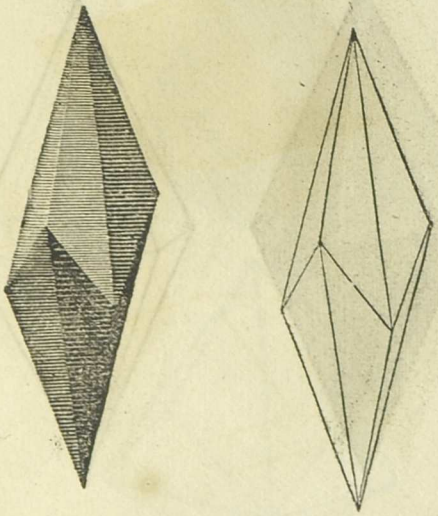
19. Obtuse Rhombohedron.



The Obtuse Rhombohedron has six faces, which are rhombs, but placed in a different direction to those of the acute rhombohedron.

DODECAHEDRONS.

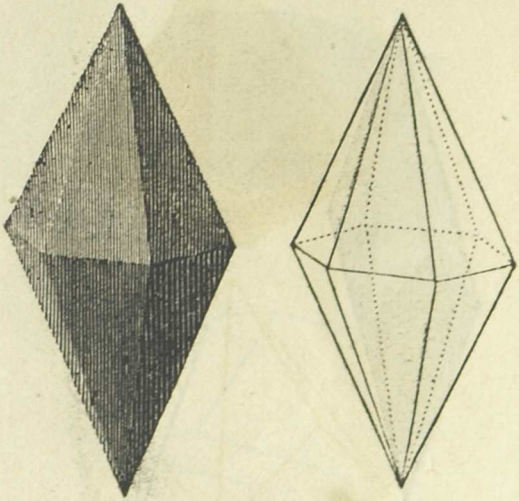
20. Scalene Dodecahedron.



The Scalene Dodecahedron has twelve faces, which are scalene triangles, from whence it receives its name.

DODECAHEDRONS.

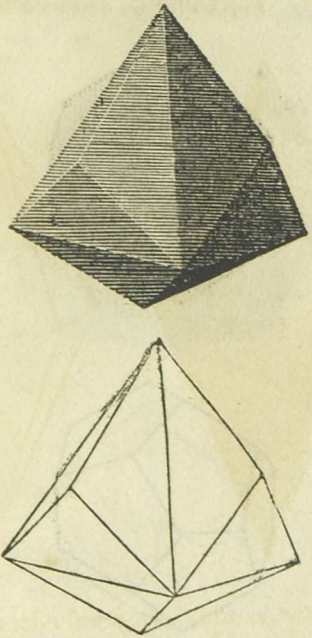
21. Bipyramidal Dodecahedron.



The Bipyramidal Dodecahedron has twelve faces which are isosceles triangles, but arranged so that the solid may be divided into two hexagonal pyramids, from whence it derives its name.

DODECAHEDRONS.

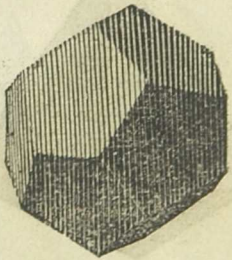
22. Tetradodecahedron.

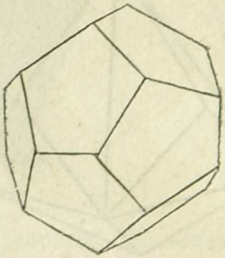


The Tetradodecahedron has twelve faces which are isosceles triangles, which are so arranged that they appear to be placed upon a *tetrahedron*, from whence it receives its name.

DODECAHEDRONS.

23. Pentagonal Dodecahedron.

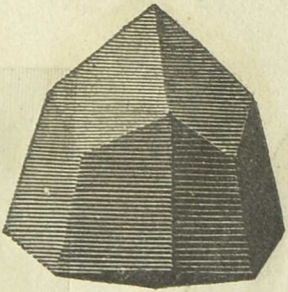


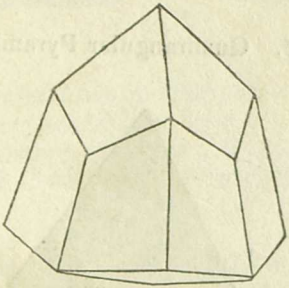


The Pentagonal Dodecahedron has twelve faces which are irregular pentagons; it is called the Pentagonal Dodecahedron to distinguish it from the other dodecahedrons.

DODECAHEDRONS.

24. Trapezoidal Dodecahedron.

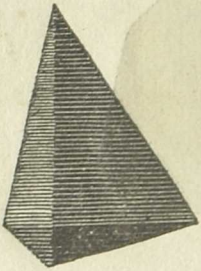




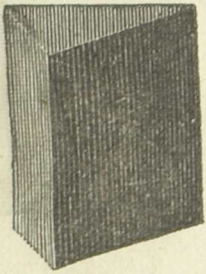
The Trapezoidal Dodecahedron has twelve faces which are trapezoids, whence it receives its name.

PYRAMIDS AND PRISMS.

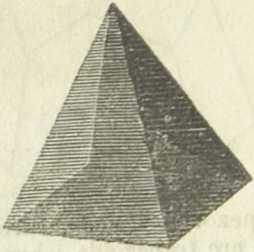
25. Triangular Pyramid.



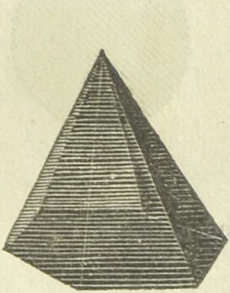
26. Prism.

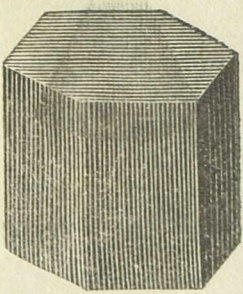


27. Quadrangular Pyramid.



28. Hexagonal Pyramid. 29. Hexagonal Prism.

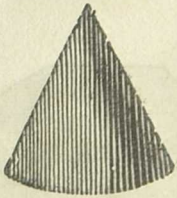




A Pyramid has one face, on which it stands, which is called its base, from the form of which base it derives its name; if it is a triangle, it is called a triangular pyramid, &c.

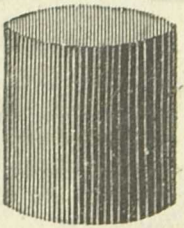
Prisms have two bases which are both alike, and are opposite to each other; from these bases the prisms receive their names, like the pyramids.

30. Cone.



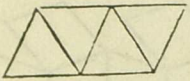
31. Sphere.

32. Cylinder.

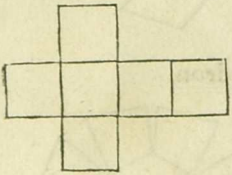


The Cone and Sphere are remarkable on account of the properties discovered by Archimedes.

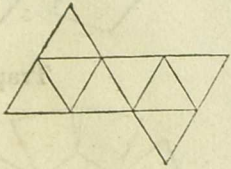
Tetrahedron.



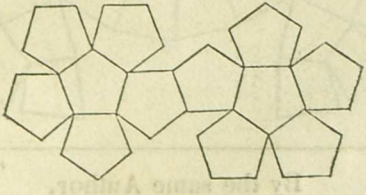
Cube.



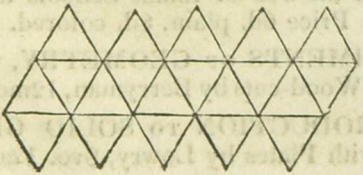
Octahedron.



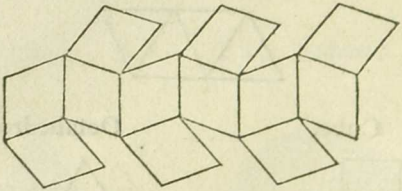
Dodecahedron.



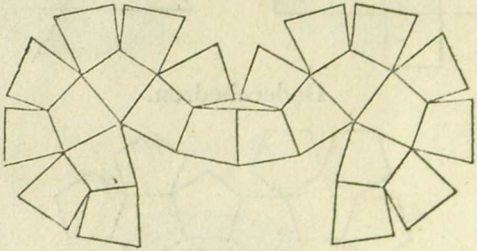
Icosahedron.



Rhomboidal Dodecahedron.



Trapezohedron.



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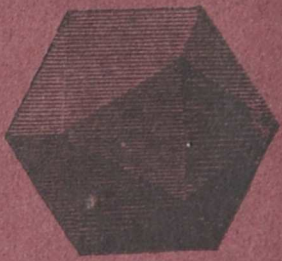
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