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THE "LINOTYPE."

Twice before have we presented in these columns the evidence, in illustration and written description, of the completion of a machine that could be successfully put upon the market to supersede typesetting, as hitherto done by hand. As first described by us, nearly five years ago, the linotype was a wonderfully complicated and delicate piece of machinery, but it was even then in successful use, doing with such regularity as to be depended upon, all the composition of one of the largest daily papers in the country, and more or less of the work of a dozen others. But the linotype has, since that time, been vastly improved and greatly simplified, although it is not to be denied that it still presents a marvelously ingenious mechanism—one which the practical printer must have a fair examination and full test of before giving it his confidence. That it has "come to stay," however, may be inferred from the fact that it is now in regular use to supplement, or to entirely supersede, the work of the old-time compositor, or typesetter, in the offices of 150 of our largest daily newspapers, about 1,000 machines being thus at present employed.

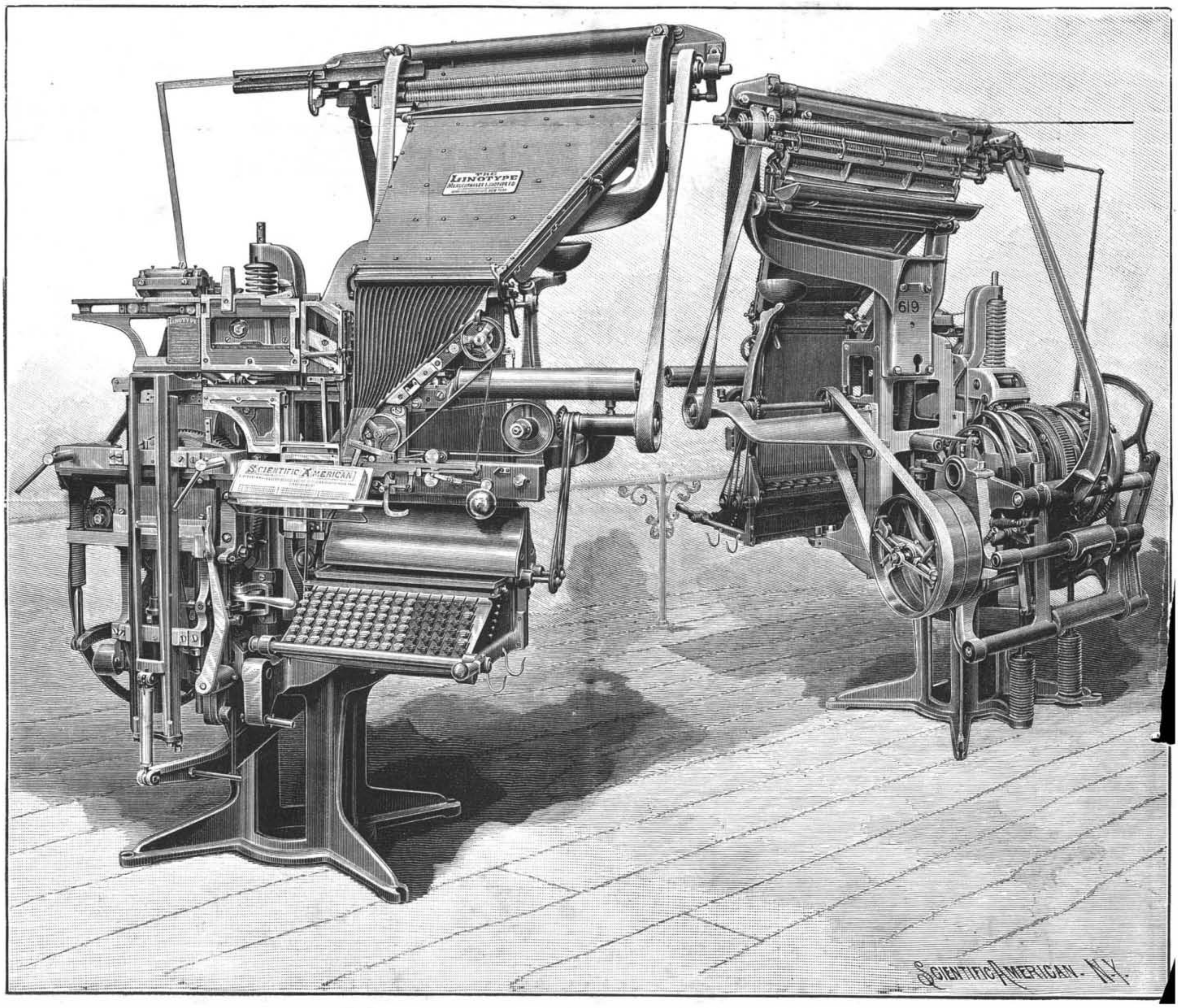
The illustration below is from photographs giving front and rear views of the machine as now built. A machine entirely similar was in daily operation at the Columbian Exposition, the "matter" thus set up for the purpose of exhibiting the machine being used in the columns of the "Daily Columbian," the official paper printed on the Fair grounds.

As will be apparent at a glance, and as suggested by the name, "linotype," the product of the machine is a casting representing a line of type, the assembling of the matrices for each letter or character in such line, and the proper placing of the spaces, being effected by touching in the proper order plainly marked keys, as in operating a typewriter, the rest of the work being automatically performed by the machine. There are in the keyboard ninety of these keys, this being the capacity of the regular machine as to the number of different types represented, in upper and lower case letters, figures, punctuation marks, etc. Each of these characters is borne upon a thin brass matrix, shown in one of the figures, the mold or matrix proper for forming the face of the letter being at "a," in one vertical edge of the piece, while in its upper end is a series of teeth, "b," by means of which the matrix is returned, after the casting is made, to the magazine.

The magazine consists of a casing supported in nearly vertical position at the top of the machine, the top and bottom plates of such casing being properly grooved to form channels in which the matrices lie loosely, on one edge, the bottom of the matrix touching the top of the one below it, so that they slide down freely when released by the key. There are two escapements at the mouth of each channel, at its lower end, connected by a rod with the key lever, their form being such as to insure very rapid operation and still prevent the release of more than one matrix on the key being touched. In leaving the mouth of the magazine the matrix drops down a vertical chute, whose front is covered by a glass door, the chutes at one side being of gradually diminishing length, so that the bottom of the chute section forms a slight incline, just below which, and at a corresponding inclination, is a fast running belt. The object of this arrangement is to increase the speed of the matrices that are not in a direct line vertically with the place of assembling, and by this means the matrices the farthest off come into position as quickly as those which are nearest, there being no transposition of the letters when the machine is worked at its highest speed.

The matrices, in the order in which the keys have been touched, are delivered to a slotted assembling block, G, where they are held loosely suspended by their shoulders, and gradually pushed along as the line is being formed, the spaces being dropped in position

(*Continued on page 24.*)

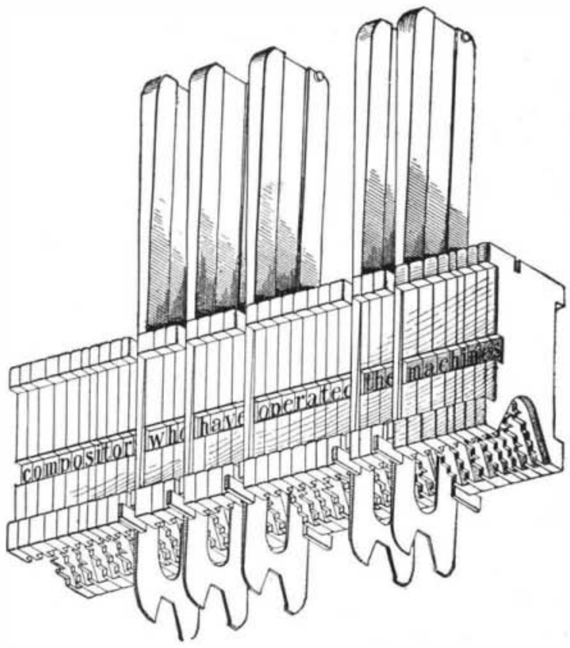


THE "LINOTYPE"—A MACHINE TO SUPERSEDE TYPESETTING.

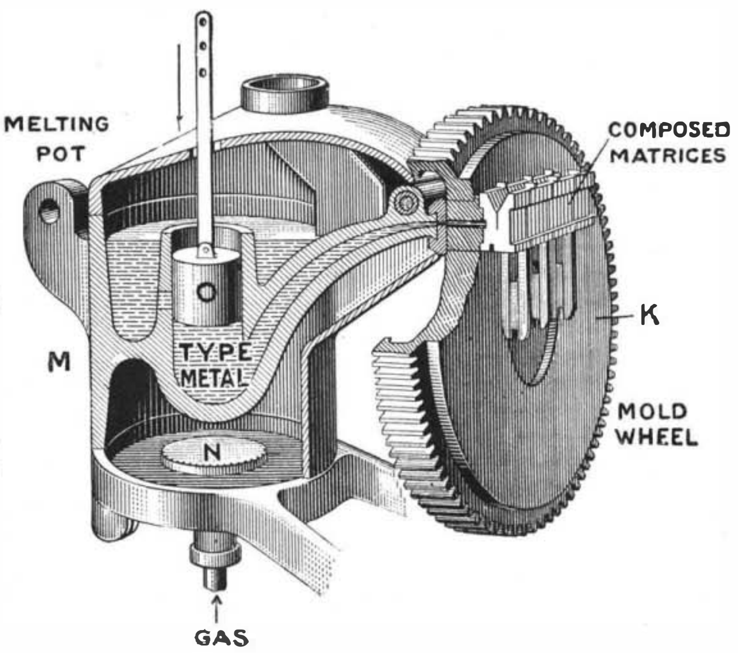
THE "LINOTYPE."

(*Continued from first page.*)

from the space box, H, by touching the space bar, J, in the same way as the type keys. As the different characters drop into place the operator can readily read and correct the matter as he proceeds, each matrix having on its back an impression corresponding with the female die it bears on the opposite edge. The spacing, however, presents one of the most interesting features of the machine. Each space bar is a composite wedge, and by sliding its top and bottom parts together its thickness is increased, while it still remains of an even thickness at the top and bottom of those portions bearing against the matrices. When, therefore, the operator sees that the line is so nearly full that it will not hold another word or part of a word, he simply presses upon a lever at his right, and the space bars do all the work of justification, all of them being simultaneously closed up sufficiently to lengthen the line to its full predetermined measure, with absolute certainty that the spacing will be entirely "even." At the same time the line of matrices is automatically engaged by clamps and transferred, as shown by the arrows, to the face of a vertical mold wheel, K, through which extends a slot, or body mold, opposite the face of which the row of characters in the matrix line is presented. The pot of type metal behind the mold wheel is kept in proper condition by a flame from a gas burner, and a channel from the pot leads to the rear face of the mold, into which the molten metal is forced by means of an automatically working plunger, when the line of matrices is presented and locked against the face of the mold. The metal is easily kept at the proper temperature by a simple device, but rarely requiring any looking after when once adjusted, and the cast body, being but a thin piece of metal, solidifies almost as soon as it touches the mold. The mold wheel then makes a partial revolution, when a blade or plunger pushes the linotype out, and between trimming knives, depositing it on a galley at the front of the machine. As this is done the knives leave shallow vertical ribs on the side of the linotypes, or slugs, and it has been found that these ribs serve a valuable purpose, giving air spaces, facilitating the drying of the papier maché stereotype molds now used by most of the large daily newspapers. A vibrating arm advances the linotypes along one after the other upon the galley, so that they thus come together in column form.



ASSEMBLED LINE OF MATRICES.



CASTING THE LINE.

After the casting of the line comes the distribution of the matrices again to the magazine, the operation being entirely automatic, and being one in which the eminent superiority of this machine is most conspicuous. For this purpose an arm lifts the line vertically, and then shifts it laterally until the teeth at the top of the matrices engage teeth on a carrier plate, R, as shown in dotted lines, this plate, with the line of matrices, being then raised to the distributor bar at the top of the magazine. The spaces remain behind when the matrices are carried up, and are transferred laterally to their box or holder. The distributor bar occupies a fixed position above the open upper ends of the magazine channels, and on its lower edge are formed longitudinal teeth or ribs adapted to engage the teeth on the tops of the matrices. But a matrix bearing any given letter differs, as to the number or arrangement of its teeth, from a matrix bearing any other letter, and the ribs of the distributor bar vary correspondingly in number and arrangement at different points in its length, the ribs being such in cross section, over each magazine channel, that they will not, at this point, hold up the particular matrix designed for such compartment. The matrices, when they are placed in suspension at one end of the bar, are pushed along it by means of longitudinal screws, each matrix remaining in engagement with the bar until it arrives over its proper magazine channel, into which it drops, ready for use again in the formation of another line. The work of distribution is thus carried on continuously, simultaneously with that of assembling the matrices. The number of pieces with which each magazine is furnished, to render it certain that there shall always be enough of each character for the line being composed,

A LINOTYPE.

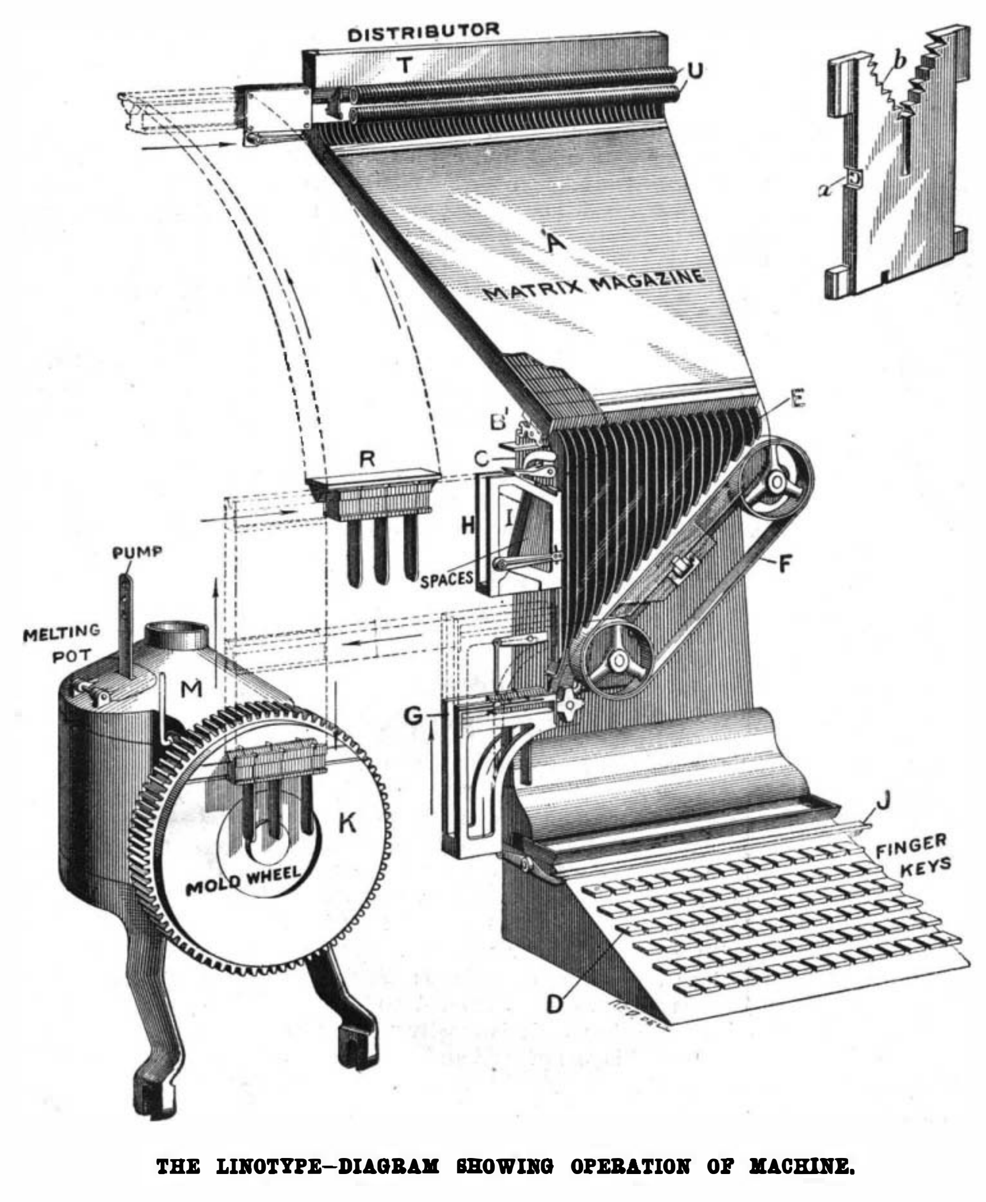
the one being cast, and the one being distributed, is fixed upon the basis of a supply of 26 matrices bearing the letter "e," all the other characters of a fount being provided in proportionate number, according to the well understood practice in the trade. There is, therefore, no such thing as being short of type, because of an excessive amount of "standing matter," in any office where the machine is employed. Any good stereotyping metal may be used in the machine, the metal being remelted and doing duty over again almost indefinitely, although it is recommended occasionally to add thereto a small quantity of bismuth. As the linotypes are used but once, the publisher is enabled to have a new dress each day, instead of being compelled to use old and dull faces as in the case of ordinary type required to do service for long periods of time. The usual heavy investment demanded in purchasing and renewing type is also wholly avoided, as is the great loss from the breakage and wear of type. The mold wheel, in the illustration, is represented as having but one mold slot, or mold proper, but these wheels are now being made with two and four slots, or molds, each representing a different size of type. The number of "faces" made for the machine includes all the regular type sizes, from agate to small pica, the magazine being complete in all particulars for each face. To change one magazine for another on the machine is the work of less than five minutes, when it is desired to change to larger or smaller type, the mold wheel being at the same time turned to a different position to bring into proper place the body mold corresponding to the face on the matrices in the magazine. One idea, however, in making the increased number of molds in the mold wheel, has been to enable the same machine, with one magazine, to produce both "solid" and "leaded" linotypes, this being effected by using a body proportionately larger than the face, as a brevier face on a long primer body, etc., such change from one to the other being then effected by simply readjusting the mold wheel.

A recent feature in the development of the machine, and its adaptation to newspaper needs, consists in the furnishing of a magazine specially adapted for the composition of display heads. This magazine has one fount of capital letters, large sized type, say a pica gothic condensed, and another of upper and lower case in comparatively small size, as nonpareil full face. With this magazine the regular "display" heading, as seen in many newspapers, may be quickly formed with linotypes.

The power required to run the machine is very small, only about one-third of a horse power, and may be supplied from any suitable source, such as a steam or gas engine or an electric motor. The cost of gas to keep the metal in proper molten condition is placed at about fifteen cents per day for each machine.

The speed at which the machine can be and is regularly and continuously operated varies considerably in different offices, according to the ability of the operators, but, taking good and bad workmen together, in many offices having each several machines, the averages by the month of the workmen equal 4,000 ems per hour for each machine, while there are some offices in which these averages, according to carefully kept records, reach as high as 5,000 and 5,500 ems per hour. Many individual compositors have made much higher records for long continued periods. The time required by beginners and the period necessary to attain the highest efficiency, varies widely, say from a month to four and six months, one who is a good compositor to start with naturally having a great advantage in quickly learning to operate the machine with facility.

The Mergenthaler Linotype Company has three factories for the manufacture of the machine and its parts, one in Brooklyn, N. Y., one in Montreal, Canada, and one in Manchester, England. The machine is, as is well known, based upon the



THE LINOTYPE—DIAGRAM SHOWING OPERATION OF MACHINE.

highly novel original patents of Mr. Ottmar Mergenthaler, though many valuable practical features, embraced in other inventions, are now embodied in it. The principal factory of the Company is in Brooklyn, and is a large fire-proof structure containing a great amount of very valuable machinery and tools, specially invented and designed to make the various parts of the machine with precision and economy. The general offices of the Company are in the Tribune building, New York, Mr. Philip T. Dodge being the President and general manager, and Mr. Frederick J. Warburton, Secretary and Treasurer. Mr. W. H. Randall is the Superintendent of the Brooklyn factory.

This article is printed from plates made from linotypes used in our forms in the same way as the types are used for the other matter.

Medicine as Practiced by the Lower Animals.*

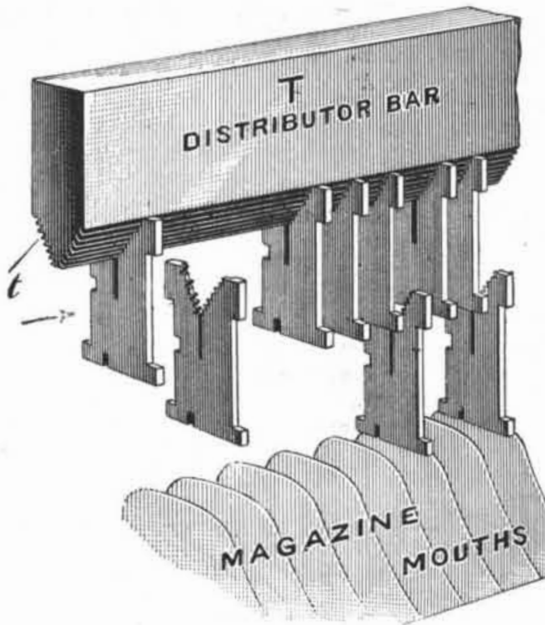
It would seem as if man were surrounded by danger, seen and unseen, throughout his entire life. From the cradle to the grave it is a struggle. In the vegetable kingdom also the same struggle for existence is seen. Every flower has its destroying insect; for every shrub there is a worm, and for the ripening watermelon the little colored boy lies in wait. But if disease threatens man on every hand, equally close at hand is the remedy with healing power, and not only do the so-called inferior human races appear to recognize this, but even dumb animals, and it would seem as if the latter, in an empirical way of course, practiced medicine.

Animals instinctively choose such food as is best suited to them, and to a certain extent the human race also shows this instinct, and medical men are sometimes at fault in not paying sufficient respect to the likes and dislikes of their patients. Women, as a rule, are more often hungry than men, and they do not like the same kinds of food; nevertheless, men and women are generally put on precisely the same regimen, especially in public institutions. Infants scarcely weaned are given a diet suitable to adults, which they dislike, and which disagrees with them. Some years ago Delaunay investigated this question in the different asylums of Paris, and ascertained that children, although they will generally eat it, do not like meat before they are about five years of age. People who like salt, vinegar, etc., may generally be allowed to satisfy their tastes, within moderation. Lorain always taught that, with regard to food, people's likings are the best guide.

A large number of animals, such as elephants, stags, birds, and ants, wash themselves and bathe. Launay lays down as a general rule that there is not a species of animals which voluntarily runs the risk of inhaling emanations arising from their own excrement. If we turn to the question of reproduction, we find that all mammals suckle their young, keep them clean, wean

OLD TIMEPIECE OF JOHN BUNYAN.

them at the proper time, and educate them—maternal instincts which are frequently wanting or rudimentary in women even of civilized nations. In fact, man may often take a lesson in hygiene from the lower animals. Animals get rid of their parasites by using dust, mud, clay, etc. Those suffering from fever restrict their diet, keep quiet, seek darkness and airy places, drink water and sometimes even plunge into it. When a dog has lost its appetite, it eats that species of grass known as dog's grass (*chiendent*), which acts as an emetic and purgative. Cats also eat grass. Sheep and cows, when ill, seek out certain herbs. When dogs are constipated they eat fatty substances, such as oil and butter, with avidity. The same instinct is observed among horses. An animal suffering from chronic rheumatism always keeps as far as possible in the sun. The warrior ants have regularly organized ambulances. Latreille cut the antennæ of an ant, and other ants came and covered the wounded part with a transparent fluid secreted from their mouth. If a chimpanzee be wounded, it stops the bleeding by placing its hand on the wound or dressing it with leaves and grass. When an animal has a wounded leg or arm hanging on, it completes the amputation by means of its teeth. A dog on being stung in the muzzle by a viper was observed to plunge its head repeatedly for several days into running water. The animal eventually recovered. A sporting dog was run over by a carriage. During three weeks in winter it remained lying in a brook, where its food was taken to it; the animal recovered. A terrier dog hurt its right eye; it remained lying under a counter, avoiding light and heat, although habitually it kept close to the fire. It adopted a general treatment, rest and low diet. The local treatment consisted in licking the upper surface of the paw, which it applied to the wound-



THE LINOTYPE—DISTRIBUTION.

ed eye, again licking the paw when it became dry. Cats also, when hurt, treat themselves by this simple method of applying continuous irrigation.

* By Dr. R. E. Anderson, Rockville, Maryland, in the *Mass. Medical Journal.*

Four Different Lights from Molecular Vibration.

Mr. Nikola Tesla has demonstrated that the phenomenon of light is producible in four different ways by the action of high frequency electricity upon suitable media. One of these methods is the incandescence of a solid, consisting of a small carbon button mounted upon a platinum wire in an exhausted bulb. When Mr. Tesla connected his body with one of the terminals of a high-tension transformer, and took an arrangement of this kind in his hand, the button became luminous. Next he took a highly exhausted bulb, containing a strongly phosphorescent body, above which was mounted a small plate of aluminum on a platinum wire leading to the outside; and the currents flowing through his body excited intense phosphorescence in the bulb. Thirdly he took in his hand a simple exhausted tube, and in the same manner the gas inside the tube was rendered highly incandescent or phosphorescent. Finally, he took in his hand a metallic wire, which appeared covered with a luminous film through the intensity of the electrical vibration. Mr. Tesla is now engaged upon the problem of producing these effects with less expenditure of energy than was employed in the operation as first arranged by him. Either method of converting molecular bombardment into light without heat, provided that it could be done economically, would be a considerable step forward in the direction where "the light of the future" is supposed to await its fortunate discoverer.

HISTORIC EXHIBIT OF THE WALTHAM WATCH COMPANY AT THE WORLD'S COLUMBIAN EXPOSITION, AT CHICAGO.

The Waltham Watch Company displayed over six hundred historical and antique watches at the World's Columbian Exposition, illustrating the various types

SIR ISAAC NEWTON'S WATCH.

of watches and movements extending over a period from 1610 to the present time. Many makers famous in the development of the watch were represented in the collection.

The most primitive timepiece was the sun dial. This is of solid silver and was made by Le Maire, of Paris, before the year 1700. The workmanship is very perfect, and the dial is elaborately engraved and in good condition to-day. On the base is a small compass, and on the face and elsewhere are the names of Paris, Rouen, Marseilles and other cities, with the declination of each. The arm is marked with the declinations, so that the proper angle for the dial face to rest against this arm can readily be made. The instrument is so made that it can be folded up and carried in the pocket. It was brought to this country by a Frenchman who went to Oregon to live. On his decease, among his effects was this sun dial. Recently it came into the possession of Mr. H. E. Duncan, of the Waltham Watch Company.

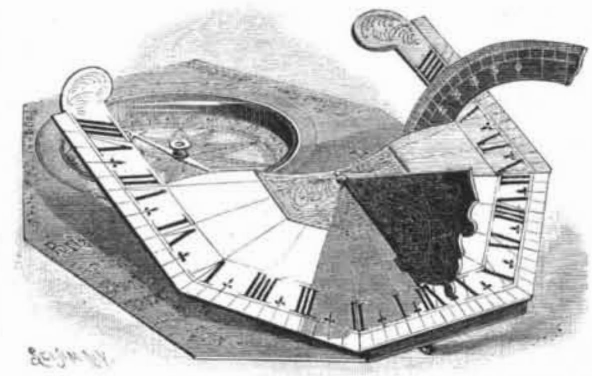
The skull watch is a grewsome timepiece, made at a time when the skill of the watchmaker was exerted more to make a striking-looking case than an accurate time-keeping watch. This case is of silver, oxidized by age. In order to tell the time, the lower jaw of the skull is dropped to expose the dial. The movement which occupied the skull cavity is lost. The dial contains Roman numerals and is delicately engraved. This watch was made soon after the year 1600, but its maker is unknown. The feature of the engraving on the dial is a picture of the day of judgment.

The watch used by the poet Milton is shown in one of the engravings. This is an instance of a case within a case, the watch proper being inclosed in an outer case. This is what is called the Nuremberg or egg-shaped watch. The watch proper is readily removed from the outside case, which is made of silver. A raised point is placed against each hour on the dial, and this, together with a heavy hand, made it easy for the poet to tell the time approximately by the sense of touch. On the back of the inner case is the name of John Milton. The movement has no hairspring, but has the fusee with string, which in this case is a piece of catgut. The movement bears striking evidence of a high quality of workmanship upon the part of its maker, Bouguet, of London. The watch was made about the year 1600.

John Bunyan's watch was made some years later than Milton's watch, and bears the name of Fitter, London. This watch has a second hand placed on the back of the movement, instead of on the dial. The dial is of silver and the entire watch is inclosed in a leather case ornamented with silver. On the back of the watch the following calendar is engraved:

Mar.	Nov.	1	8	15	22	29
Augus.		2	9	16	23	30
May	Jan.	3	10	17	24	31
Octob.		4	11	18	25	
Apr.	Jul.	5	12	19	26	
Sep.	Dec.	6	13	20	27	
Jun.	Feb.	7	14	21	28	

The watch is very elaborately engraved. The movement is of the same style as the Milton watch, but is more elaborate in its workmanship.



ANCIENT POCKET SUN DIAL.

It was evident that only the latest achievements of the watchmaker's art would satisfy Sir Isaac Newton, for his watch, which is shown on this page, is an elaborate mechanism. It was made by Girod, of Paris, in the seventeenth century, and is an astronomical watch inclosed in a shell enameled case. On the face are three dials. One is an hour dial, underneath one section of which is a little disk which tells whether it is day or night, the day being designated by the sun and rays of light and the night by the stars and moon. The dial is ⅝ of an inch in diameter. The calendar dial has thirty-one gradations, one for each day in the month, and near by is a little aperture in which the name of the month is shown, with the number of days in the month. As the watch lay in the showcase, but not running, this little recorder indicated "Aug. 31." The third dial represents the lunar month and is graduated for 29½ days. A little aperture near this dial shows the changes in the moon. The entire face of the watch is gold, while the dials are silver. The case is also of silver. The outer case is of enamel and shell, the pieces of shell being riveted by silver rivets