THE

ENGINEER'S AND MECHANIC'S

ENCYCLOPÆDIA,

COMPREHENDING

PRACTICAL ILLUSTRATIONS

OF

THE MACHINERY

AND

PROCESSES EMPLOYED IN EVERY DESCRIPTION OF MANUFACTURE

OF THE

BRITISH EMPIRE.

With nearly Two Thousand Engravings.

BY LUKE HEBERT,

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EDITOR OF THE HISTORY AND PROGRESS OF THE STEAM ENGINE, REGISTER OF ARTS, AND JOURNAL OF PATENT INVENTIONS, ETC.

IN TWO VOLUMES.

VOL. I.

"How much useful knowledge is lost by the scattered forms in which it is ushered to the world! How many solitary students spend half their lives in making discoveries which had been perfected a century before their time, for want of a condensed exhibition of what is known!"—BUFFON.

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bottom in large globules: this is chloride of azote. By putting a thin stratum of common salt at the bottom of the basin, we prevent the decomposition of the chloride of azote by the ammoniacal salt. It should be prepared only in very small quantities. A small quantity of it thrown into a glass of olive oil, produced a most violent explosion, and the glass, although a strong one, was broken into fragments. It also detonates strongly when brought into contact with phosphorus and many of its compounds, with various fixed oils, with oil of turpentine, naphtha, fused potash, aqueous ammonia, nitrous gas, and various other substances, but not with sulphur or resin. Iodide of azote may be most readily prepared by putting pulverulent iodine into common water of ammonia. It is pulverulent, and of a brownish black colour. It detonates from the smallest shock, and from heat, with a feeble violet vapour. When properly prepared, it frequently detonates spontaneously; hence, after the black powder is formed, and the liquid ammonia decanted off, the capsule should be left in perfect repose. Dr. Ure mentions, that in transferring a little of it from a capsule of platina to a piece of paper, the whole exploded in his hands. It should therefore be prepared with the greatest care, and in only very small quantities, and should not be preserved.

DIACOUSTICS. The consideration of the properties of sound refracted in passing through different media.

DIAGONAL, in Geometry, a right line drawn across a figure from the vertex of one angle to the vertex of another.

DIAGONAL SCALE. See SCALE.

DIAGRAM. A geometrical scheme for the explanation of the properties of a figure, or for the illustration of machinery; in which case it differs from a drawing, by the parts being represented by single lines without any breadth.

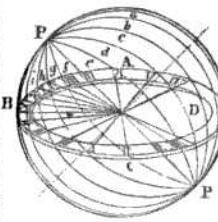
DIAL, or SUN DIAL. An instrument for measuring time by means of a shadow cast by the sun upon a surface properly placed for the purpose. Sun dials are an invention of very great antiquity, and are frequently mentioned in the Bible; and Vitruvius speaks of one made by the ancient Chaldee historian, Berosus, on a reclining plane, almost parallel to the plane of the equinoctial. Before the invention of clocks and watches, dials afforded almost the only means of marking the lapse of small portions of time; and dials were, therefore, generally to be seen in most places of public resort, as churches, crossways, markets, &c.; but since that invention, and the immense improvements made in it, dials have gone gradually into disuse, and are now rarely to be met with in England, where, indeed, the variable nature of the climate materially limits their utility. On the Continent they are still to be met with; and one kind, called the pillar dial, consisting of an elegant stone column, is frequently introduced as an ornament in the squares and market places. Our ingenious neighbours, the French, have likewise contrived a method of calling attention, at least once in the day, to the silent progress of the shadow over the dial, by means of a small mortar placed on the meridian line of a dial with a burning lens placed over the touch-hole, at such a distance and angle, that as soon as the sun arrives on the meridian, its rays, concentrated by the lens, set fire to the powder, which discharges the gun, and thus announces the hour of noon.

"We take no note of time but from its loss:
To give it then a tongue is wise in man."

Dials of this description are placed in the gardens of the Palais Royal, and of the Luxembourg.

DIALLING. The art of drawing dials on any surface, plane or curved. On account of the limited utility of this art, from the causes before noticed, we shall confine ourselves to explaining the general principles of dialling, which may be aptly illustrated by the phenomena of a hollow or transparent sphere of glass. Then suppose *a* P B *p* to represent the earth as transparent, and its equator as divided into 24 equal parts, by so many meridian semicircles, *a b c*, &c., one of which is the geographical meridian of any given place, as London, which is supposed at the point *a*; and if the hour of 12 be marked upon that meridian, and upon the opposite one, and all the rest of the hours in succession on the other meridians, those meridians would be the hour circles of London; because, as the

sun appears to move round the earth, which is in the centre of the visible heavens, in twenty-four hours, he will pass from one meridian to another in an hour. Then, if the sphere had an opaque axis as P e P, terminating in the poles P and P, the shadow of the axis, which is in the same plane with the sun and with each meridian, would fall upon every particular meridian and hour when the sun came to the plane of the opposite meridian, and would, consequently, show the time at London and at all other places on the same meridian. If this sphere were cut through the middle by a solid plane A B C D in the rational horizon of London, one-half of the axis e P would be above the plane, and the other below it; and if straight lines were drawn from the centre of the plane to those points where its circumference is cut by the hour circles of the sphere, those lines would be the hour lines of an horizontal dial for London; for the shadow of the axis would fall upon each particular hour line of the dial when it fell upon the like hour circle of the sphere. Those who are further interested in the subject we would refer to Emerson's *Dialling*, and Ferguson's *Lectures on Mechanics*. Dr. Brewster, in the Appendix to his valuable edition of this latter work, has described an analemmatic dial, which sets itself. Many ingenious constructions of dials are also given in Dr. Hutton's *Translation of Montucla's Recreations*.



DIAMETER, in Geometry, the line which, passing through the centre of a circle, or other curvilinear figure, divides it or its ordinates into two equal parts.

DIAMOND. The most brilliant and the most valued of all the minerals. It is found of all colours—white, grey, red, brown, yellow, green, blue, and black; the colourless varieties are the most esteemed. If very transparent and pure, they are said to be of the first water; and in proportion as they depart from this transparency and purity, they are denominated of the second or third water. The extraordinary lustre of the diamond is said to be derived from its reflecting all the light which falls on its posterior surface at an angle of incidence greater than 24° 13′; artificial gems reflect only half this light. The weight, and, consequently, the value of diamonds, is estimated in carats, one of which is equal to four grains; and the piece of one diamond, compared to that of another of equal colour, transparency, purity, form, &c., is as the squares of the respective weights. The average price of rough diamonds that are worth working is about two pounds for the first carat; and the value of a cut diamond being equal to that of a rough diamond of double weight, exclusive of the price of workmanship, the cost of a wrought diamond of

	£	£8
1 carat is		
2 ditto is	$2^2 \times 8$ =	32
3 ditto is	$3^2 \times 8$ =	72
4 ditto is	$4^2 \times 8$ =	128
5 ditto is	$5^2 \times 8$ =	200

This rule is, however, not extended to diamonds of more than 20 carats (value 3,200*l.*); the larger ones, in consequence of the scarcity of purchasers, being disposed of at prices greatly inferior to their estimated worth. It does not appear that a larger sum than 130,000*l.* was ever given for a diamond, which was brought by a gentleman named Pit, from India, and was hence called the Pit diamond. Diamonds can only be cut and polished by their own substance. The operation is commenced by rubbing several against each other while rough, after having first glued them to the ends of two wooden blocks, thick enough to be held in the hand. The powder thus rubbed off the stones

is received into a little box for the subsequent purposes of grinding and polishing them. These operations are effected by a mill, which turns a wheel of soft iron, on which is sprinkled the diamond dust, mixed with oil of olives; the particles of diamond becoming imbedded in the soft iron by the rubbing action, and presenting a multiplicity of opposing cutting angles to the stone under operation, which is thereby shaped according to the design of the operator. The same dust well ground and diluted with water and vinegar is used in the sawing of diamonds, which is performed by an extremely fine iron or brass wire; the operation being similar in principle to the sawing of blocks of stone for the use of the mason, by means of sharp sand and a blunt blade of iron. Brilliants are those diamonds which are cut in faces at the top and bottom, and whose table or principal face at top is flat. Rose diamonds are quite flat underneath, with the upper part cut into many little facets, usually triangles, the uppermost of which terminates in a point. The only chemical difference between diamond and the purest charcoal is, that the latter contains an extremely minute portion of hydrogen. It is said that diamonds have been recently artificially produced from charcoal.

DIAPASON. An interval in music that expresses the *octave* of the Greeks. This term is likewise applied to the rule or scale whereby musical instrument makers adjust the pipes of organs, and cut the holes of hautboys, flutes, &c. in due proportion, for performing the tones, semi-tones, and concords, with precision.

DIAPER. A kind of cloth, on which is formed a variety of designs, chiefly employed for table linen. See WEAVING.

DICE. Small cubical pieces of bone or ivory, marked with dots on each face, from one to six. To give uniformity to their figure, or to make true dice, is of course a very simple art; but the ingenuity of the dice-maker is called into action to construct false or untrue dice for the sharping gamester; for him they are so skilfully constructed or loaded, as to ensure a preponderance of favourable chances, without incurring the probability of the cause being discovered. Some of their nefarious processes are known to us, but it is not our province to extend the knowledge of so vile an art.

DIFFERENCE is the remainder after taking the less of two quantities from the greater.

DIFFERENTIAL, in the higher Geometry, is an infinitely small quantity, or part of quantity, so small as to be less than any assignable one, and is thus denominated because it is frequently considered as the difference of two quantities, and as such, is the foundation of the differential calculus. The term differential is also applied, in Mechanics, to various machines for imparting to a body the difference of motion of two other bodies moving in contrary directions; an example of this is shown in the Chinese crane, under the article CRANE. For further instances, see PULLEY DIFFERENTIAL, SCREW DIFFERENTIAL, and WHEEL DIFFERENTIAL.

DIGESTER. A strong vessel formed of iron or copper, the lid of which screws down, and is made tight by luting or grinding; and the steam not being allowed to escape, the water acquires a very high temperature, by which its solvent powers are greatly increased. To prevent accidents, a small safety valve is inserted in the lid. The digester is the invention of the celebrated Papin.

DIGIT, in Arithmetic, any one of the ten numerals 1, 2, 3, 4, 5, 6, 7, 8, 9, 0; also a measure equal to three-quarters of an inch.

DILATATION. The expansion of a body into a greater bulk by its own elastic power. It differs from rarefaction: for though the effects of both are nearly, if not quite the same, yet the latter arises from the application of heat. It has been observed by modern philosophers, that bodies which have been compressed and are again set at liberty endeavour to dilate themselves with a force equal to that by which they are compressed; accordingly they are found to sustain a force and raise a weight equivalent to the force of compression. Bodies in the act of dilating by their own elasticity exert a greater force at the beginning than towards the end, as being at first more compressed; and the