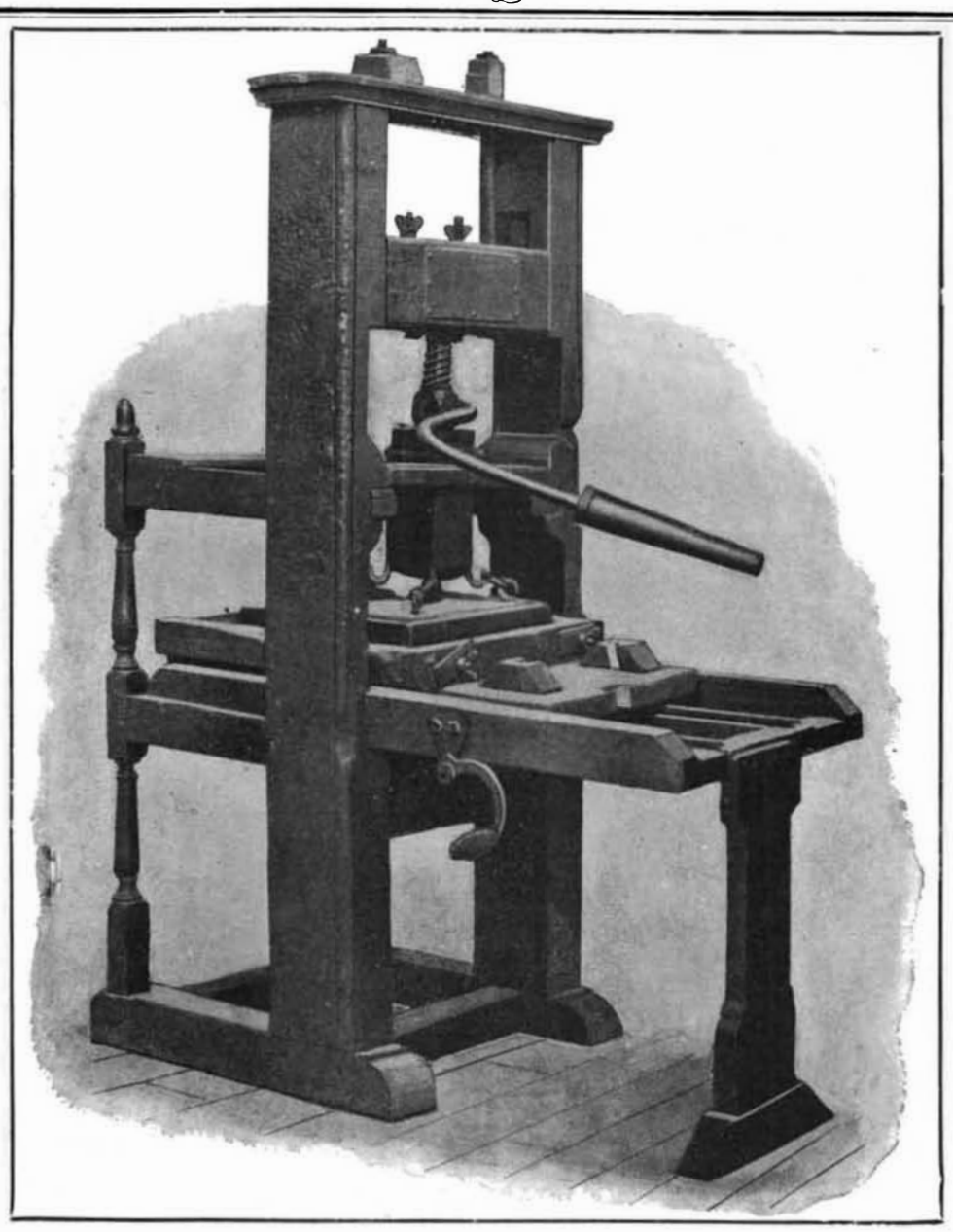
meet the present requirements, would call for the mounting of about 1,500 modern guns and mortars of from 8 inch to 16 inch caliber, and 360 rapid fire guns. At the present writing New York, San Francisco and Boston have between them some 50 to 60 modern guns and mortars mounted in place; and including the sum voted at the close of the Congress of 1895-96, about 20 per cent of the necessary sum has been appropriated. The accompanying diagram of a modern United States 8 inch rifle may be taken as typical of the guns which will be mounted in the proposed system of coast defense. It is an all-steel, built-up hooped gun, with a breech-loading mechanism of special pattern, and great facility of manipulation. This comparative diagram, together with the comparative table of the 8 inch guns of the Mississippi and the Massachusetts, show the growth in size and power during fifty years. It is only during the past few years that the manufacture of modern armor has been undertaken in the United States, yet we have easily moved to the front place by the introduction of the Harvey system of face-hardened armor, by means of which the resisting power of a plate is increased some 50 per cent. Already our makers are filling important orders for European navies, and the English Admiralty have adopted a modified form of the system in preference to any other for all ships now building and planned.



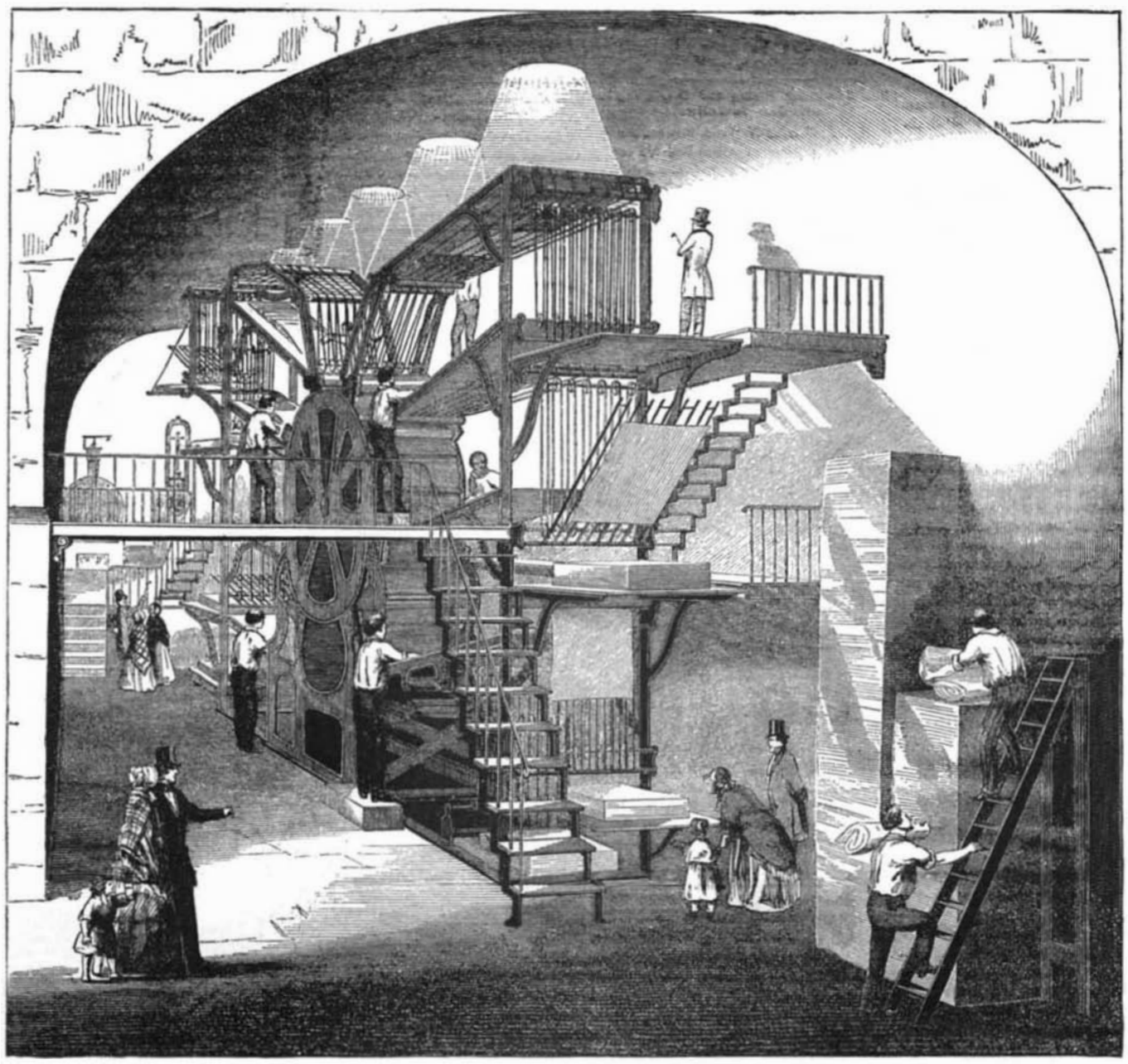
THE FRANKLIN HAND PRESS IN THE NATIONAL MUSEUM WASHINGTON.

FIFTY YEARS IN THE PRINTING BUSINESS.

The far more general dissemination of intelligence, the rapid and efficient means of intercommunication between all parts of the world, with the cheapening and broadening of all educational facilities, constitute, perhaps, the most notable feature of the progress of the world during the past half century, and the one most vitally contributing to the success of all our great industries—the perfection and introduction of most of the world's great inventions. The printing press has been the great disseminator of knowledge, the cheap educator of the people. As a promoter of its efficiency the electric telegraph has performed most splendid service, finding therein its earliest efficient support, and an array of inventors have found a profitable field in the numerous devices which contribute to the perfection of the printing press of to-day or add to its ability to most promptly and cheaply serve the largest number of readers. In the development of the printing art in the United States the name of Franklin will ever be memorable, so that it is most fitting that we should illustrate Franklin's own press before reviewing the great inventions which contributed so largely to the dissemination of cheap literature and which more properly belong to the epoch we are considering.

The press shown in the engraving is what is known as a Ramage press, and it was used by Benjamin Franklin in London in 1725. The press is constructed almost entirely out of wood, though iron was subsequently used in many of the parts. On the clumsy frame the great statesman has left the marks of his inky fingers. It is now in the National Museum, at Washington. In the early part of the present century Earl Stanhope invented a press made entirely of iron, the frame being cast in a single piece. The power was applied by a combination toggle joint and lever. The Columbian press was invented by a Philadelphian in 1817. The power was applied by a compound lever. In 1829 the Washington press of Samuel Rust was introduced, and many improvements were introduced in inking, and later a self-inking device was invented. The first power press produced in America was that of Daniel Treadwell, of Boston, in 1822. The Adams press was invented in 1830, and has superseded all other platen presses, the impression being given by raising the bed upon which the form rests against a stationary platen. The first attempt to make a rotary press was that of Friedrich König, in 1814. In this the type moved horizontally, and it could give 1,800 impressions per hour.

The first great step toward facilitating the rapid and cheap production of the modern newspaper was made by Col. Robert Hoe, of New York, about 1840, when the first of the type-revolving presses was built. At about the same time a type-revolving press on materially different lines, the Applegath machine, was brought into practical use in England. This machine was first employed by the London Times in 1848. In the Applegath machine the typeholding cylinder revolved on vertical axes, and the machine could print about 12,000 single sheets on one side in an hour. In the Hoe machine the type cylinder revolved on a horizontal axis. This arrangement for feeding the sheets was more simple, and the capacity of the press varied according to the number of impression cylinders arranged around the type cylinder, these presses being successively made with four, six, eight, and ten impression cylinders, respectively. A four-cylinder press of this kind was built for the Philadelphia Ledger in 1845. The first eight-cylinder press was built for the New York Sun in 1850, and the first ten-cylinder press for the New York Herald in 1857. Our engraving shows the eight-cylinder Hoe press of 1850 as furnished to the New York Sun office. The average capacity of the presses was 2,000 single sheets per hour per cylinder, or 20,000 sheets per hour, on one side, on the largest press, the ten-cylinder. These presses were 37 feet long, 18 feet high, and 21 feet wide, and were



EIGHT CYLINDER HOE PRESS OF 1850 USED IN PRINTING THE NEW YORK SUN
Capacity, 20,000 per hour. Reproduced from an early print in the SCIENTIFIC AMERICAN.

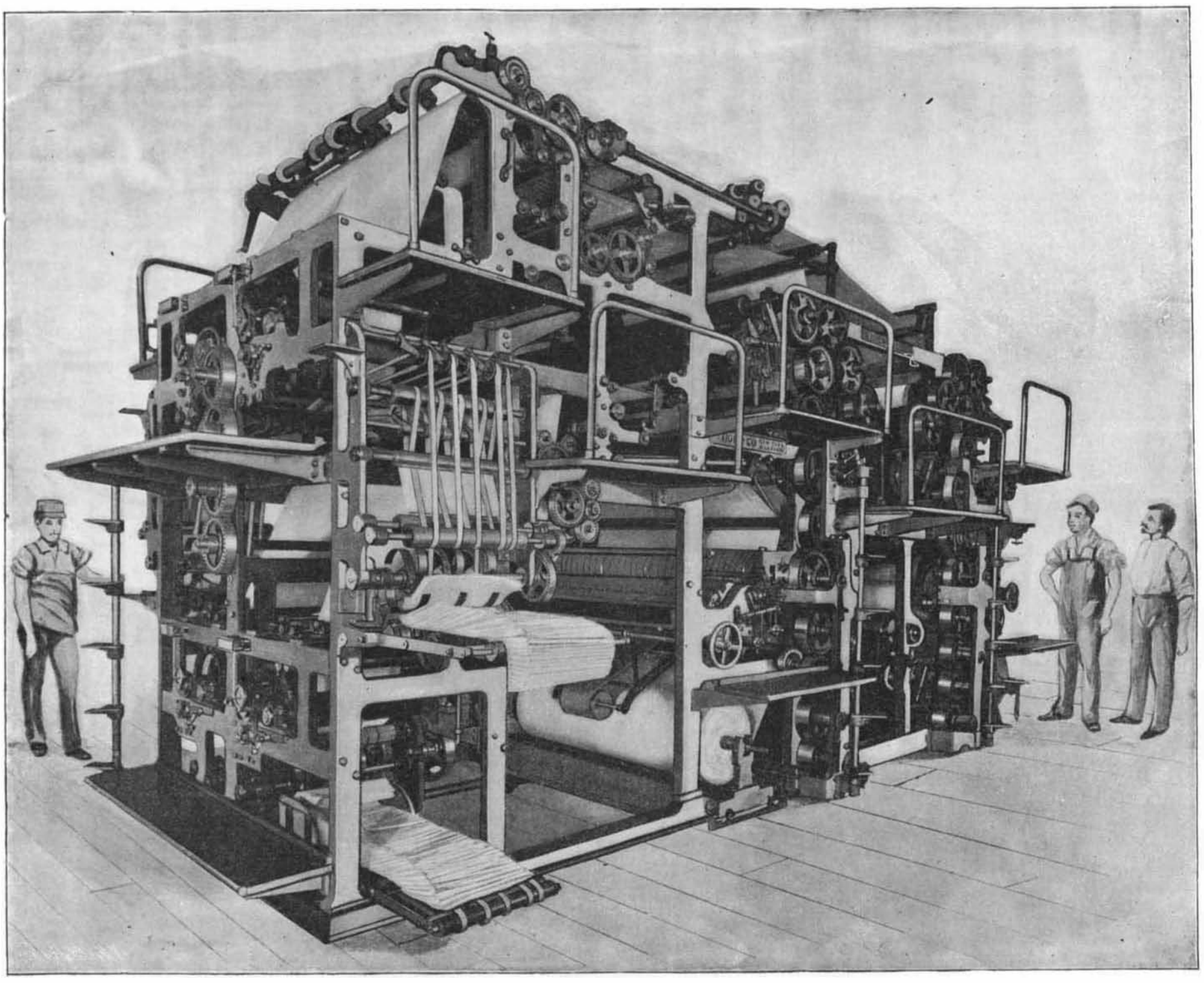
beautiful pieces of mechanism to look at in full operation, as all their working parts could be seen to advantage, the ten feeders, five on each side, supplying the sheets, which traveled on tapes to and around an impression cylinder, the latter pressing the paper against the inked type, which was held on the large central revolving cylinder. Between each two impression cylinders the type passed under inking rollers, and the paper printed upon was passed back by tapes to delivery boards, each revolution of the main cylinder of the ten-cylinder press thus printing ten separate sheets of paper.

The great advance thus effected upon all previous means of fast newspaper printing was deemed one of the highest triumphs of mechanical genius during the decade from 1850 to 1860, but this success was entirely along the lines established by the presses at work in 1845. Still faster work was, however, imperatively demanded, to meet the enormous increase in the public demand for newspapers, which publishers were enabled more easily to furnish at reduced prices, when the substitution of wood pulp for rags had greatly lessened the cost of paper. But it is of primary importance to note, in connection with the next great advance in fast printing, that all promptly issued editions of newspapers, prior to 1860, were printed from the type forms direct. To make stereotype plates with sufficient expedition for the requirements of newspaper work had not, before that time, been considered practicable, but this difficulty was removed in 1861 by the employment of a steam bed to dry a novel style of papier mache matrix, or mould, which could be conveniently used for making stereotype reproductions of the type pages, in the form of plates to fit around cylinders. At first it required half an hour to make a single plate, but now a plate is made in about seven minutes, and half a dozen duplicates of the same plate can be made in fifteen minutes. This made possible the modern "perfecting" press, so called because both sides of the paper are printed in passing through the press. In its largest size, the octuple machine, of which but one has yet been placed in operation, this press prints, folds, and counts 96,000 complete eight-page papers per hour, or 48,000 sixteen-page papers, the size of the page being that of the ordinary daily newspaper. The press has eight plate or impression cylinders, there being eight stereotype plates or pages on each cylinder, and the paper of double width is fed from four independent rolls, 73 inches wide, one side being printed upon as the paper passes over the set of stereotype pages on one cylinder and the other side being printed upon as it passes over the plates of another cylinder. The paper rushes through the cylinders at a speed of thirty-two and one-half miles an hour, the several sheets being separated and folded, and passed out of the press with accuracy and precision. The entire work is automatically performed, after the press is once started, but it requires the active labor of ten men and boys to operate it and to remove the folded sheets as fast as they are printed.

We illustrate one of these presses, which is now in operation in the printing room of the New York World. The two others will also be placed in position as soon as completed. The presses are 14 feet high and 25 feet long. The machine delivers the papers counted out in bundles of twenty-five. When all three presses are installed, they will be able to print each hour 748,000 eight-page sheets, or an equivalent of an output of over 42 tons of printed matter per hour.

Besides, however, the improvements which have been made to facilitate the printing of the daily newspaper, there has been equally marked progress during the past fifty years in bettering the appliances for the printing of books, magazines, and illustrated newspapers. In 1837, Messrs. Harper & Brother, the great New York publishers, had in use thirty-seven hand presses and but one machine press, and between 1840 and 1855 two kinds of presses had almost the exclusive sale in the American market, the Adams and the Hoe. The Adams press was, until a much later period, considered the most excellent of all presses for book work. It had a flat bed and platen, the impression was even and the distribution of the ink most perfect, but its speed was only about 1,000 impressions an hour. There are now less than ten manufacturers of printing presses in the United States, making the presses commonly used in book and job printing offices, and for newspapers having but a limited circulation. In these presses the type forms are placed on a flat bed which reciprocates under a cylinder around which the paper is carried to receive its impression, this style of press allowing for the most even inking of the forms as they pass under horizontally arranged rollers. Among presses of this description which were early in the field, and have attained a wide use, have been, besides the presses made by R. Hoe & Company, the A. B. Taylor, the Campbell, the Cottrell, the Potter and the Babcock. An objection to the use of these presses for book work was at first found in the fact that the stereotype plates were liable to be broken by the great pressure brought to bear upon them by the impression cylinder, but this objection was overcome by the introduction, about 1850, of electrotyping, whereby much better and stronger plates could be made.

In noting the great size of the newspaper of the present day, the large amount of reading matter daily presented, one other agency has also had a most important influence, namely, the typesetting machine. It is probable that in no other line of effort have so many inventors labored as in that of making an efficient typesetting machine, and so far has success been attained that in most of the large newspaper offices of the country typesetting machines are now employed. Among such machines may be mentioned the Alden, the Thorne, the Paige, the McMillan, the Rogers, and the Mergenthaler. The latter sets and casts type lines, and was fully illustrated and described in the SCIENTIFIC AMERICAN of January 13, 1894.



THE HOE OCTUPLE PRESS OF THE NEW YORK WORLD.

Capacity, 96,000 per hour, or 1,600 every minute. The paper travels through the press at the rate of 32½ miles an hour. The paper is printed, pasted, cut, folded, and counted automatically.