cylinder or one-sided machine, which has been recently brought to the highest state of perfection by Mr Samuel Bremner. It is generally used for commercial and fine book-work on one side of the paper. There are different varieties of cylinder machines, distinguished by trade-marks or the names of their makers ; but the general principles, apart from details, are practically identical. There is a strong cast-iron frame, with bearings to carry the cylinder, which runs across the machine transversely, nearly in the centre. The cylinder revolves by gearing connected with a main shaft, which also works the other moving parts. This shaft is turned by a wheel for hand or steam power.

The table

for carrying the type is also provided with a flat inking board of wood or iron, used for distributing the ink. It travels backwards and forwards, that is, with a reciprocating motion. At one end of the machine is the *feeding-board,* on which the pile of paper to be printed is placed. The layer-on places each sheet against metal marks, con­sisting of rectangular pieces of steel or brass mounted on a bar under­neath, which rises and falls according as the sheet is being laid to and taken away from them. When placed against these marks, en­suring correct “lay,” the sheet is seized by grippers or light metal claws fixed on a bar inside the cylinder. These clutch the sheet and carry it forward round the cylinder, which in its revolution brings it forcibly in contact with the type forme moving forward underneath, when the impression is effected. Immediately after the grippers release their hold, and the sheets are removed singly by an attendant called a *taker-off,* or by a mechanical automatic arrangement called a *flyer,* and deposited on the taking-off board. At the end of the machine farthest from the laying-on board is fixed a trough, which contains the ink ; it is fitted with the *dud roller* of cast-iron, which revolves by means of a band or ratchet- wheel and pawl. A flat bar or knife with a thin edge is set up against the metal roller lengthways by adjusting screws, which regulate the passage of the ink, and permit a thin film to pass the knife. A composition roller, called a *vibrator,* is fixed underneath, which takes off the ink that has already been deposited on the duct roller and leaves a ridge or strip of it on the inking slab. As the carriage returns, this strip of ink is distributed on the inking table by rollers placed diagonally across the machine. The diagonal position gives them a waving motion ; hence they are called *wavers.* The inking of the forme is done by another set of rollers called *inkers,* placed near the impression cylinder. The inking rollers receive their ink from what is distributed on the table and coat the type while it is passing underneath them.

Thus the nine operations of the hand-press requisite to print one impression are greatly reduced. The bed carrying the type to and fro from the point of impression moves mechanically, superseding the running in and out of the carriage by the rounce and handle of the hand-press. The inking table, although independent, forms part of the type table, and some of the rollers distribute and others ink, this again being done mechanically and without a second operator. The platen and the tympan, as well as the levers by which the impression is given, are in effect combined in the cylinder, which rotates by gearing, the pressure being applied during the motion of the table itself. The laying-on of the sheet upon the tympan and folding it down on the forme are superseded by the presentation of the paper to the grippers ; and the taking-off of the sheet after raising the tympan is superseded by removing it when released by the grippers and laying it on the adjacent table,— both immeasurably easier operations and done much more rapidly. Indeed both laying-on and taking-off may be done automatically, as is explained below. The result is that, while two men are re­quired to print a sheet of book-work on one side of the paper at the speed of 250 an hour at the hand-press, ma­chines of this class worked by one operator print about 1200 per hour. Even

this com­parison does not convey a com­plete idea of the enormously in­creased productive­ness of the cylin­der machine over that of the press. By the latter, the largest sheet prac­tically that could be printed was double demy, 23 × 35 inches, the superficies of which is 8 ∙5 square inches ; single-cylinder machines are now made to print eight sheet double crown, the superficies of which is 4800 square inches. These sheets being afterwar<ls cut up into double crown sheets, the pro­ductiveness of the machine to the press would be, per hour, about 8000 to 250.

As already mentioned, a self-acting feeding apparatus has been invented for supplying single sheets to cylinder machines. The pile of paper is laid on a feeding board or table, between gauges. A pneumatic tube takes up one sheet at a time ; it is then run down tapes to a point at which india-rubber fingers bring it to the side lay of the machine, and it is printed with perfect accuracy of register. Once started, the machine works automatically, and the services of both layer-on and taker-off are dispensed with.

We may now describe that class of machines by which the paper is printed on both sides, or perfected, during one passage through the machine. The Applegath and Cowper or ordinary machine has two impression cylinders, having a continuous rotary motion towards each other. The frame is necessarily long, usually about 15 feet, and the width of the machine about 5 feet, these dimensions depending upon the size of the sheet to be printed. The table or carriage is double, containing two beds for the two formes of type, to impress the two sides of the paper, and two distributing tables for the ink. At each end is a complete roller apparatus, consisting of duct, duct roller, vibrator, and wavers. Close to the large cylinders on each side are the inking rollers. The table has a reciprocating motion, as in a single-cylinder machine. The dis­tinctive feature is the ingenious manner in which the sheets are printed first on one side and then on the other. This is effected by carrying them over cylinders and drums by means of tapes. The pile of sheets stands on a high table placed at one end. The sheet is fed into the apparatus and led round an entry drain ; thence it is carried round the large right-hand impressing cylinder, and underneath this, on the table, which is moving at the same speed as the cylinder, is the inner forme properly inked. The paper thus receives an impression on one side. It is next led up to the right-hand drum, which it passes over, the printed side of the sheet being then downwards. Continuing, it is brought under the second or left-hand drum and on to the left-hand impression cylinder, which it passes with the printed side still downwards, or next to the cylinder, exposing the other side to the type of the outer forme on the table underneath. The drams have thus re­versed the position of the paper : the side which was outside when passing the first forme is inside when passing the second forme, which accordingly prints the sheet on the opposite or blank side. The sheet is finally run out by the tapes and delivered in the space between the large cylinders, seized by a taking-off boy, and deposited