splendour with solemnity; they have the manful energy of Mantegna without his harshness, and the richness of Giorgione without his luxury. Succeeding pictures show an increase of this richness, and a character more nearly tender. An altar piece, painted for the church of San Zaccaria, seems to indicate a transition, and that the venerable master is acquiring all the softer splendour and keeping pace with Giorgione and Titian, the young pupils of the school. Nay, at the very close of his career, Bellini left the old devotional cycle in which he had produced works so moving and august, and painted for Alphonso of Ferrara a mythology in the most gorgeous manner of the ripe Venetian school. This is the Feast of the Gods, now at Alnwick Castle, a picture to which Titian set the finishing touches, and to which the companion, by Titian himself, is now at Madrid. Bellini died on the 29th of November 1516, full of years and honours. We have seen that he was associated with his brother in the decoration of the Great Hall of the Council in 1479. In 1483 he was appointed Pittore del Dominio, and exempted from the charges of his guild. All the painters of the state at one time or another were associated with him or passed through his school. Among the most distinguished of his scholars and assistants who will not need separate mention, we may name Marco Basaiti and Vincenzo Catena, many of whose works pass for their master's. He was the honoured associate of statesmen and men of letters. In 1506, when Albert Dürer visited Venice, where he was subject to some annoyances, he found the noble old man not only the most courteous of the Venetian artists in his reception of a stranger, but the best in his profession ("der best im gemell").

Many pictures in various galleries pass as portraits of one or other of the Bellini. But of those that are styled likenesses of Giovanni, none can be proved authentic, while the only certain portrait of Gentile is a medal by Camelio. (Vasari, ed. Lemonnier, vol. v. pp. 1–28; Sansovino, *Ven. descr.*, 125, *seq.*; Ridolfi, i. 90–99; Crowe and Cavalcaselle, *History of Painting in North Italy*, vol. i. pp. 100–193.) (S. C.)

BELLINI, Lorenzo, physician and anatomist, was born at Florence in 1643. After completing his studies in general literature he went to Pisa, where, assisted by the generosity of the grand duke Ferdinand II., he studied under two of the most learned men of that age, Oliva and Borelli, the former of whom instructed him in natural philosophy and the latter in mechanics. He likewise studied medicine under Redi, and mathematics under Marchetti. At the early age of twenty he was chosen professor of philosophy at Pisa, but did not long continue in this office; for he had acquired such a reputation for skill in anatomy, that the grand duke procured him a professorship in that science, and was himself a frequent auditor at his lectures. After a long residence in Pisa, he was invited to Florence and appointed physician to the grand duke Cosmo. He was also made senior consulting physician to Pope Clement XI. Bellini died in 1703, in the sixtieth year of his age. His works were published in a collected form in 1708 (2 vols. 4to), and reprinted in 1732.

BELLINI, Vincenzo, one of the most celebrated operatic composers of the modern Italian school, was born at Catania in Sicily, November 3, 1802. He was descended from a family of musicians, both his father and grandfather having been composers of some reputation. After having received his preparatory musical education at home, he entered the conservatoire of Naples, where he studied singing and composition under Tritto and Zingarelli. He soon began to write pieces for various instruments, as well as a cantata and several masses and other sacred compositions. His first opera, *Adelson e Savina*, was performed in 1824 at a small theatre of Naples; his second dramatic work, *Bianca e Fernando*, saw the light two years later at the San Carlo theatre of the same city, and made his name known in Italy. His next work, *Il Pirata*, was written for the celebrated Scala theatre in Milan, to words by Felice Romano, with whom Bellini formed a union of friendship to be severed only by his death. The splendid rendering of the music by Tamburini, Rubini, and other great Italian singers, contributed greatly to the success of the work, which at once established the European reputation of its composer. Almost every year of the short remainder of his life witnessed the production of a new operatic work, each of which was received with rapture by the audiences of France, Italy, Germany, and England, and some of which retain their place on the stage up to the present day. We mention the names and dates of four of Bellini's operas familiar to most lovers of modern Italian music, viz.:—*I Montecchi e Capuleti* (1829), in which the part of Romeo has been a favourite with all the great contraltos of the last seventy years; *La Sonnambula* (1831); *Norma*, Bellini's best and most popular creation (1832), and *I Puritani* (1834), written for the Italian opera in Paris, and to some extent under the influence of French music. In 1833 Bellini had left his country to accompany to England the great singer Pasta, who had created the part of his *Sonnambula*. In 1834 he accepted an invitation to write an opera for the national Grand Opera in Paris. While he was carefully studying the French language and the cadence of French verse for the purpose, he was seized with a sudden illness and died at his villa in Puteaux near Paris, September 21, 1835. This unexpected interruption of a career so brilliant sheds, as it were, a gloom of sadness over the whole of Bellini's life, a sadness which, moreover, was foreshadowed by the character of his works. His operatic creations are throughout replete with a spirit of gentle melancholy, frequently monotonous and almost always undramatic, but at the same time irresistibly sweet, and almost disarming the stern demands of higher criticism which otherwise would be compelled to reprove the absence of both dramatic vigour and musical depth. To the feature just mentioned, combined with a rich flow of *cantilena*, Bellini's operas owe their popularity, and will owe it as long as the audiences of our large theatres are willing to tolerate outrages on rhyme and reason if sung by a beautiful voice to a pleasing tune. In so far, however, as the defects of Bellini's style are characteristic of the school to which he belongs, they fall to be considered in a general treatment of the whole subject. See Music.

BELLINZONA, or Bellenz, one of the three towns which are the capital in turn of the Swiss canton of Tessin or Ticino. It is built on two hills, one on each side of the Ticino at the entrance of the Riviera valley, and is so situated as completely to bar the passage by that route between Italy and Germany. Its fortifications, which were of great strength during the Middle Ages, have been partially restored. There are three castles, the Castello Grande, Corbario, and Di Mezzo, which belonged to the three cantons of Uri, Unterwalden, and Schwyz respectively; the first of these is now used as an armoury and prison. The abbey church is a fine building of the 16th century, and contains some paintings of value. The Augustinian convent is now used as a Government house. The inundations of the river are prevented from injuring the town by a large dyke, built by the French in the reign of Francis I. A considerable transit trade is carried on with Italy, and there is a famous manufacture of *acqua di cedro* from the blossom and rind of the orange. Bellinzona was in existence at least as early as 1242, when it was conquered by Otto Visconti. It was long an object of contest between the Swiss and the Milanese; in the 15th century it was the scene of a famous battle, in which the Swiss were defeated; and it finally passed into the hands of the three cantons of Uri, Unterwalden, and Schwyz after the battle of Marignano in 1515. Population in 1870, 2051.

BELLMAN, Karl Mikael, the greatest lyrical poet of Sweden, was born at Stockholm on the 4th of February 1740. His father, who held a responsible official position, was descended from a family that had already distinguished itself in the fine arts; his mother, a gifted and beautiful woman, early instructed him in the elements of poetry and music. When quite a child he suddenly developed his extraordinary gift of improvising verse, during the delirium of a severe illness, weaving wild thoughts together lyrically, and singing airs of his own composition. From this time he gave himself up to the poetic art, and received great encouragement from the various eminent men who met round his father's table, among whom was Dalin, the favourite poet of the day. As early as 1757 he published a book of verse, a translation of Schweidnitz's *Evangelical Thoughts of Death*, and for the next few years wrote a great quantity of poems, imitative for the most part of Dalin. In 1760 appeared his first characteristic work, *The Moon*, a satirical poem, which was revised and edited by Dalin. But the great work of his life occupied him from 1765 to 1780, and consists of the collections of dithyrambic odes known as *Fredman's Epistles* and *Fredman's Songs*. These were not printed until 1790. The mode of their composition was extraordinary. No poetry can possibly smell less of the lamp than Bellman's. He was accustomed, when in the presence of none but confidential friends, to announce that the god was about to visit him. He would shut his eyes, take his zither, and begin to improvize a long Bacchic ode in praise of love or wine, and sing it to a melody of his own invention. The genuineness of these extremely singular fits of inspiration could not be doubted. The poems which Bellman wrote in the usual way were tame, poor, and without character. The *Fredman's Epistles* glow with colour, ring with fierce and mysterious melody, and bear the clear impress of individual genius. These torrents of rhymes are not without their method; wild as they seem, they all conform to the rules of style, and among those that have been preserved there are few that are not perfect in form. The odes of Bellman breathe a passionate love of life; he is amorous of existence, and keen after pleasure, but under all the frenzy there is a pathos, a yearning that is sadder than tears. The most dissimilar elements are united in his poems; in a bacchanal hymn the music will often fade away into a sad elegiac vein, and the rare picturesqueness of his idyllic pictures is warmed into rich colour by the geniality of his humour. He is sometimes frantic, sometimes gross, but always ready, at his wildest moment, to melt into reverie. A great Swedish critic has remarked that the voluptuous joviality of Bellman is, after all, only "sorrow clad in rose-colour," and this underlying pathos gives his poems their undying charm. His later works, *The Temple of Bacchus*, a journal called *What you Will*, a religious anthology entitled *Zion's Holiday*, and a translation of Gellert's *Fables*, are comparatively unimportant. He died on the 11th of February 1795. Several statues exist of Bellman. One represents him naked, crowned with ivy, and striking the guitar; the best is the splendid colossal bust by Byström, which adorns the public gardens of Stockholm, which was erected by the Swedish Academy in 1829. Bellman had a grand manner, a fine voice, and great gifts of mimicry, and was a favourite companion of King Gustavus III. The best edition of his works is one lately published at Stockholm, edited by J. G. Carlén.

BELLONA, in *Roman Mythology*, the goddess of war, corresponding to the Greek Enyo, and called now the sister or daughter of Mars, now his charioteer or his nurse. Her worship appears to have been promoted in Rome chiefly by the family of the Claudii, whose Sabine origin, together with their use of the name of "Nero," has suggested an identification of Bellona with the Sabine war goddess Nerio. Her temple at Rome, founded by Appius Claudius Cæcus, 296 B.C., stood in the Campus Martius, near the Flaminian Circus, and outside the gates of the city. It was there that the senate met to discuss the claims of a general to a triumph, and to receive ambassadors from foreign states. In front of it was the *columna bellica* where the ceremony of declaring war was performed. From this native Italian goddess is to be distinguishad the Asiatic Bellona, whose worship was introduced into Rome from Comana, in Cappadocia, apparently by Sulla, to whom she had appeared, urging him to march to Rome and bathe in the blood of his enemies. For her a new temple was built, and a college of priests (Bellonarii) instituted to conduct her fanatical rites, the prominent feature of which was to lacerate themselves and sprinkle the blood on the spectators. To make the scene more grim they wore black dresses from head to foot.

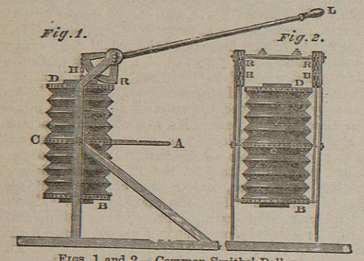
BELLOT, Joseph René, one of the heroes and victims of Arctic exploration, was born at Paris, March 18, 1826. At the age of fifteen he entered the Naval School, in which he studied two years, and earned a high reputation. He distinguished himself in the French expedition of 1845 against Tamátave in Madagascar; and although he was not yet twenty he received the cross of the Legion of Honour at the close of that year. He was afterwards attached to the staff of the station, was promoted to the rank of *Enseigne de Vaisseau* in November 1847, and in 1851 obtained permission to join the English expedition then preparing to go out, under the command of Captain Kennedy, in search of Sir John Franklin. On this occasion he displayed great courage, presence of mind, and self-devotion, rendered important services, and made the discovery of the strait, which bears his name, between Boothia Felix and Somerset Land. Early in 1852 he was promoted lieutenant. In the same year he accompanied, as a volunteer, the expedition sent out by the English Government under Captain Inglefield on the same quest. His intelligence, his devotion to duty, and his courage won him the esteem and admiration of all with whom he was associated. While making a perilous journey with two comrades across the ice, for the purpose of communicating with Captain Inglefield, he was overtaken by a storm, August 21, and being blown into an opening between the broken masses of ice was seen no more. A pension was granted to his family by the Emperor Napoleon III., and an obelisk was erected to his memory in front of Greenwich Hospital.

BELLOWS and BLOWING-MACHINES are machines for producing a current of air, chiefly in order to assist the combustion of a fire.

The common bellows now in use probably represents one of the oldest contrivances for this purpose. It consists of two flat boards, of oval or triangular shape, connected round their edges by a piece of leather so as to form an air chamber. The leather is kept from collapsing, on separation of the boards, by two or more hoops, which act like the ribs in animals. The lower board has a hole in its centre covered inside by a leather flap or valve opening inwards; it has also fastened to it a metal pipe or nozzle, of smaller aperture than the valve. On raising the upper board, the air from without lifts the valve and enters the cavity; then on pressing down the top board, this air is compressed, shuts the valve, and is driven through the pipe with a velocity corresponding to the pressure.

The blast here is, of course, not continuous, but in puffs,—a certain interval being needed for refilling the bellows after each discharge. This drawback was remedied by the invention of double bellows. To understand their action, it is only necessary to conceive an additional board with valve, like the lower board of the single bellows, attached by leather under this lower board. Thus two similar cavities are obtained, separated by the lower board of what was the single bellows. The lowest board is held down by a weight, and another weight presses the top board. When the lowest board is raised it forces air into the upper cavity, and the valve of the middle board prevents return of this air. The lowest board being then depressed, air enters the lower cavity from without, and this in its turn is next forced into the upper cavity. The weighted top board is meanwhile continuously pressing the air of the upper cavity through the nozzle. While the blast thus obtained is continuous, it is not wholly free from irregularities.

The common smiths' bellows, made on the principle just indicated, are generally of circular form, as shown in figs. 1 and 2. A is the blast pipe, B the movable lowest



Figs. 1 and 2.—Common Smiths' Bellows.

board, C the fixed middle board (into which the pipe is inserted), and D the movable upper board pressed by a weight. The lowest board is moved by means of the lever L and the chain H working on the roller R. The weight required to produce a certain force of blast is easily determined; if the diameter of the bellows be 1 foot, the area will be 113·19 inches, and the upper board will require a weight of 56·5 lb for a blast equivalent to a pressure of ½ lb on the square inch, or a velocity of 207 feet per second, which is well suited for a smith's forge. By a simple arrangement for altering the diameter of the pipe the force of the blast may be varied.

It may be noted that in some parts of the Continent a simple form of bellows is made of two wooden boxes, each open on one side, and the one just fitting into the other. The open sides being opposed to each other, the upper enclosing box is made to move up and down over the other, with which it is jointed at one part, and which is provided with a nozzle, and a valve opening inwards. The change of capacity produces a blast. There is considerable loss of air, however, from the boxes not exactly fitting.

The blowing-machines now almost exclusively used for blast furnaces are of the cylinder and piston type (which is the principle adopted, it may be remarked, in a small hand bellows used by the Chinese). At first the blowing cylinders were single-acting, that is to say, they had the power of propelling a blast only when the piston was moving in one direction. With two or more of these blowing cylinders attached to one crank-shaft, worked by a water-wheel, a tolerably steady pressure of air was obtained. But in these and other respects considerable progress has been realized.

The cylinder-engines of the present day (which are generally driven by steam) may be classed in two chief systems, according as the cylinder is placed horizontally or vertically. In the former case the steam and blast cylinders are usually in one line, the same rod carrying the pistons of both, and being guided on both sides, while a fly-wheel is employed as regulator. In the vertical systems the steam and blowing cylinders are sometimes similarly connected, but, in the larger engines, they are generally placed one at each end of a beam connecting their pistons. The vertical engines have been most popular in England and in some parts of the Continent (as Silesia), but the other type (almost exclusively used in Westphalia and on the Rhine) is now adopted in several English works.

The general action of many of these machines may be illustrated by the large blowing engine at the Dowlais iron-works, erected in 1851. Fig. 3 is a representation of

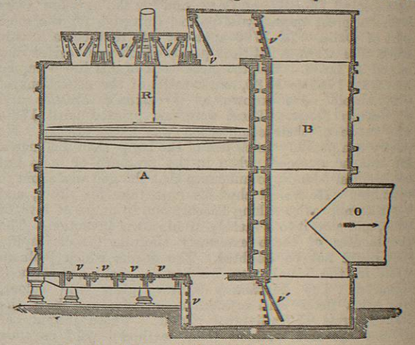


Fig. 3.—Section of Cylinder of Blowing Engine.

its blast cylinder, the piston of which, made air-tight by packing, is moved by the oscillating beam of the engine. The cover of the cylinder, and also its bottom, have several openings, furnished with valves *v*, which open inwards. Other valves *v'*, above and below, open into a lateral chamber B, which is connected by the aperture O to the different tuyeres of the furnaces. Suppose, now, the piston is at the top and begins to be forced down. The air in the upper part of the cylinder becomes more and more rarefied, and the difference of density between it and that of the blast in chamber B, causes the upper valve *v'* to be applied firmly to the metallic surface before which it is hung. The upper valves *v*, on the other hand, will be raised by the external air which enters to compensate the rarefaction. The same motion of the piston compresses the air below it, causing the lower valves *v* (which open inwards) to be firmly closed, while the valve *v'* will be raised and admit the air into chamber B, whence it passes to the furnace. When the piston is raised the reverse takes place; the lower portion of the cylinder receives air from without, and the upper discharges its air through the pipes leading to the furnace. Thus a nearly continuous flow is obtained. To ensure regularity the pipe O is made to communicate with a closed reservoir of wrought iron, where the variations are destroyed by the elasticity of the air itself. The cylinder here figured is 144 inches in diameter, with a stroke of 12 feet, and discharges about

44,000 cubic feet per minute, at a pressure of 3½ lb to the square inch.

Where it is desirable to make small blast engines do the work of large ones, compensating smallness of size with velocity, it becomes necessary that the air valves be moved otherwise than by the simple action of the air itself. The best form of such an arrangement is that devised by Mr Slate, in which there is an annular slide valve placed outside the blast cylinder; it receives its motion from a crank connected with the fly-wheel shaft. Thus, with lap and lead of the valve properly proportioned, a high velocity can be attained, and the tremor and jar that are observable in some of the larger engines are entirely absent. Two such engines working together, with their cranks at right angles, give such a uniform blast that no regulator of any kind is needed. In Fossey's engine, which appeared in the Exhibition of 1862, the slide valves are replaced by discs with radial perforations, which are put in slow rotatory motion by gearing connected with the main shaft.

The blast engines with slide valves, however, have not proved so advantageous in practice as was anticipated, owing to the large amount of friction on the valve surfaces, greater liability to derangement, and the wear and tear resulting from such rapid motion.

As a recent example of engines of the vertical type, with steam and air cylinders in one line (which have now come a good deal into use in the north of England) we may briefly notice the compound cylinder blowing engines at the Lackenby Iron-Works, Middlesborough. These engines were described by Mr Alfred Hill before the Institution of Mechanical Engineers in 1871. Fig 4 (copied from the drawings by permission of the Institute and of Mr Hill) presents them in vertical section.

They consist of a high pressure non-condensing engine and a low pressure condensing engine, the latter supplied by steam from the former,—this arrangement being adopted for economical reasons. A is the high pressure cylinder (32 inches in diameter) and C the low pressure (80 inches). Both engines have a stroke of 54 inches; and a peculiarity is that they are coupled by cranks placed directly opposite each other instead of, as usual, at right angles,—a light fly-wheel being relied on to carry them over the dead centres. This secures a better balance of the engines, and expansion of the steam in both cylinders in the most advantageous manner; it also obviates the danger of breakages common in the case of right-angle cranks, which probably arises from the tendency to sudden acceleration of one engine over the other at the commencement of each stroke,—full steam pressure being then upon both pistons simultaneously, whilst the resistance of the blast pressure is acting against only one of the blowing pistons. In the blowing cylinders B, the inlet valves in the bottom are circular disc valves of leather, eighteen in number. The inlet valves T on the top of the cylinder are arranged in ten rectangular boxes, having openings in their vertical sides, inside which are hung leather flap valves. The box covers are made hollow, and are carried down between the backs of the leathern flaps (so as to diminish the air-space as much as possible). The outlet valves *o* for air are ten in number, at each end of the cylinders, and are hung against flat gratings, which are fixed round the circumference of the cylinder. Enclosing each cylinder is an air-tight wrought-iron case M, into which the blast is delivered, and a branch at one side (not shown in figure) conveys the blast to the main. The area of the inlet valves is 860 square inches, or about $\frac{1}{5}$th the area of the piston; that of the outlet valves is about $\frac{1}{8}$th. For details of the balanced slide valves of the steam cylinders, the surface condenser D, the circulating pump E, the air-pump F, the feed pumps G, &c., we must refer to Mr Hill's paper.

The capacity of each blowing cylinder is 157 cubic feet: consequently, the total quantity of blast supplied from both

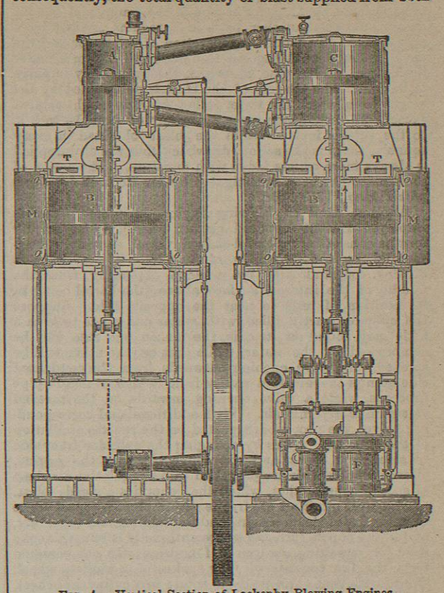


Fig. 4.—Vertical Section of Lackenby Blowing Engines.

cylinders at the regular speed of 24 revolutions per minute is 15,072 feet per minute, measured at atmospheric pressure; thus the supply of blast, including loss by leakage, amounts to 190,000 cubic feet per ton of iron made. The pressure of blast in the blast-main is very free from fluctuations,—owing, doubtless, to its large size, 12¼ times the joint capacity of the two blowing cylinders. The indicated power of the engine is found to give a total of 290 horse; that of the two blowing cylinders 258.

Among the more powerful blowing engines of piston and cylinder type at present in use, may be mentioned, besides that at Dowlais referred to above, those of Woolwich dockyard, employed for supplying air to forty forge fires, the Kirkless Hall engines, constructed from Robert Wilson's designs for the Wigan Iron and Coal Company, and the seven engines of Schneider and Co. at Creusot, three of which are horizontal engines of an old type, and the other four direct-acting vertical engines. Descriptions of these will be found in various standard works on metallurgy and engineering. For a description of the large blowing and exhausting engines lately constructed for the new Post-Office in London, see *Engineering*, 20th February 1874.

An ingenious mode of obtaining a blast is adopted in Savoy, Carniola, and in some parts of America; it is the *trompe* or water-blowing engine. A flow of a few yards of water is required. From the bottom of a reservoir water is admitted, by removal of a plug from a conical-shaped aperture, into a large vertical wooden pipe, which terminates below in a wind chest. The water, falling

in streamlets, carries down with it air drawn in through sloping holes near the top of the pipe. The wind chest below has an opening for escape of the water, and the air passes out from another part, in a regular stream, by a nozzle pipe. To facilitate separation of the water and the air, it is found advantageous to fix a small platform under the bottom of the pipe, on which the water may impinge in its fall. The tension of the blast is determined by the height from which the water falls; but this height seldom exceeds 27 feet, which gives a pressure of from 1½ to 2 lb to the square inch. While the blast obtained is very equable, there is the serious drawback that the air supplied is always more or less laden with moisture. The action of the *trompe* has been investigated by Mr Rodwell (*Philosophical Mag.*, 1864, 1867).

Another kind of blowing engine, in which water is employed, is that invented by Mr Street; in its simpler form it consists of a barrel-shaped vessel, supported horizontally by the two ends of its axis. The cylinder is divided longitudinally by a plane extending from the middle of the internal surface above (the barrel being in its position of rest) to near the opposite side. Suppose the cylinder partly filled with water and made to turn a little way round on its axis, the air on one side will be compressed by the water, while that on the other will be rarefied. A valve opening outwards from the condensed side admits the air to a cavity from which a nozzle pipe proceeds, while a valve opening inwards on the rarefied side admits external air. With additional and corresponding valves, the process is repeated on the reverse oscillation of the cylinder. Thus by swinging the cylinder from side to side, by a crank and rod connected with the engine, alternate puffs of air are propelled into a regulative air chest of special construction, which then supplies a steady blast.

Fan-blast machines are frequently employed, especially to urge the fire of steam boilers, and in puddling and reheating, and in the cupola furnaces where anthracite is burnt, or coke used for remelting pig-iron in foundries. In one common form the fan consists of four spokes of a rimless wheel, tipped with vanes and made to rotate in a cylindrical chest, in which it has often a slightly eccentric position. There are openings on both sides round the spindle for admission of air, which, sucked in by the centrifugal action of the fan as it quickly rotates, flows towards the vanes, and is driven through an exit pipe attached to another part of the cylinder.

There are numerous varieties of these engines. An American machine, introduced into England a few years ago by Mr Ellis, has found considerable favour. It is represented in section in fig. 5. It consists of an iron cylindrical casing A, open about a fourth part of its circumference (*a* to *b*) for admission of air, and an exit pipe B. Inside the casing is another cylinder, placed eccentrically to it, and which always fits close up against the wooden packing C. This cylinder acts as driver for the three fan blades or pistons D, which are capable of passing out and in through longitudinal slits in its circumference. There is a shaft passing through the small cylinder, and concentric with it at the ends, but cranked in the middle part so as to become concentric with the casing. The inner cylinder revolves round the axis of the ends of the shaft, and on the cranked part revolve the fan blades or pistons, driven by the cylinder. The outer extremities of the fan blades follow closely the inside face of the casing. The crank is placed opposite to the point where the inner cylinder touches the inside of the casing, always retaining, it must be remembered, the same position; when passing this point, the blades are wholly withdrawn inside the cylinder, but when passing the opposite point they are thrust out to the fullest extent, and are always working into or out of the inner cylinder as it revolves. The air is thus continually being drawn in at the upper opening, compressed, and delivered by the lower one.

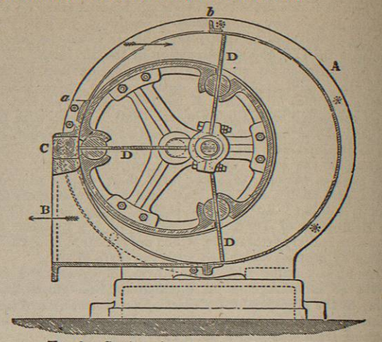


Fig. 5.—Section of an American Blowing-Machine.

The rotary blower, invented by Messrs Root of Connersville, Ind., is one which has of late years found extensive use both in America and Europe. The arrangement differs in some essential features from that of the ordinary fan; it acts by regular displacement of the air at each revolution, as shown in fig 6. A pair of horizontal shafts geared together at both ends traverse a case of the form of two semi-cylinders separated by a rectangle equal in depth to the diameter of the semi-cylinders, and in width to the distance between the centres of the shafts. These shafts carry a pair of solid arms, each having a section somewhat resembling a figure of eight; the action of which, as they revolve, takes the air in by an aperture at the bottom of the machine, and expels it with considerable pressure, if required, at the top. The gearing outside serves merely to keep the revolving pieces in their proper position, and the power is applied directly to each shaft. One of these machines, employed to give the blast in a pneumatic railway under Broadway, New York, delivers, when worked to maximum speed, a volume of 100,000 cubic feet of air per minute. The engine is also much used in the Bessemer steel-works of this country.

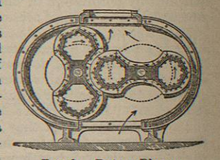


Fig. 6.—Rotary Blower.

Among the exhibits at a recent exhibition of the Franklin Institute in America, was shown a new form of blower, acting much on the same principle as the Root blower, but, according to the report of the committee, offering certain advantages over the latter. From a cross section of the chamber it appears that three drums of equal size are enclosed in it, two in a line below and one above; the upper one is provided with wings, and the two lower have wide slots along their entire length, allowing the wings to enter in the course of rotation. The function of the two lower drums is to supply alternately abutments to prevent the escape of the air. They are caused to revolve in proper relation with the motion of the upper drum by spur-wheels on the journals, which mesh into another spur-wheel on the shaft of the upper drum. In the moving parts of this machine there are no parts that come into actual contact except the teeth of the spur-wheels. The report allows the superiority of this rotary blower of Baker, *inter alia*, as regards durability, little pulsation, absence of internal friction and of the need of lubrication, suitability for blowing either hot or cold air, and less power required for the amount of air discharged. A fuller account of it will be found in the *American Artisan* for March 1875.

For the arrangement of bellows in organs see the article Organ. (A. B. M.)

BELLUNO, the ancient *Belunum*, is the capital of a province of Northern Italy, and the seat of a bishop, situated at the confluence of the Piave and the Ardo, in long. 12° 8′ 46″ E. and lat. 46° 7′ 46″ N. Besides the cathedral, which was built by Palladius, there are fifteen churches, a theological seminary, a gymnasium, a theatre, and a library. A society of arts and sciences and a chamber of commerce have their meetings in the city. Water is supplied from the neighbouring hills by a remarkable aqueduct. The principal industries are the manufacture of silk, wax, leather, and pottery; and a considerable trade is carried on in wood. Population, 15,509.

BELON, Pierre, French naturalist, was born about 1517 at the hamlet of Soulletière, in Maine. He studied medicine at Paris and took the degree of doctor. He afterwards travelled in Germany, and heard some lectures at the famous University of Wittenberg. On his return to France he was taken under the patronage of the Cardinal de Tournon, who furnished him with means for undertaking an extensive scientific journey. Belon started in 1546, travelled through Greece, Asia Minor, Egypt, Arabia, and Palestine, and returned in 1549. A full account of his travels, with illustrations, was published in 1553. It passed through several editions, and was translated into Latin and German. Belon, who was highly favoured both by Henry II. and by Charles IX., was assassinated one evening in April 1564, when coming through the Bois de Boulogne. Besides the narrative of his travels he wrote several scientific works of considerable value, particularly the *Histoire Naturelle des Estranges Poissons*, 1551, and *L'Histoire de la Nature des Oyseaux*, 1555.

BELPASSO, a town of Sicily, on the slopes of Etna, in the province of Catania, and about 8 miles from the city of that name. In 1669 it was destroyed by an eruption. The inhabitants rebuilt their town on a new site at Mezzo Campo, but, finding the locality unhealthy, they afterwards returned to their original position. Population, 7620.

BELPER, a market-town of Derbyshire, situated on the banks of the Derwent, which is here crossed by a stone bridge. It is 7 miles north of Derby, on the Midland Railway. For a considerable period one of the most flourishing towns in the country, it is principally indebted for its prosperity to the establishment of cotton-works by Messrs Strutt in 1777. It also manufactures linens, silks, hosiery, nails, and earthenwares; it has three churches, several chapels for Independents, Methodists, Baptists, &c., a mechanics' institution, and a subscription library. In the neighbourhood are the remains of a mansion where John of Gaunt used to reside. Population (1871), 8527.

BELSHAM, Thomas, a Unitarian clergyman, was born at Bedford in 1750. He was educated at the Dissenting Academy at Daventry, where for seven years he acted as assistant tutor. After three years spent in a charge at Worcester, he returned as head of the Daventry Academy, a post which he continued to hold till 1789, when, having adopted Unitarian principles, he resigned all connection with the institution. He superintended during its brief existence a new college at Hackney, and was then called to the charge of the Gravel Pit congregation, which had been formerly held by the famous Priestley. In 1805 he was appointed to the Essex Street chapel, where he remained till his death in 1829. Belsham's first work of importance, *Review of Mr Wilberforce's Treatise entitled Practical View*, 1798, was written after his conversion to Unitarianism. His most popular work was the *Evidences of Christianity*; the most important was his translation and exposition of the Epistles of St Paul. He was also the author of a work on philosophy, *Elements of the Philosophy of the Human Mind*, 1801, which is entirely based on Hartley's psychology. Belsham is one of the most vigorous and able writers on the Unitarian side.

BELSHAM, William, brother of the preceding, was born in 1752, and died in 1827. His productions were mainly historical and political writings, advocating the politics of the Whig party. Several detached historical treatises were collected together, and published in 1806 under the title, *History of Great Britain to the conclusion of the Peace of Amiens in* 1802, 12 vols.

BELSHAZZAR, the name of a Babylonian prince mentioned in the book of Daniel. According to the account in the fifth chapter of Daniel, Belshazzar was king of Babylon at the time of the capture of the city by the Medes and Persians, and was slain when the city was surprised during a festival. No ancient historian mentions the name of Belshazzar among the successors of Nebuchadnezzar, and there has been considerable controversy as to the identity of the unfortunate monarch. The successors of Nebuchadnezzar, according to the copyists of Berosus, were as follows:—Evil-merodach, two years, son of Nebuchadnezzar; Neriglissar, or Nergalsharezer, four years, son-in-law of Nebuchadnezzar; Laborosoarchod, nine months, son of Neriglissar; Nabonidus, seventeen years, not of the royal family. Niebuhr and some others identified Belshazzar with Evil-merodach; other scholars with Neriglissar; and a third section, including Ewald and Browne, identified him with Nabonidus. There is no necessity now to argue against these and similar views, as they are set aside by the Babylonian cuneiform inscriptions, which show that Bel-sar-uzur, or Belshazzar, was the name of the eldest son of Nabonidus, the last king of Babylon. In some of his latter inscriptions Nabu-nahid or Nabonidus mentions his eldest son Bel-sar-uzur in such terms as to lead to the impression that the young prince was associated with himself on the throne; and this explains several difficulties between the historians and the book of Daniel with respect to the capture of Babylon. After the defeat of the Babylonian forces Nabonidus fled to Borsippa, while the young prince Belshazzar was left in charge of Babylon, the capital, which was closely besieged by the Medes and Persians. The historians all say that Nabonidus, the last king of Babylon, submitted to the conquerors at Borsippa after the taking of his capital, while the book of Daniel states that Belshazzar was slain on the night of the capture of Babylon. These two statements have been supposed to contradict each other, but we now know that they refer to two totally distinct princes whose fates were quite different. The inscriptions of Nabonidus which mention Belshazzar are found on clay cylinders from Mugheir and other Chaldean sites, and they were first discovered and published by Sir Henry Rawlinson, to whom we owe this rectification in ancient history. One of these passages in a prayer reads: "Me Nabu-nahid, king of Babylon, from sin against thy great divinity, do thou save me, and health and long days numerous do thou multiply. And of Bel-sar-uzur,—my eldest son, the delight of my heart in the worship of thy great divinity, his heart do thou establish, and may he not consort with sinners." The other texts are after the same form, and give no new details as to Belshazzar,—the account in the fifth chapter of Daniel containing all that is known of his history. The numerous works written on this subject before the discovery of the cuneiform inscriptions are