AMERICAN INDUSTRIES.—No. 36.

THE MANUFACTURE OF POWER PRINTING PRESSES.—A PRINTING PRESS MANUFACTORY—COTTRELL & BABCOCK.

Probably no single feature of our Centennial Exposition, in 1876, occasioned greater surprise to foreign visitors, as well as many of our own people, than the department in which were exhibited copies of over 8,000 different American newspapers. It was a collection which showed, in a way that mere figures could never bring home to the mind, how emphatically we are a reading people. In the first page illustrations of this issue we have sketched the making of the machinery with which many of these newspapers are printed, in a factory, where, also, are constructed machines for the finest letter-press work; in fact, the printing done on these presses includes every variety of what printers know as good work, either in colors or plain black, and from them have been issued some of the most beautiful specimens of the typographic art. The business is one in which American mechanics and artisans have long occupied a leading position, and the establishment we here represent has attained a deservedly high place therein.

It is not our purpose to show by what successive steps, and from what rude original contrivances, the printing press has been brought to its present state of efficiency. Volumes might be written upon this subject. Nor will the mammoth "lightning" presses required by our leading daily newspaper establishments be here considered. Each advance that has been made in the construction of such printing machinery, where fine workmanship was not so much an object as a high rate of speed, has been heralded in the columns of every newspaper in the land. But these large presses, marvels of skill and ingenuity as they are, form only a very small proportion of the number of printing machines which are operated in every city and every large town in the land. For all books, for every description of work in which engravings are used, for printing in colors, and for miscellaneous service, as well as for a great majority of the newspapers of the country, presses are required which, while doing many times as much as could be accomplished by the old hand process, will do a far better class of work than can be obtained where speed is the principal object sought. The SCIENTIFIC AMERICAN, for instance, could not be printed on what are known as the "lightning" presses without utterly destroying its clear and beautiful impression and ruining the work of the artists and engravers who make its illustrations, for the proper presentation of a fine wood engraving not only requires a great deal of time in "making ready," so that each detail of the picture may receive just the right shading and emphasis, but the printing must be done on machines of the greatest exactness, in which each part can be kept to its work with the utmost precision.

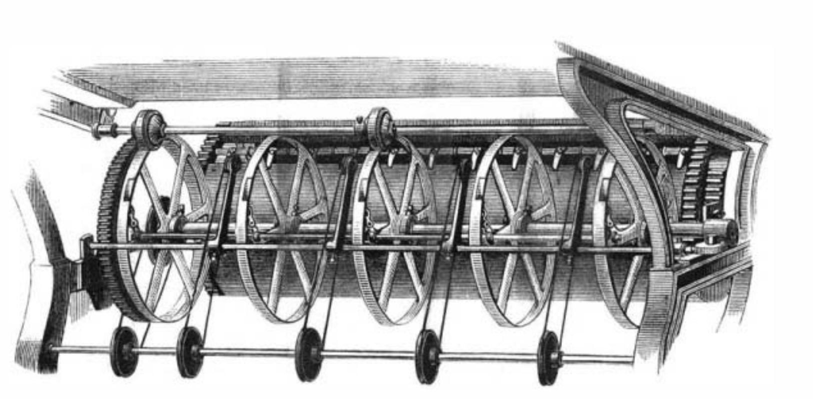

Fig. 1.—COTTRELL'S PATENT SHEET DELIVERY AS APPLIED TO THE COTTRELL & BABCOCK POWER PRESSES.

In nearly all of this class of printing the types or electrotype plates are secured on a flat bed, which is made to move forward and back under a revolving cylinder, which carries the paper and gives the impression, and with which are connected the rollers for inking. The Adams press, which for many years held the leading position as a machine for book work, differs radically from this plan, and gives the impression with a flat platen, as in a hand press, instead of by a cylinder, the press being very heavy, and working at a comparatively slow rate of speed. Excellent printing can be done on the Adams machine, but it is now fast being superseded by the cylinder presses, and very few new Adams presses are at present being made. It will be readily seen that in running a heavy iron bed plate, of sufficient size to hold the type or the plates of a large newspaper or book form, backward and forward over a track eight to twelve feet long, to make it run even and true to a hair, without any jar, in perfect connection with the large revolving cylinder above it, and so that the heavy impression shall be given each time with entire accuracy and evenness over the whole surface, and to do this work as rapidly as required, with perfect facilities for the even distribution and supply of ink, and the delivery of the printed sheets free from smut or blemish, not only calls for the best of mechanical workmanship, but involves a multitude of details which afford a wide field for the display of practical ingenuity. These are the main points in the working of nearly all power printing presses, but it is only within a few years that they have been so improved as to do their work as well as at present, with so great speed and so little trouble in arranging for each successive form.

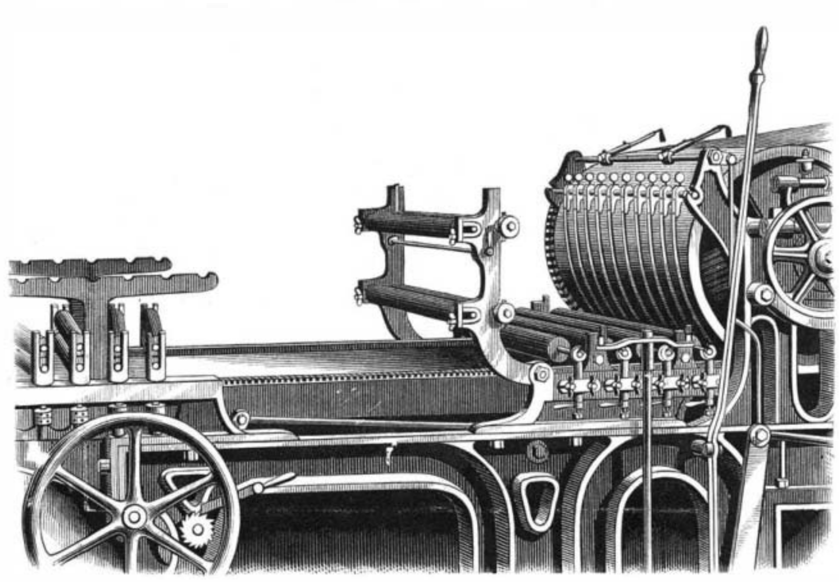

Fig. 2.—COTTRELL'S PATENT HINGED ROLLER FRAME, AS APPLIED TO THE COTTRELL & BABCOCK POWER PRESSES.

For the attainment of these ends, the invention by Mr. Cottrell of his device for controlling the momentum of the cylinder was of great practical utility. Previous to its introduction, the impression cylinder, always turning one way, would at times drive the bed with which it is geared, and again be driven by it, its reversed motion at each end of the track making its speed uneven, and thus destroying that exact working which is a prime necessity for the impression cylinder. To remedy this evil Mr. Cottrell introduced an automatic device for checking the momentum of the cylinder as the bed is retarded, thus keeping the gears up to the work side of the teeth, and harmonizing the motion of the cylinder with the irregular speed of the bed. With this patented friction motion improvement a higher rate of speed is attainable, and a more perfect "register," as printers style the printing of the matter each time exactly where it is meant to go on the paper, and generally making the reading on one page exactly in a true line with that printed on its back.

Of yet greater importance, however, to the smooth working of the press, without jar or an excessive amount of wear and tear, was Mr. Cottrell's patent air spring for stopping and reversing the bed. This has been heretofore described, with illustrations, in the SCIENTIFIC AMERICAN, at the time the patent therefor was issued, and its practical success on presses to which it has since been fitted has fully justified all the estimates as to its value which its inventor then put upon it. All the other movements in a press, except that of the bed, are rotary, but for high rates of speed powerful springs are necessary at each end of the track on which the bed travels, to check and reverse its motion. Mr. Cottrell has made perfect air springs for this purpose, so that a plunger, with an ingeniously fitted and adjustable packing, shall work into an air cylinder; the latter is provided with an automatically working vent at its head, which destroys the vacuum at such point on the return motion as will prevent any suction on the withdrawal of the plunger, and, the exact amount of momentum it will require to compress a given amount of air to a certain density being easily demonstrable, it is thus a simple matter to adjust the air spring as may be required for a light or heavy form on the bed, or for a greater or less rate of speed. The weight of the bed, however, is so much greater proportionately than that of any type form, that a scale showing pressures to which the gauges for the air spring should be set for different rates of speed has been made, and is now fixed on a plate on each machine.

For instance, the plate on a four roller, two revolution press, with a bed 35 by 52 inches, reads:

Set plungers so gauges shall indicate—

For 800	impressions an hour,	15	lb.	square inch.			
" 1,000	"	"	"	20	"	"	"
" 1,200	"	"	"	30	"	"	"
" 1,400	"	"	"	40	"	"	"
" 1,600	"	"	"	45	"	"	"
" 1,800	"	"	"	50	"	"	"

From 2,500 to 3,000 lb. resistance is necessary to overcome the momentum of the bed of such a press, working at a speed of 1,600 impressions per hour, and in no other way it is believed has it been found possible to so adjust the resisting force to the needs of the work so advantageously as is effected in this device. In connection with this air spring, also, Mr. Cottrell has obtained another patent for a "governor attachment," whereby, when the press is started, the spring is automatically put on as the speed progresses, or taken off when it is diminished, or when stopped the bed will come gently to rest. To any printer who has been accustomed to the working of presses with the old style springs, the ease and readiness with which the motion of the bed is controlled, with the aid of these two inventions, no matter what the rate of speed, or how variable it is, seems at first quite marvelous.

Another valuable invention of Mr. Cottrell was his patented device for an improved sheet delivery, as shown in Fig. 1. Previously the delivery of sheets, after the impression had been taken, was effected by a complicated arrangement of wheels and tapes, which had to be readjusted for each new form, and any carelessness in which was likely to cause the ruin of the edges of the types or engravings of the form. By this device the tapes are dispensed with, much time is saved in "making ready," and the sheets are delivered free from smut.

The "Hinged Roller Frame," which is also a patented device of Mr. Cottrell, is shown in Fig. 2, A representing the frame for the distributing rollers, as turned back for convenience in handling or adjusting the form rollers, B. When the press is working these distributing rollers are turned down upon and revolve and vibrate in connection with the form rollers, but they may be swung clear by a single movement, and removed without unscrewing the boxes, or will be again locked in place by the downward movement of the frame. The invention covers one of those important details in which pressmen often lose a good deal of time, which by this device may be saved.

In the engravings on our first page the picture at the top represents the department in Cottrell & Babcock's factory where the large or "drum" cylinder presses are put together, and where much of the detail in finishing the several parts as they come from the foundry is attended to. These presses with large cylinders do not work as fast as those with smaller cylinders, but, with the improvements which have been introduced, they are capable of doing a great variety and most excellent quality of work while being run at a speed which was not formerly attainable.

In the view given in the middle of our large engraving at the left hand side is shown the room for the construction of what are known as "country" presses. These machines are designed as far as possible to meet the wants of printing offices in places where the business is not yet fully developed, and where a few hundred dollars in the price of a machine is one of the leading considerations. There is a great demand for such presses, for in every small town throughout the country which has its newspaper, the proprietor, if he have only a hand press, which is what a great many of them use, is looking forward to the time when his own circumstances and the growth of his town shall warrant him in "coming out" with a power press.

At the bottom of our illustration is shown the department where the presses of latest design and most improved construction are made. The "two revolution" press, as its name indicates, has two revolutions of the impression cylinder for each printed sheet. It is solidly built, and can be run at a speed of from 1,500 to 2,000 impressions per hour, at the same time doing first-class work, either on illustrations or in color printing. It runs smoothly on compensating bearings, which allow for wear so as to maintain uniform accuracy, and, with the various patented improvements which Mr. Cottrell has introduced affords a "working" machine of acknowledged desirability in any first-class printing office. The "stop" cylinder press, however, represents the very highest attainment in this class of machines for the production of the higher grades of work. The cylinder makes but one revolution for each impression, stopping for each sheet, while the motion of the bed continues; the latter has four separate bearings directly under the point of impression, giving absolute solidity, and the sheet is so fed on the cylinder, while it is at rest, as to insure a uniformly perfect register. The ink distribution is very thorough, as it must necessarily be in all fine work, and the impression can be adjusted to a hair. The firm call this machine the *ne plus ultra* of printing machines; but, although so much has already been done in the way of improving printing presses, we are not disposed to concede that the end has yet been reached, thoroughly excellent as this press is.

The "perfecting" presses made by the firm, for printing both sides of the paper while the sheet is going through the press, is built with a cylinder for curved stereotype plates for reading matter, over the drum cylinder, around which the paper afterward passes and receives an impression from the form on the flat bed, where the illustrations and more difficult matter are supposed to be made up. This machine is especially designed for the large illustrated weeklies, in many of which our readers will notice how common it is to have two or more pages with pictures and two or more without, all through—this arrangement coming from the fact that all the engravings are, so far as possible, printed on one side of the sheet of paper, after the other side has been printed, sometimes on a less expensive press. The engravings in this paper, it will be observed, appear with the type matter on nearly all of the pages.

In the general view at the right hand in the middle of the page is a good representation of the various buildings in which these presses are made at Westerly, R. I. The most prominent building at the right in the picture is the main structure, to the left of which is the pattern shop, while in the rear are the foundry, blacksmith shop, engine room, etc. The buildings cover about two acres of ground, and the location is a most admirable one, on the Pancatuc river, about five miles above Stonington, where coal and iron can be brought direct to the firm's docks, and from whence their heavy machines may be shipped, at but a small cost for freight.

Messrs. Cottrell & Babcock have obtained nine different patents and two reissues, all but one of which were for inventions of Mr. Cottrell, who has devoted all his energy and ingenuity toward perfecting power presses.

The business offices of Cottrell & Babcock are at No. 8 Spruce street, New York, and 112 Monroe street, Chicago, Ill.

The Wire Age.

Whenever, in walking or riding through the streets of our great cities and towns, the eye is directed upward, a perfect network of wires is seen stretching from building to building and from chimney to gable. The appearance is as if some huge spider had been at work silently and covered in the compact city, holding it a prisoner in the meshes of its net. The view is bewildering, and it seems impossible that any practical or important use can be made of these iron wires, so numerous as almost to shut out the sunlight. It is but little more than thirty years since only a single one could be seen connecting some important building with another in a distant city, by which telegraphic communication was maintained; and forty years ago not even one was visible anywhere. We live in the *wire age* of the world's history, and a most interesting and wonderful epoch it is. We know that these iron filaments subserve the purpose of nerves of thought and sensation, and over them, or through them, the world's commerce is carried on. In the human organization we know that if any accident or event happens to the extremities, the fleshly nerves transmit instantly the news to the seat of sensation, the brain; and so it is with the iron nerves in the external world, which science has arranged; not an event of importance can transpire in any part of the globe which is not instantly "*wired*" to the great cities, and the news spreads everywhere with the rapidity of thought.

Until within the past four years, the wires were capable only of transmitting signals of a complex nature, but easily understood and interpreted by experts; now, human beings talk with each other over the iron, and it seems to make, as it were, a unit of the great family of man. Words, actual words, produced by the organs of speech, are ever winging their way, with the speed of lightning, over cities, across rivers and mountains and woods, and voices are recognized scores of miles away. The wires needed in cities for transmitting fire and burglar alarms, for police calls, time signals, and other municipal purposes, are many in number; and when to these are added the wires for telegraphic and telephonic purposes, the question of space or room for them becomes an important one. These wires must all be independent of each other; there must be no contact anywhere; else serious errors and complications occur. In this city the fire alarm system has been so often interfered with that the chief engineer has called the attention of the city government to the matter.

The time is not far distant when additional wires will become necessary for the purposes of electric lighting, and, perhaps, warming. In the years to come the whole country will be covered with them unless some plan is devised by which electrical currents can be conveyed in the earth by wires protected in tubes of clay or metal. It is certain that some method of this nature must be adopted, and that quite speedily.—*Boston Journal of Chemistry.*

Working Wire.

There are many jobs which require wire, in some one of its many sizes and in some form, as rings or springs, to complete them. Improperly treated, wire is a very obstinate material, if at all "springy" or possessing temper, either from condensation by drawing, or by hardening, it will not occupy the space or shape in which it is formed, and calculation or experiment is necessary to guide the workman to a satisfactory result. All wire of any stiffness, when coiled, will open or expand, making the coil larger in diameter and longer in stretch. In ignorance or neglect of this quality, a workman once tried to form a spiral spring of wire to play upon a flat rod one inch wide by three-eighths of an inch thick. He wound the wire on the flat rod, and when released the spiral was a sight to make his shop companions laugh. The coil was elegant, but scarcely useful; its short diameter and its long diameter alternated in a beautiful geometric spiral, instead of preserving a straight line. Sometimes it is necessary to make a spiral, or rather a coiled spring, of a certain diameter, to fit a hole, or to fit a rod acting as its core or support. It is impossible to give rules to determine the amount of expansion of the coil in diameter, as the nature of the material is so varying. This variation comes from the stiffness of the wire, the size of the wire, and the material—whether brass, iron, or steel.

In the case of desiring to produce a coiled spring of a certain diameter it is best to try a simple experiment with the specimen of wire to be employed. Wind one or two turns on a rod of the proper size for the core, and then, releasing it, measure the interior of the ring or spiral, and compare with the diameter of the core or rod. Reduce the size of the core or rod to an amount a little more than the difference between the size of the hole in which the spring is to work and the rod on which it was formed. If the wire is of a gauge that when wound on a half-inch rod it will fill loosely a hole three-quarters of an inch in diameter, but when allowed to expand the coil requires a hole seven-eighths of an inch, wind the wire on a rod three-sixteenths of an inch smaller than the half-inch rod. This example may not be definite enough to be made into a rule, but it is given as an illustration. A trial should be made, as before mentioned, by coiling the wire around a core of the estimated diameter, and thus determine the amount of opening or spring of the coil. It may be feasible, in some cases, to anneal the wire before forming it into springs. In this case the wire can be wound to the finish size at once. But with brass or iron wire, the springiness of which depends upon the condensatian of the particles by the drawing dies, this plan is not practicable, as hardening and tempering by heat and water will not restore the stiffness of the wire. But with steel wire it is better to use the wire in an annealed form, making the spring just as it is to be in its finished state, and then tempering it, a process which is described further on.

It is a comparatively easy matter to make a close or expanding coiled wire spring in the lathe. The size of the core rod having been determined, all that is necessary is to keep the winding wire close to the previous coil, and this can be done by hand feeding and guiding. The rod on which the spring is wound is placed on the lathe centers, and one end of the wire secured in the dog end, when the lathe may be started on a slow speed, the wire being led to it by hand. This is a handy way also to form rings, the coil being cut apart either with a file or cold chisel.

But in forming open or compressing springs, there must be greater care employed. The stiffest open spring from a certain size of wire is that which has the interstices of the same space as the wire's diameter; so, such a spring—or rather two of them—may be formed by winding two wires at the same time, making a close spring, doubled. When completed, one is unscrewed from the other. A more open spring may be guided by means of a thin piece of iron with a hole large enough to receive the core on which the spring is wound, the hole being in one end of the piece and the other having a handle attached. A small hole should be made through the piece close to the large hole to receive the wire. In operation the guide is slipped on the core spindle up to the dog end, the wire passed through the small hole, and secured by the dog. Then start the lathe, holding the guide close against the rotating core, pulling toward the operator, and the wire, passing through the small hole in the guide from one side, winds against the guide on the other. It is evident that the thickness of the guide will determine the width between the coils. A still better way of forming an open spring is to use an engine lathe with screw cutting feed. With this the grade of the spring may be determined with great accuracy.

Sometimes it is necessary to close the ends of close coiled springs so as to make a central pull by means of hooks or loops. There is machinery to do this with rapidity, but for ordinary jobs hand work is sufficient. The closing is effected by a gradual reduction of the diameter of the coils at the ends of the spring. Unless the wire is very rigid and obstinate, repeated blows with a mallet, a lead hammer, or a copper hammer will do the work satisfactorily. The open end of the spring should be held at an angle on the bench block, and the hammer wielded, striking backward toward the held end of the spring, the spring being turned in the hand in the direction of the coiling. Before the end is closed, a looped piece of wire should be introduced to form a holder for the end of the spring, the projecting end of the looped wire to be formed into a hook or ring.

Large springs of large wire, which from its size and rigidity cannot be managed during winding by the hand, should be made on a contrivance similar in principle, build, and operation to the tire tenders in the blacksmith shop, or the pipe formers in a tin shop. These consists of two rolls to give a forward motion to the material and another to give the curvature. In spring forming the modifications consist in substituting narrow wheels with a V or segmental groove on their peripheries for the two rolls, which receive the wire, and a guide instead of the back roll to produce curvature. The two grooved wheels should be geared together, so as to turn in opposite directions, and the guide should be a curved piece, standing at an angle to the axial rotation of the rolls or wheels. And this guide should be capable of being set up to the rolls or moved back from them, to determine the diameter of the coil, and should also be capable of being inclined from a vertical position, more or less, to make a close or open spring. The guide should have a lip on its working edge to guide the wire. With such a contrivance, coiled springs of steel rod, a quarter of an inch and more in diameter, may be readily formed.

Sometimes a weak spring is required where a flat forged spring would be costly. In this case a piece of stiff wire of hard brass or unannealed iron may do the work when coiled two or three times around a core, the coiled portion forming the spring, leaving ends to be formed into loops or secured by screw, or left to act on the movable attachment it is to actuate, as a pawl. The principle of such a spring is seen in an extreme form in the U, or main spring, of a gun lock. In this spring the two long arms have little to do with its action, the spring or life being wholly in the curve between the two arms. The wire spring has its curve in one or more complete circles.

Coiled springs of steel wire are tempered by heating them in a box, or piece of gas pipe, in which they are packed with bone dust or animal charcoal, precisely as though they were to be heated for case hardening. If a piece of gas pipe is used, which is very handy in such work, one end should be closed by a screw plug or cap, and the open end luted with clay. When sufficiently heated—the box or pipe deep red—remove the spring, or plunge spring and its receptacle together into a bath of animal oil. Do not attempt water hardening or the use of crude petroleum. If common whale oil is not handy, melt lard and use it while it is liquid. The wire will be sufficiently hard to require drawing. This should be done by putting the spring in a shallow pan, with tallow or animal oil, over the forge fire, and agitate the pan and its contents until the oil takes fire. Take the springs out, and when the oil is burned off cool them in water.—*Boston Journal of Commerce.*

Correspondence.

Lighting Mines by Reflectors.

To the Editor of the Scientific American :

The proverb, "Necessity is the mother of invention," is so trite that its quotation calls for an apology, but its truth has been demonstrated recently in so valuable a way in the prosecution of an important and dangerous work here, that, for the benefit of other workers in like professions—mining engineers—who may meet with similar difficulties and dangers, I give you the result of an experiment in the use of sunlight as a means of illuminating underground workings.

An important part of my work during the past two years has been the construction of a deep adit level, to serve also as a base of development of the vein and a main channel of out-carry for ores extracted on higher levels of the mine, and it has been attended with serious difficulty and danger in consequence of the existence of inflammable gases in the rock through which it passes. Three serious explosions have occurred during the past six months, due to its ignition by workmen using open lights, and eleven persons were very badly burned. Workmen at last reached such a condition of fear of consequences that they could not be induced to take such chances of death, to earn a living, as work in the tunnel offered. Safety lamps would not furnish sufficient light. The question, then, was what safe means of illumination could be used. This question was decided, in a measure, in a peculiar way, and was the direct result of necessity, which compelled me to go into the header of the tunnel to look after a party of men that had just been burned by an explosion. I had recourse to a common looking-glass for a reflector of the sunlight. The result was marvelous. The whole tunnel was a flood of bright daylight—sides, roof, and floor, throughout its entire length of 2,500 feet, and all furnished by such a glass as can be bought in your city shops for a dime. Confidence was at once restored in my workmen, and now, while we can command the sun, we can command more labor than the work will employ.

The conditions of the tunnel and the philosophy of the light are these:

The tunnel is perfectly straight, 6½ x 5½ feet inside of timbers; its course south 36° 15′ west from the mouth; and is ventilated by a current of air forced in by a Burleigh compressor operated on the outside.

The philosophy of the light—its intensity and perfect diffusion—is thus accounted for: The air driven into the tunnel is saturated with moisture in the process of compression, and upon being released in the header, resolves itself into its natural volume, when the excess of water is liberated in the condition of a mist or fog, very light, of course, and millions of these atoms of water become direct reflectors at as many million angles. To convey an approximate idea of the intensity and brilliancy of the light it will, perhaps, be sufficient for me to say that the smallest type used in your publication is as clear at a point 3,000 feet from the looking-glass as in the open sunlight, and every item in your paper can be read at any point in the tunnel as rapidly and with as much ease as if out of doors.

It may be that some unfortunate may derive a benefit from having the use of this light suggested to him. If it will save one individual from being burned, as I have been, or as I have seen a number of my workmen, I shall be fully compensated for the time spent in preparing this communication, and you will be entitled to the thanks of the mining profession everywhere for publication.

The light may be used for many purposes underground, and many times diverted from the first mirror line.

JNO. W. C. MAXWELL.

New Idria, California, February 20, 1880.

A Fatal Italian Disease.

An Italian correspondent of the *Lancet* calls attention to an insidious and frightfully fatal disease called "pellaga," of which no less than 97,000 Italians are said to be dying, at the present time, the number of victims representing 3.62 per 1,000 of the whole population, and in the infected departments, especially in Lombardy and Venice, a higher proportion than ever occurred during the worst cholera epidemic in France. The disease usually runs a slow course, like consumption. Its cause is believed to be the exclusive consumption of maize in a deteriorated condition and the unhealthy state of the hovels in which the rustics live.

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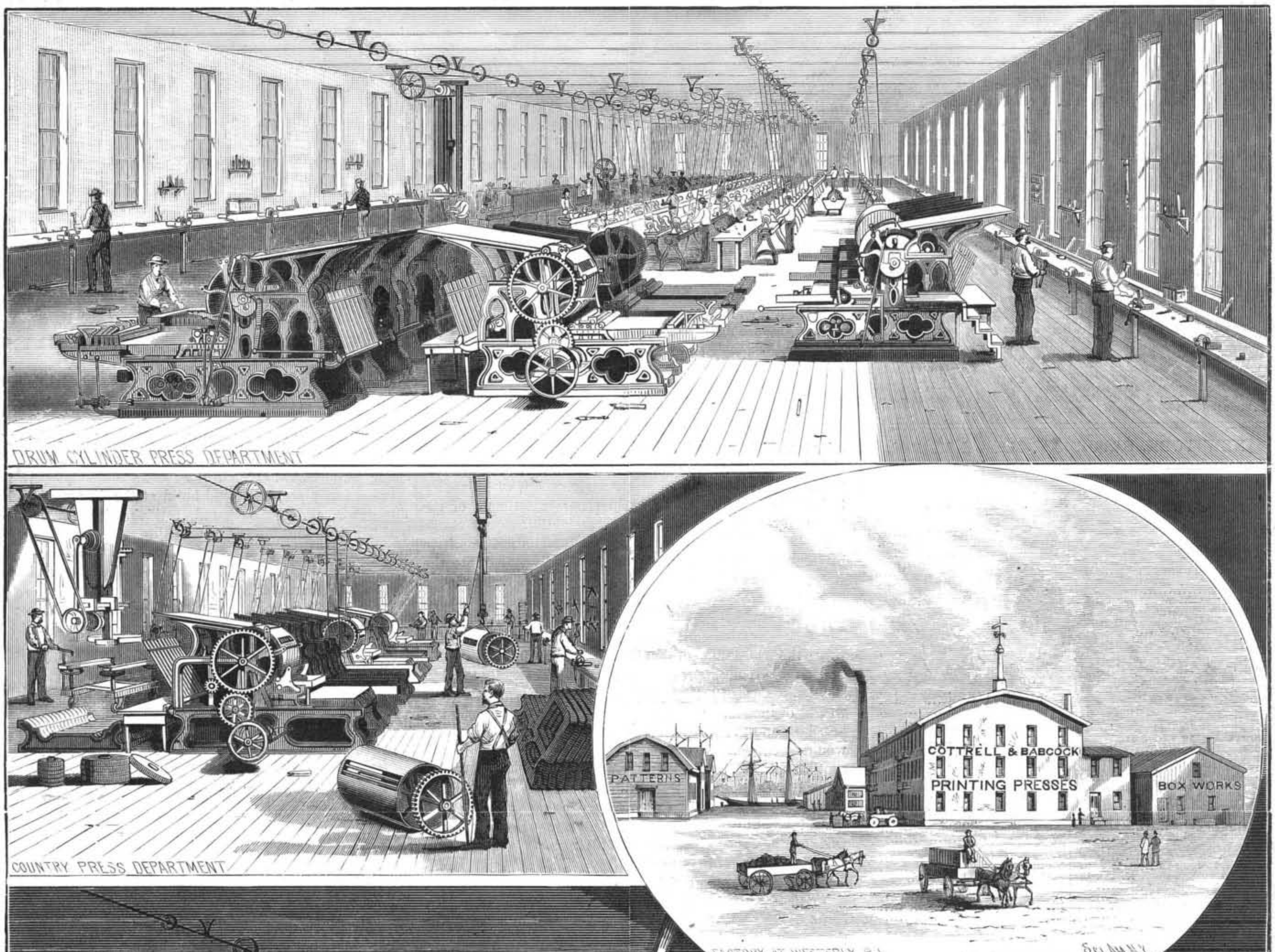

THE MANUFACTURE OF POWER PRINTING PRESSES.—WORKS OF MESSRS. COTTRELL & BABCOCK, WESTERLY, R. I.—[See page 196.]