THE PRINTING OF "THE CENTURY."

THERE was a general belief twenty years ago that the materials, methods, and machinery of magazine printing had nearly reached full development. Old publishers and printers said that it was unreasonable to expect better paper or finer presswork; it was absurd to hope for higher results by changing the methods of printing which had been sanctioned by long experience. Most emphatically was the proposition laid down that fine printing could not be done with speed or at low cost. If finer paper were wanted, that paper must be of superior fiber and hot pressed, at a price necessarily prohibitory. It was folly to talk of better engraving. The London school of engravers had already reached the high-water mark of close wood-cutting; but while they had fully shown their ability to cut finely, printers had signally shown the inability of printing machinery to print their blocks properly. The "Penny Magazine," useful and meritorious as it was in many features, was a warning of the folly of attempting to print good woodcuts on cylinder presses. Designers of merit had refused to draw upon blocks that would be spoiled in printing. Some of the abler engravers had abandoned the practice of engraving on wood in despair at the unworthy reproduction of their best efforts by the printers.

The printing trade here had made similar experiments and had reached the similar conclusion, that fine printing can be done only on the hand press. English writers on engraving had oracularly declared that the province of engraving on wood was limited to the delineation of form only; that it could acceptably produce light and shade only in a conventional style; that it was presumptuous for an engraver on wood to attempt any serious deviation from the outline style of Dürer and Holbein.

Whoever looks over the bound volumes of illustrated periodicals between 1850 and 1870 cannot fail to note the depressing influence of this experience and of these teachings as shown in the flatness and muddiness of woodcuts in which the engraver had made, or tried to make, nice distinctions of light and shade, and the coarseness and scratchiness of a more open style of cutting in which the engraver had servilely followed the lines of the designer. Every designer and every engraver was hampered in his work by apprehensions that the block would not be properly printed.

The publishers of THE CENTURY had to prepare their first number, of November, 1870, upon the mechanical track laid down for them by the printing trade. The only available form of printing machine that met the conditions required was an improved form of "drum-cylinder," on which fair presswork might be had if the pressman was very skillful. The publishers were warned that cylinder presses were type smashers, sure to damage fine engraving. This prophecy failed. The careful adjustment of pressure by means of overlays prevented excessive wear, but there was a lack of sharpness of line and brightness of color in the prints from the woodcuts, as there always must be when impressions are taken against the elastic resistance of a rubber cloth or blanket. To limit the force of impression to the flat surface of a woodcut, to prevent the overlapping of pressure on the edges and sides of engraved lines, one must print against a hard inelastic impression surface. On small jobbing presses this method of getting sharp impressions had been in use for many years. Why not try it on the magazine? This called for another change. Of what use to prepare an inelastic impression surface when the paper to be printed was made elastic and spongy by dampening? To get sharp, clean lines, the paper must be printed dry. Old pressmen shook their heads at this innovation, and said it could not be done. But it was done. At first not with complete success, but well enough to show the possibilities of excellent results when the pressman had full mastery of the details of the new method.

This change called for still another. The ink was now in fault. Ink that was good for damp was not good for dry paper. This seems a petty obstacle; but many kinds of ink had to be compounded and many trials made before the ink could be furnished that had the needed blackness, that spread itself fairly on the types, and that dried quickly on the paper.

The success of the new method warranted the publishers in attempting a higher grade of illustrations. Some of them were too difficult to be properly done on the drum-cylinder press, which did not have inking facilities or strength enough to face them fairly. The better machine that was needed was found in the newly developed "stop-cylinder printing machine,"

which promised the needed strength and inking facilities. This stop-cylinder did better presswork, but at slower speed and at greater cost, yet its capacities were often seriously overtaxed by the close and shallow engraving furnished by engravers who were striving to reproduce with picks or lines the effective tints of designs made entirely with the brush. The woodcut which could be made to give one fair proof after an hour of manipulation on the part of the engraver could not be made to give a proper print on the press from its electrotyped duplicate at the required rate of twelve copies a minute. The shallowness of the counters of these cuts was so slight that the cut itself seemed perfectly flat. Shallow as this counter was, it was often made more so by the process of molding and electrotyping. It was necessary to improve the quality of the electrotype plates. Repeated experiments led to no new discovery, nor to any radical change in methods, but they did compel the purchase of improved machinery, and did induce habits of nice observation and attention to trifles, which were of marked benefit.

The greatest obstacle to the perfect printing of woodcuts always has been the uneven surface of printing paper. If the reader will look through a magnifier at a sheet of ordinary paper, he cannot fail to note that the surface is uneven — broken in every direction with little pits or depressions. Paper is but a felting or tangle of interlaced fibers which make the sheet thickest in the places where the fibers cross each other with a corresponding unevenness of surface. When printed on ordinary types that have deep counters, these pits or depressions are too shallow to affect the print. If the paper be dampened, the supply of ink full, the impression strong, and the impression surface elastic, the type will sink to the bottom of these depressions without any noticeable thickening of line. Under these conditions no one can see any lack of smoothness in the print. But these are not the conditions under which fine woodcuts can be rapidly printed. The paper must be dry and smooth; the impression must be confined to the surface; the lines must not be jammed in or unequally sunk below the surface of the paper.

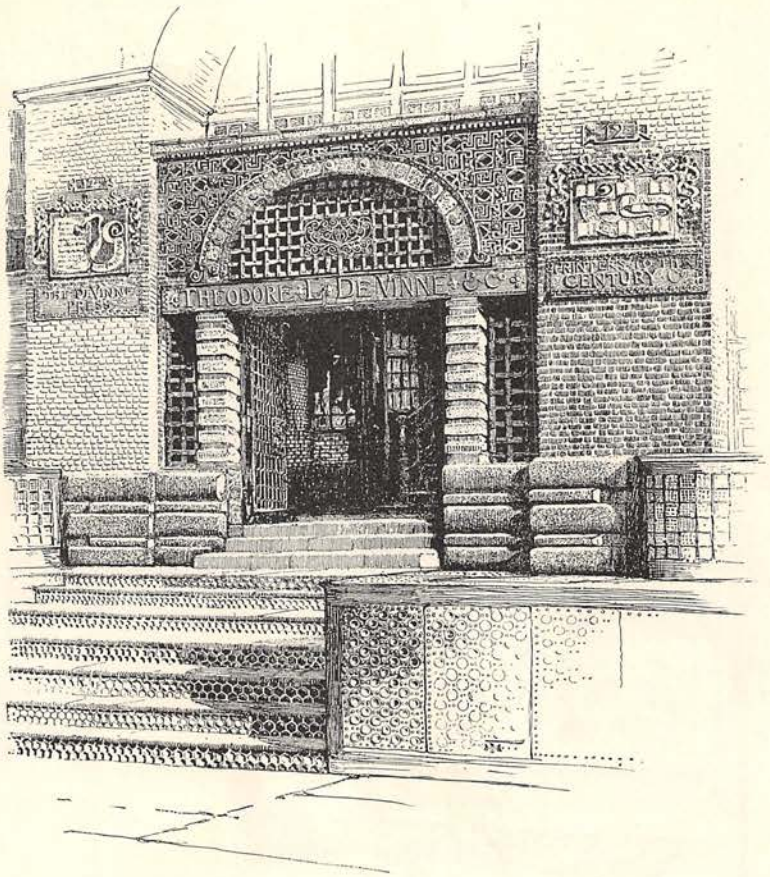
The old approved method of smoothing paper was by pressing each sheet through hot plates — a process which made the vellum, or hot-pressed paper, so much admired twenty years ago. But this process was slow, uneven in results, and too expensive to be considered for magazines. The American method of smoothing a sheet in a web by passing it through stacks of calendering rollers was adopted from the beginning of the magazine, but it had disadvantages. Great pressure was required to make the sheet smooth; but if the pressure was too great the fiber was crushed, the paper became transparent and so hard that it would not properly receive and retain ink, the surface became shiny, waxy, and irritating to the eye.

The only way to make paper smooth enough for the work was to fill these pits or depressions while the paper was in the process of manufacture with a soluble filling which made an absolutely uniform surface readily smoothed by the calendering rollers. The amount of this filling is small; the effect it produces on the print is great. The delicacy of line and tint shown in the engravings of the last five years could not have been reproduced with even a tolerable degree of faithfulness if they had not been shown on this surfaced paper. The new form of mechanical engraving, commonly known as the half-tint style, is equally dependent for its effect on surfaced paper. No other paper can show with such clearness the whole scale of color from the palest gray to the intensest black.

The changes that have been recently made in the theory and the processes of printing will perhaps be more clearly understood by an examination of the methods and machinery now used for the printing of THE CENTURY MAGAZINE.

Printing begins with type-setting, which is done now as it was four hundred years ago. Every letter must be picked up by hand and adjusted by human fingers to its fellows. For good book-work there is as yet no short cut, no royal road. There are, it is true, type-setting machines doing efficient service on daily newspapers, and others that give good promise of usefulness in the more exacting branch of book-work, but they have not curtailed the employment of the four thousand compositors who set type by hand in this city. Type-setting by hand is slow work. A quick workman can set five columns of THE CENTURY in a day of ten hours; but the performance of the average compositor does not exceed, hardly reaches, two pages a day. The composition of the magazines is done by young women, whose work is as accurate and acceptable as that done by men. The women are paid the same rates as men.

A large printing house needs many types; there must be many kinds, and a great many of each kind. In this printing house the types and the appurtenances for keeping them in order occupy two large floors, each of about seven thousand superficial square feet. Not one-tenth of this type is in daily use, but all of it is needed, for any kind may be demanded and must be accessible at a moment's notice. Each face or style of type, and each character or



ENTRANCE TO THE DE VINNE PRESS.

type of that face, must have its place, and be kept in that place.

The compositor who works on CENTURY copy stands before two inclined cases containing boxes for characters in roman type; she picks types out of the case without examination, and puts them into a "stick," which is a small iron tray carried in her left hand. When the stick is filled with lines of type she puts these lines on a "galley," which is a long tray of brass. When the galley has been filled with type a proof of its contents is taken on a rolling press. Now the proofreader begins his work, by silently reading the proof as he follows the voice of the copy-holder, who slowly reads aloud from the copy used by the compositor for setting this type. If any letter or word has been omitted or misspelled the fault is noted and marked. The marked proof goes back to the compositor for correction, which is done. A new proof is then taken and revised, and sent to the editor or the author. The return of this proof contains editorial corrections, and usually the order to "make up," which means to rearrange the long strip of types on galley in the form of pages with their appropriate illustrations.

These woodcut illustrations are the jewels of the magazine. How frail they are! how tenderly they have to be cared for! A careless thump or scratch, neglectful exposure to too much heat or dampness, and their beauty is marred forever. To prevent losses by these accidents, every woodcut is proved on the hand press soon after its receipt, and a mold taken in beeswax on which an electrotype shell is deposited. These shells weigh less than an ounce, and are carefully preserved and used only in case of an accident to the woodcut. The proofs of the cuts are sent to the foreman of the press-room, who uses them for his "overlays," of which more will soon be said.

After proving and molding the cuts are sent to the maker-up, who frequently finds them quite obdurate and inflexible — too long, too short, too irregular, rarely ever adapted to the places for which they were made. To find the proper place for each cut, and make it fit there, is

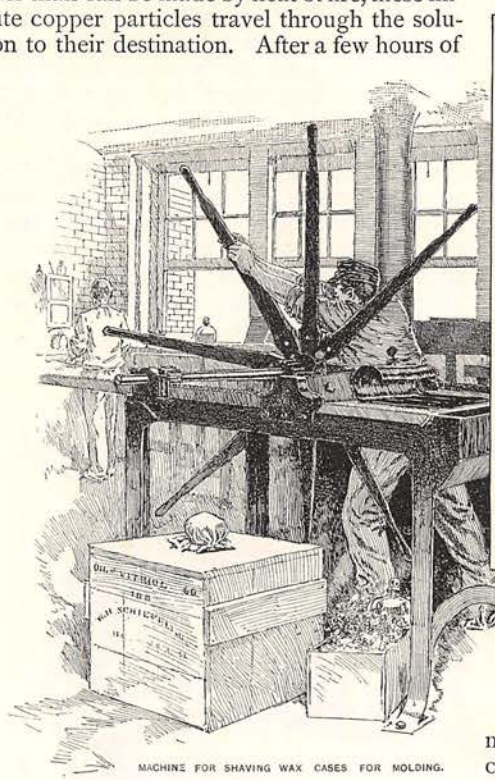
THE VESTIBULE.

a part of his business which calls for patience and ingenuity; but the author or the editor lends his help, and the work is done. Then follows another proof, which is read by a new reader, and is marked with more corrections. Perhaps another proof still; but finally comes the editor's seal and stamp of approval — *Cast* — and off go chase and contents to the electrotype foundry.

When made up the pages are fastened in square frames of iron that are called chases, which allow them to be transported to the foundry, or to be kept securely waiting orders for correction or alterations. Many pages have to be kept in type; some of them wait but a few days, others for months before the order comes for casting. For the text of THE CENTURY five thousand pounds of type are provided, and all of this is often used.

Let us follow the chases of type, securely nested in boxes to prevent bruising, to the electrotype foundry on the sixth floor. This is the one room that cannot be kept bright. The furnace, the machines, the batteries, and the pervasive atoms of black-lead floating through the air are sad hindrances to neatness. The types, apparently clean enough, are carefully washed, and then dusted with these atoms of black-lead. The chase of type is now put in a molding press and pressed with great force against a plate covered with a thin sheet of wax that has been coated with the black-lead. This material prevents the wax from sticking to the form in the operation of molding, and also acts as a con-

ductor of electricity on the non-conducting surface of the wax mold. It is not a cleanly or a pleasant material to handle, but there seems to be no other available substitute. The pressure on the wax gives a minutely faithful but reversed duplicate of the face of the type. The mold is next submerged in a vat of turbid fluid which seems innocent and peaceful enough, but in it mysterious forces are noiselessly at work. Put a key or any bit of iron against two of the rods on which the mold is suspended and you instantly see a shower of electric sparks. The buzzing little dynamo in the corner by its rapid revolution is sending through the fluid an electric current which liberates particles of copper from the solution in the bath and attaches them to the mold. In impalpable atoms, finer than can be made by heat of fire, these minute copper particles travel through the solution to their destination. After a few hours of exposure lift the wax mold and you will see it covered with a thin shell of bright copper about as thick as a sheet of ordinary writing paper. This shell is the duplicate of the face or surface of the types and woodcuts in the chase. It is too thin to be used for printing: it must be "backed up" and mounted.



MACHINE FOR SHAVING WAX CASES FOR MOLDING.

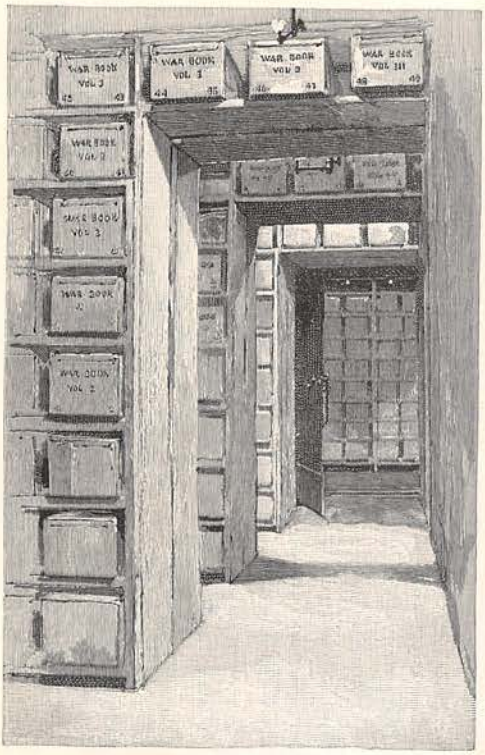
IN THE ELECTROTYPE ROOM.

A jet of steam or hot water is next applied to the deposited copper shell, which melts the underlying wax and permits the shell to be relieved from the mold. On the back of this shell tinfoil is melted, which serves as a solder for the melted electrotype backing metal that is poured over it, making a plate about one-fifth of an inch thick. When the plate is cool it is put under a planing machine and reduced to a thickness of about one-seventh of an inch. A screaming, vicious-looking little circular saw now takes the plate and trims off the rough and superfluous metal on the edges, after which the plate is straightened perfectly level and shaved to the desired thickness. Next comes the beveler, a form of side plane which makes the angled shoulders required by the clamps which are to hold it on the press. Now the finisher takes up the plate and scrutinizes it for the correction of trivial defects. Then a proof is taken and compared with the type proof.

ROUTING MACHINE.

Unlike the type, or the frail woodcut which may be in the page, this electrotype plate can receive a hundred thousand impressions, or more, without loss of beauty or sharpness. It can be handled, packed, and transported with more ease and greater safety than the type or the wood. The page of type costs, composition included, about seven dollars; a full page of woodcut costs from one hundred to two hundred dollars. The electrotype of either costs less than one dollar. These are the reasons why electrotypes are made.

The electrotype foundry is a miniature machine shop, with machines on every side—to plane, to saw, to bevel, to rout, to mold, to melt, to carve. One of the peculiarities of this room is a little machine which bevels both sides



IN THE PLATE VAULT.

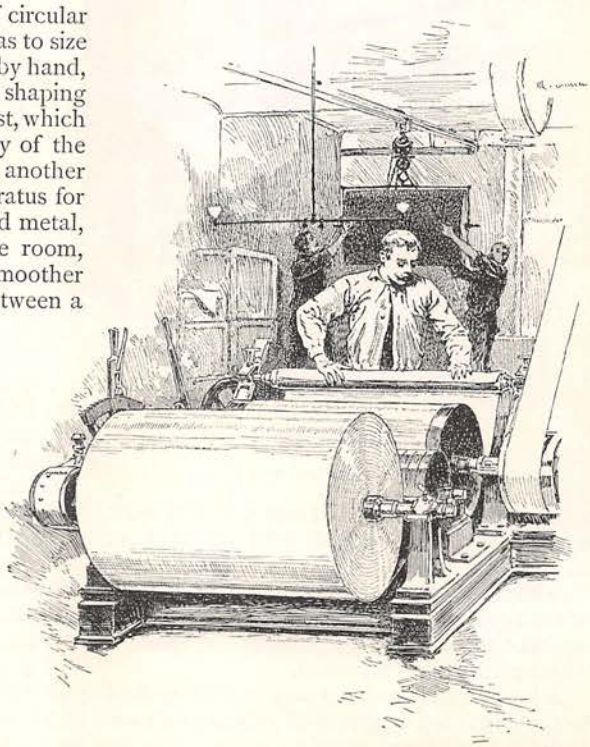
of a page at one operation, by means of circular beveled cutters, insuring an accuracy as to size not to be had when the beveling is done by hand, and by two distinct operations. The shaping machine, with its gas heater and air blast, which curves a flat plate to fit the periphery of the printing cylinder of the web press, is another novelty. There again is a newer apparatus for bending to a true curve plates of cold metal, the invention of the foreman of the room, which produces a curved plate of still smoother and truer surface. The difference between a fairly smooth and a truly smooth surface may seem trivial, but on this trifle depends the success of fine printing on a rotary press.

The inspection of the plate does not end with the finisher, for a new proof of it is taken on the hand press, and its face is carefully searched for the hidden defects of air bubbles under the shell, bruised letters, or uneven surfaces. If the defects cannot be economically remedied the plate is condemned and a new one is ordered.

Plates that have to be printed in red ink, like the cover of "St. Nicholas," or that will have to receive unusual wear, like the advertising pages of THE CENTURY, are coated with a film of nickel, which resists the scaling of the ink or the wear of the press. For special purposes a film of steel can be substituted.

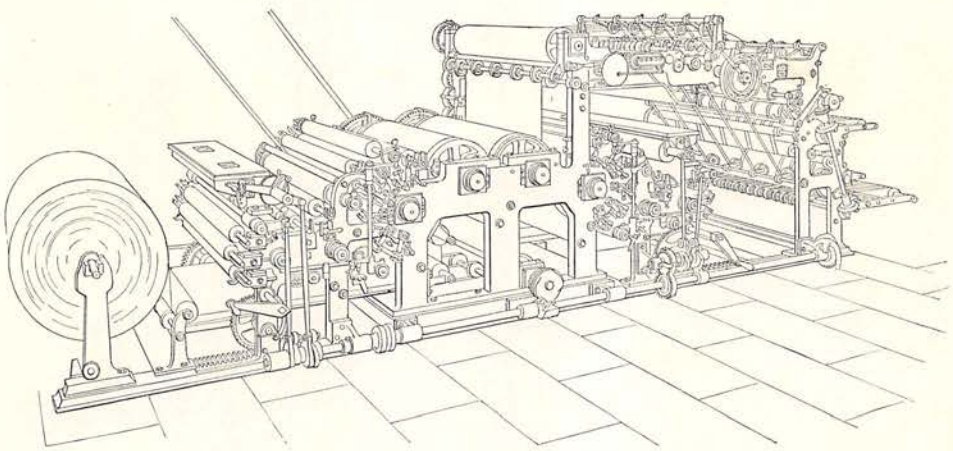
The plates that are passed as ready for press go to the plate vault, the only place in the building in which gas burns all day. Between solid piers five feet thick are here piled, tier after tier and row after row, many tons of boxed plates. Each set of thirty-two plates is in a specially labeled box, and each has its place on a range of shelves which extends backward in impenetrable gloom. All are readily accessible to the plateman: at five minutes' notice he will furnish any plate that may be called for. It is his work not only to keep the plates in order on the shelves, but to get them in order for the presses. The plates have to be mounted by him on movable blocks; to be firmly fixed in chases so that they cannot be disturbed by the action of the machine; to have their margins nicely adjusted, and their positions so determined that they shall be printed properly on the paper, and folded and cut with exactness.

One of the most attractive portions of the press department is the vault — a long room under the sidewalk on Lafayette Place, beautifully lighted by the bulkhead of iron and glass sixteen feet overhead. At the end of a long row of machinery stands the web press



REWINDING PAPER.

—a massive and complicated construction, specially built by Messrs. R. Hoe & Co. for printing, cutting, and folding the plain and the advertising pages of THE CENTURY. Web presses for newspapers are common enough, but this press has distinction as the first, and for three years the only, web press used in this country for good book-work. At one end of the machine is a great roll of paper more than two miles long when unwound, and weighing about 750 pounds. As the paper unwinds it passes first over a jet of steam which slightly dampens and softens, but does not wet or sight. Pulleys at once seize the creased sheet and press it flat, in which shape it is hurried forward to meet three circular knives on one shaft which cut it across in four equal pieces. Disappearing for an instant from view, it comes out on the other side at the upper end of the tail of the press in the form of four-folded sections of eight pages each. Immediately after, at the lower end of the tail of the press, out come four entirely different sections of eight pages each. This duplicate delivery shows the product of the press to be at every revolution of the cylinders sixty-four pages, neatly printed,

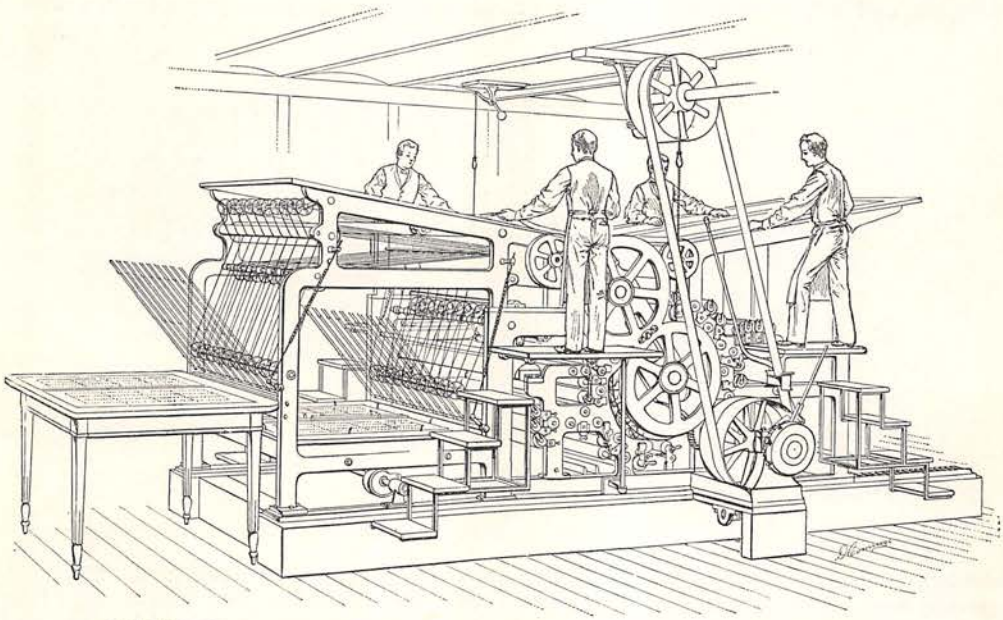


THE WEB PRESS FOR PRINTING AND FOLDING SIXTY-FOUR UNILLUSTRATED PAGES AT ONE REVOLUTION.

sodden, its hard surface, and fits it for receiving impressions. It next passes under a plate cylinder on which are thirty-two curved plates, inked by seven large rollers, which print thirty-two pages on one side. Then it passes around a reversing cylinder which presents the other side of the paper to another plate cylinder, on which are thirty-two plates which print exactly on the back the proper pages for the thirty-two previously printed. This is done quickly—in less than two seconds—but with exactness. But the web of paper is still uncut. To do this it is drawn upward under a small cylinder containing a concealed knife, which cuts the printed web in strips two leaves wide and four leaves long. As soon as cut the sheets are thrown forward on endless belts of tape. An ingenious but undetectable mechanism gives to every alternate sheet a quicker movement, so that it falls exactly over its predecessor, making two lapped strips of paper. Busy little adjusters now come in play, placing these lapped sheets of paper accurately up to a head and a side guide. Without an instant of delay down comes a strong creasing blade over the long center of the sheet, and pushes it out of truly cut, and accurately registered and folded, ready for the binder. Two boys are kept fully employed in seizing the folded sections and putting them in box trucks, by which they are rolled out to the elevator, and on these sent to the bindery.

This web press is not so fast as the web press of daily newspapers, but it performs more operations and does more accurate work. It is not a large machine, nor is it noisy, nor does it seem to be moving fast, but the paper goes through the cylinders at the rate of nearly two hundred feet a minute. It does ten times as much work as the noisier and more bustling presses by its side. Made especially for THE CENTURY MAGAZINE, it prints that and nothing else, for its large regular editions keep it fully employed. The reprinted numbers of THE CENTURY and all the other publications of The Century Co. are done on other presses. This web press has other limitations: it is not at all an economical machine for small editions, nor can it be successfully used for the fine woodcuts of the illustrated articles of THE CENTURY. The pages that contain these woodcuts, and the entire text of the "St. Nicholas," hitherto have been done on a slower

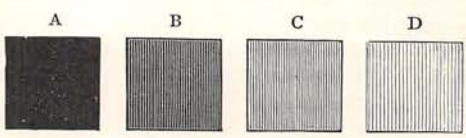
and smaller machine known as the stop-cylinder, which prints sixteen pages only on one side of a sheet at the rate of about 750 impressions an hour. One machine can produce in one month but a small portion of the illustrations required for the magazine. It follows that there are many of these stop-cylinders, and that the printing plates are made in duplicate and sometimes in triplicate, and, to get out the edition in time, that these duplicates go to press on different machines. To get the superior quality of presswork demanded this delay in performance and this multiplication of machines has been submitted to for many years.



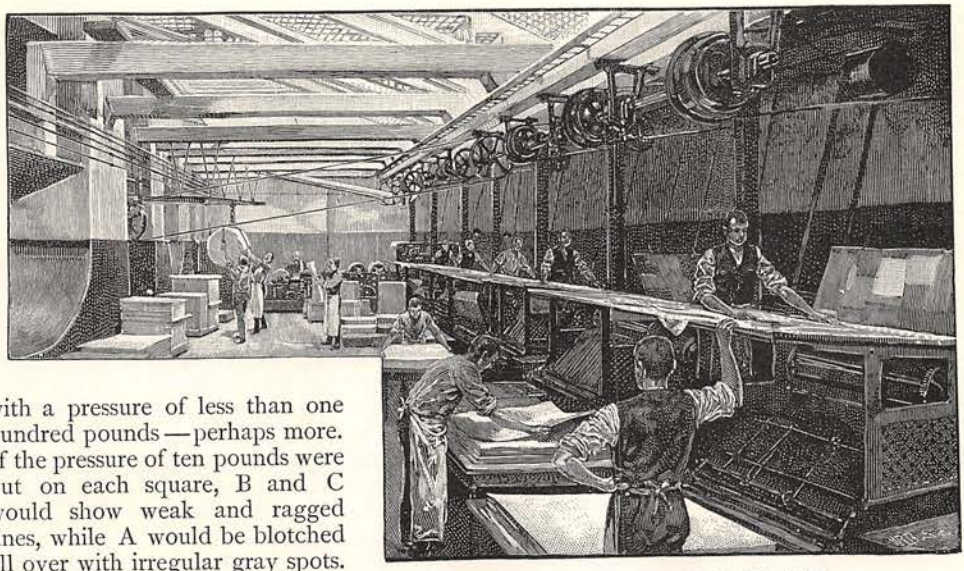
THE NEW ROTARY PRESS FOR PRINTING SIXTY-FOUR ILLUSTRATED PAGES AT ONE REVOLUTION.

Encouraged by the success of the web press in magazine presswork, the printers of THE CENTURY have applied the rotary principle to a new machine for fine illustrations, expressly made for them by Messrs. R. Hoe & Co. and but recently put to work. Sixty-four plates of THE CENTURY, truly bent to the proper curve, are firmly fastened on one cylinder sixty inches long and about thirty inches in diameter; sixteen inking rollers, supplied with ink from two ink fountains, successively ink these sixty-four plates with a delicacy and yet with a fullness of color never before attained. The shafts of the impression cylinder and the plate cylinders, 4½ inches in diameter, do not spring or give under the strongest impression. Although rigid in every part, in the hands of an expert pressman it can be made responsive to the slightest overlay. This machine is fed by four feeders from single sheets in the usual manner, and does the work of four stop-cylinders in superior style. The gain in performance is not as great as the gain in quality of presswork, but quality was considered more than speed. The performance of the machine could have been more than doubled by adding to it other cylinders which would print on both sides of the paper; but careful experiment has proved that the finest woodcuts cannot be properly printed with this rapidity. To get the best results the ink on one side of the paper must be dry before it is printed on the other side.

These are the presses on which the skill of the overlayer is most signally shown. The theory of overlaying may be explained by this diagram:



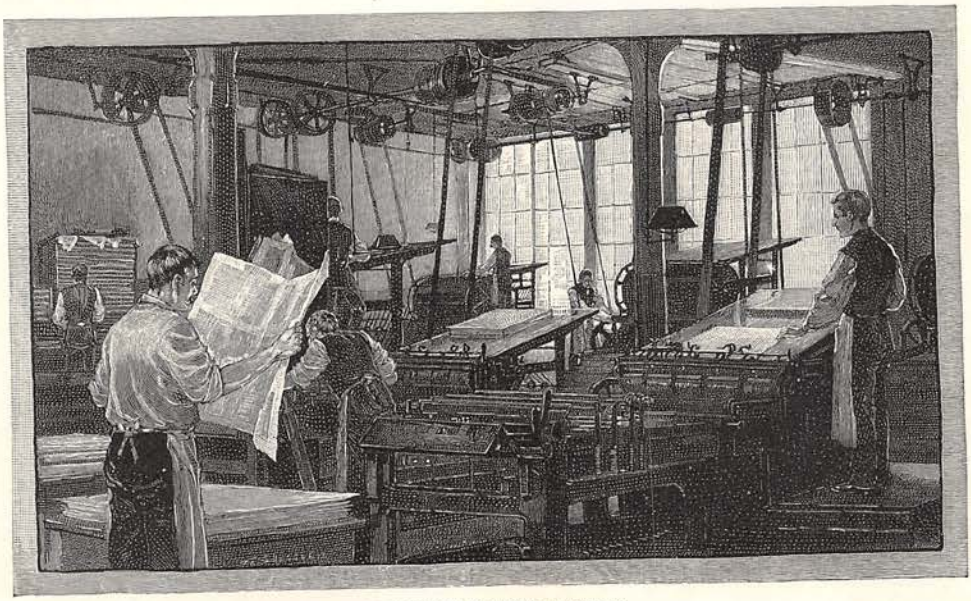
Suppose A B C D to be separate hand stamps engraved on wood. If the surface of the stamp marked D were inked the moderate pressure of ten pounds would transfer these thin lines to paper. C, having more lines, and offering more resistance, would call for a pressure of twenty pounds or more to insure a good print. B is still blacker, and resists much more, requiring say fifty pounds to force it fairly. A, which is entirely black, could not be smoothly printed



THE PRINTING MACHINES IN THE VAULT.

with a pressure of less than one hundred pounds — perhaps more. If the pressure of ten pounds were put on each square, B and C would show weak and ragged lines, while A would be blotched all over with irregular gray spots. If the pressure were made one hundred pounds or more, the lines of B and C would be hard and muddy, and D would be worn out before one hundred impressions had been taken.

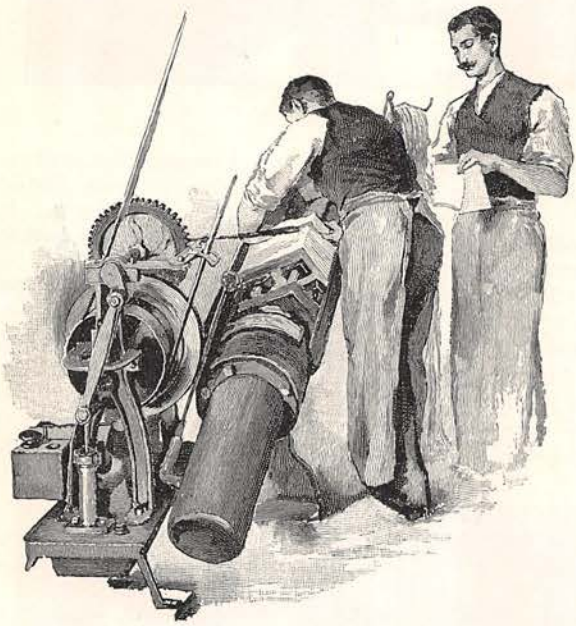
Overlaying is merely an intelligent adjustment of pressure on woodcuts — a pressure adjusted to suit the resistance, so that light lines shall have little and solid surfaces much pressure. So treated, light lines will print sharp and clear; the compact and closer lines of middle tints will be smoothly gray, and the solid portions of the dark shadows will be full velvety black. The different degrees of light and shade in every woodcut require this graduation of pressure. The theory seems simple enough, but putting the theory in practice is not. Every printing machine is made so that the pressed and the pressing surfaces shall be in exact parallel — so that pressure shall be absolutely uniform in every part. If woodcuts were like the ordinary text-types of books and newspapers in their equality of color and their equal resistance to impression, there would be no need of overlaying; no more pressure would be required in one portion than in another.



STOP-CYLINDER PRINTING MACHINES.

But woodcuts are conspicuously unequal—the thin lines, the close lines, the solid blacks, are irregularly combined. Yet each must have a different degree of pressure. On simple diagrams, like A B C and D, the result desired can be reached by pasting one or more thickness of paper over C, two thicknesses over B, and three or four over A. Adding thickness to the pressing surface gives the additional pressure. On a woodcut in which light and shade are intermixed the work is extremely difficult—not to be explained by words; to be learned only by experiment and the study of repeated failures. The rarity of well-printed, and the commonness of badly printed, woodcuts are indications of the difficulty of the art.

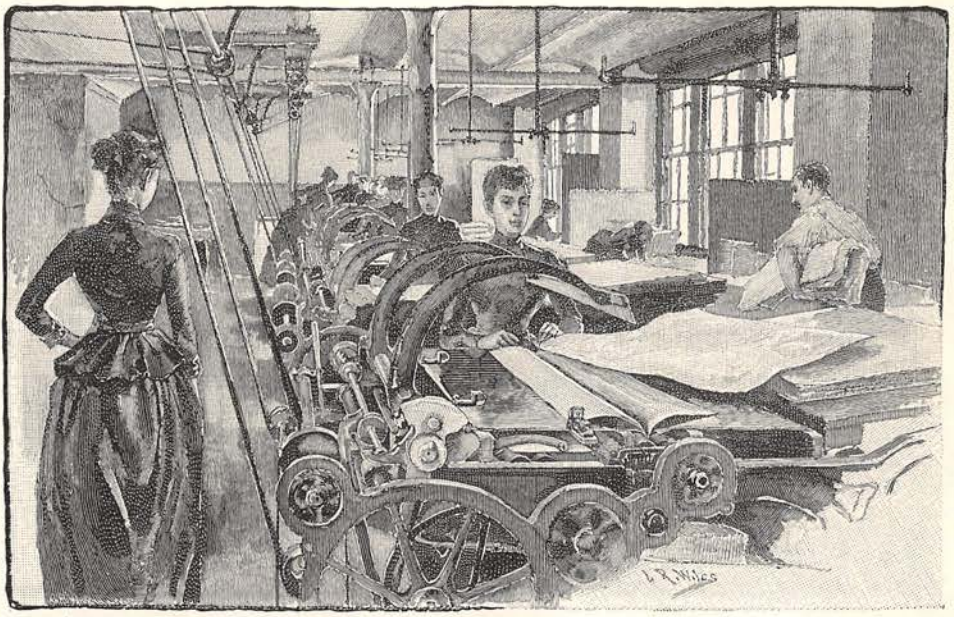
This floor and the floor above are filled with large presses, and the air trembles with their busy hum. All day long belts are spinning, heavy forms of type swing to and fro on their carriages, and sheets of paper are sweeping down the revolving cylinder and dancing out on the fly-fingers. Every one is busy. There are no idlers, but no one is in a hurry. Yet the piles of sheets that go to the elevators every hour prove that work is done with good result. The only machines which do hurry are the heavy elevator engines that start like race-horses when the porter pulls the rope. Let us try their speed, and go up again with boxes of sheets on the platform to the bindery, which occupies the eighth and a part of the seventh floor.



HYDROSTATIC DRY-PRESSING MACHINE.

In no other part of the building are work and workmen so crowded. Folding and stitching are simple operations when done leisurely, but to do them quickly and well calls for many machines and many hands. Compact arrangement must be made and needless travel avoided. There should be no unnecessary carrying forward and backward of the six tons of paper which have to be moved every day from one part of the room to another. The folded sheets of the web press are brought up by the elevator in box trucks that can be easily rolled in any direction and are put before the dry-pressers—compact little hydrostatic machines in which folded paper two feet thick is soon reduced in bulk one-fourth. The pressure is kept on the paper after it has been removed from the press, and it can be so kept for many days. These two presses, with two workmen, do more and better work than could be done by a dozen hydrostatic presses of the old pattern. The illustrated forms are folded on machines specially made for the work, which fold and cut sheets of thirty-two pages and deposit them in four long trays in the form of four sections of eight pages each. All these sheets when folded are passed through the dry-presser and kept under pressure until they are perfectly flat, compact, and free from sponginess.

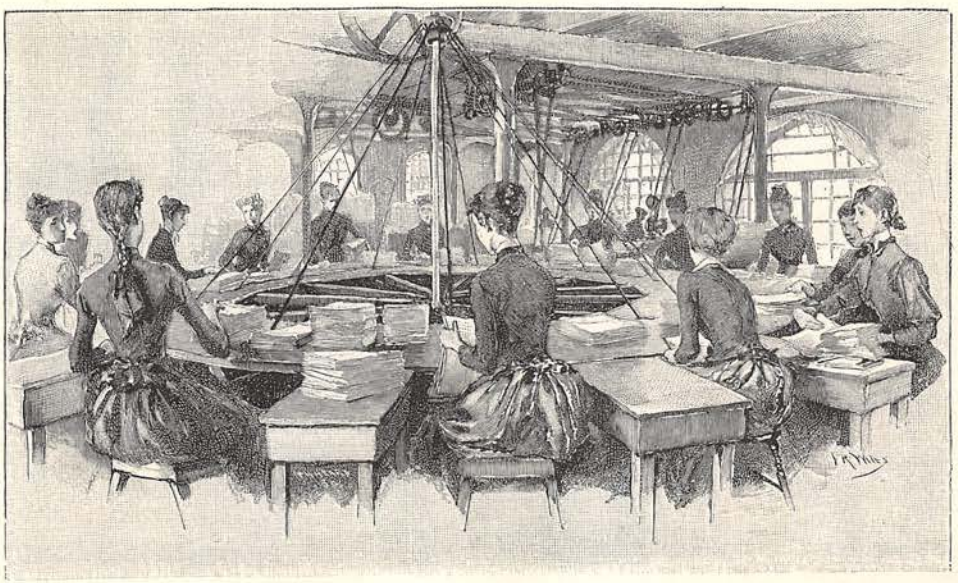
At this stage THE CENTURY MAGAZINE is in the form of twenty-five or more different sections of folded paper, scattered in as many boxes. The next process is to get them together in regular order. The magnitude of the task will be better understood when it is known that the sum total of these twenty-five or more pieces of folded paper in an ordinary edition of the magazine is never less than five million and in a large edition is often more than six million pieces. To put one piece out of its order is to spoil a copy—perhaps two copies. It is necessary that the work be done with exactness, but equally important that it be done with speed. Under the old methods of gathering, the twenty-five sections were laid down in piles and in regular order on a long table, and the gatherers in slow procession walked beside it and picked up each section in turn. How many miles a gatherer walked in a day; how tired she was before the day was half over; how little she did, even when she did her best; how much room she occupied to the annoyance of other hands—need not now be computed. It is enough to say that gathering was always a hateful task to employed and employer. To lighten this work an ingenious Englishman, whose name is unknown to the writer, invented a circular or rotary gathering table, on which the paper



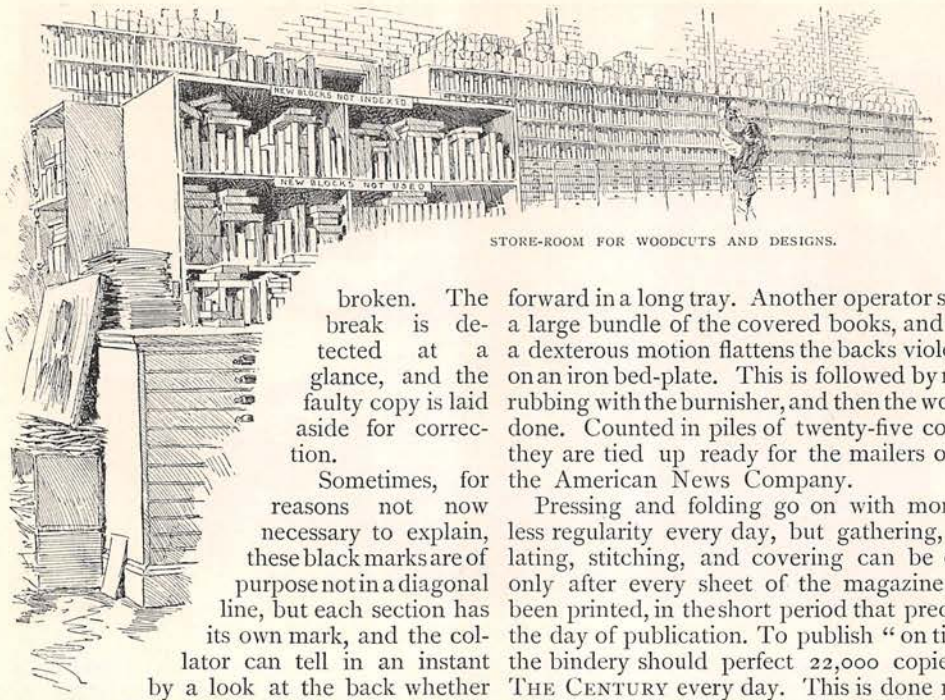
FOLDING MACHINES.

would travel to the gatherer, instead of having the gatherer travel after the paper. Here is the apparatus, which occupies a large space in the middle of the room. Around this table sixteen young women are seated, gathering the sections as they are successively presented. One can readily see that much more work can be done in a given time, in a smaller space, and with less fatigue.

The gathered sections are now passed to the collator, who rapidly examines them for faults. If there be a section too much or too little, or a section out of place, the fault can be instantly detected. How is this done? Take off the paper cover on the back of the magazine and you will see that each section of the text has its own peculiar black mark on the back of the fold. These black marks are intended to be so arranged that they shall make a continuous black diagonal line on the back. If there should be one black mark too many, or one too few, the continuity and regularity of the black line is



REVOLVING TABLE FOR GATHERERS.



STORE-ROOM FOR WOODCUTS AND DESIGNS.

broken. The break is detected at a glance, and the faulty copy is laid aside for correction.

Sometimes, for reasons not now necessary to explain, these black marks are of purpose not in a diagonal line, but each section has its own mark, and the collator can tell in an instant by a look at the back whether the magazine is or is not perfect.

Stitching machines on the other side of the room now receive the gathered copies. Compared with other machinery these wire-stitchers do not seem overstrong, but note how swiftly and securely they drive and clench two staples of wire through more than half an inch of paper. The older readers of THE CENTURY hardly need the reminder that twelve years ago the work of stitching was done by a "stabbing machine," which punched irregular holes in the paper, through which a hand-sewer put needle and thread — a slow process, which made a spongy and shackly pamphlet. The wire-stitcher can readily perfect one thousand copies in an hour, and it does its work in a manner much more satisfactory to the reader.

Covering, the next process, is also done, to some extent, by a machine. The wire-stitched but uncovered magazines are put in order on a long tray, at one end of which is an automatic clasp, which takes them one by one at regulated intervals to the prepared cover. Each cover is accurately placed by hand before iron fingers, which carry it around a narrow rotating wheel, the edge of which, exactly the thickness of the back of the magazine, is covered with melted glue. As the cover passes around the wheel the inside of the back is covered with a film of glue. It is then carried to a place where the back of the stitched magazine drops exactly upon the glued back of the cover. Sudden and strong pressure on this back firmly unites the back to the cover, after which it is pushed forward in a long tray. Another operator seizes a large bundle of the covered books, and with a dexterous motion flattens the backs violently on an iron bed-plate. This is followed by more rubbing with the burnisher, and then the work is done. Counted in piles of twenty-five copies, they are tied up ready for the mailers or for the American News Company.

Pressing and folding go on with more or less regularity every day, but gathering, collating, stitching, and covering can be done only after every sheet of the magazine has been printed, in the short period that precedes the day of publication. To publish "on time" the bindery should perfect 22,000 copies of THE CENTURY every day. This is done regularly, and the performance is often exceeded without strain. In this room, where the need of despatch is most urgent, are none of the ordinary indications of hurry. There is no running to and fro, no shouting or scolding, no feverish or frantic impatience. Every one works briskly, but no one works hurriedly.

At the elevator door the magazines separate

A WIRE-STITCHER.

—some to the American News Company, whose carts morning and afternoon stand before the door; others to the mail-room on the uppermost floor. Within a week they will be in thousands of homes on the American continent; in two weeks they will be on sale in every large European city; in six weeks at most they will meet each other, coming from opposite directions in Japan and Australia.

The mail-room and the store-room on the top floor have nothing noticeable in the way of machinery, but a good deal to show in the way of intelligent classification. Ask for any woodcut that has been printed within twelve years and you shall have it in a few minutes. To the ordinary observer these arrangements may not seem impressive, but every one who has had much handling of such disorderly objects as woodcuts, proofs, copy, sketches, back numbers, will at once recognize the executive ability which has found a place for everything and which has kept everything in its place.

Twenty years is but a short interval in the chronology of an art that is more than four hundred years old, but a good deal has been done for the improvement of printing between the years 1870 and 1890. Cylinder presses have supplanted hand and platen presses in printing woodcuts and large editions of fine books. Dry paper has taken the place of damp paper. In many large printing houses the appliances for dampening have been abolished, or set aside to be used only for rough and hand-made papers. Smooth-surface papers of moderate price have been introduced that take a sharper impression and show cleaner grays and more vigorous blacks than can be had from impressions on the luxurious India and Japan papers. Easy working and durable black inks are as common now as they were scarce twenty years ago. Electrotype plates are made of smooth surface, and are curved with unharmed lines, to fit the cylinders of rotary printing machines on which they produce presswork that fully meets the most exacting requirements. Last, but not least, the final pressing of the printed work, which makes a solid and shapely magazine, is done more quickly and more thoroughly by pressing in the fold than was ever done when the work was pressed in sheets. Some of these items may seem of trifling importance to the reader. Singly, they may be; collectively, they are not. Whoever compares the first number of this magazine with the latest, must admit that decided improvements have been made in magazine printing. In the literary workshop of which John Milton dreamed, "the pens and heads, sitting by studious lamps, musing, searching, revolving new notions and ideas," were those only who thought and wrote. Now, the thinkers have mechanical helpers. In machine shops and paper mills, in printing houses and electrotype foundries, are other studious men equally busy in mechanical devices that aid the writers in realizing this dream of the "Areopagitica."

IN THE MAILING ROOM.

Theodore L. De Vinne.

practical guidance. The study of history, in order to be really useful, ought to be directed to tracing the progress of civilization, not in political forms merely, but still more in those underlying principles, moral, philosophical, and others, which really shape and control political affairs themselves. If properly pursued, too, historical study is admirably fitted to inspire the student with the spirit of progress, and with that regard for justice and the common weal which is so essential to the right conduct of public affairs.

But there is a further consideration which seems to have escaped the notice of most of the advocates of political education. It seems to be thought by those who have planned courses of study in political science, that a knowledge of political economy and political history and a few related subjects is sufficient to fit a man for statesmanship, or for acting as a public counselor in political affairs; but is not this a mistake? The politician, whether leader or counselor, has his specialties, of course; but if he is nothing but a specialist, he is by no means fitted for the conduct of affairs. What he needs above all, after a spirit of justice, is a true conception of human life and of the relative value of the different elements that go to make up civilization. If he has been so superficially taught that he regards material good as the chief object of human endeavor, he will be wholly incompetent to govern a nation in the way most conducive to its well-being; for the end of life is not to amass and display wealth, but to cultivate those higher interests of science and art, literature, morals, and religion, which give to humanity all its dignity and worth.

How narrow and uncultivated men, if they happen to become legislators, may treat the higher interests of mankind, we have practical illustration in the conduct of our own Congress toward literature and art. Artists and others petition to have the tariff on works of art repealed, but Congress contemptuously increases the tariff. The same spirit is seen in the persistent refusal of our national authorities to secure an international copyright, while inventors of machinery are fully protected, and have their just rights in all civilized lands.

The truth is, the work of statesmanship is so broad and multifarious that no narrow special training can be an adequate preparation for it. A good general education ought to be added to the special one; and the political studies themselves ought to be so broadened as to include ethics especially, and such a study of history as will show the student the real springs of civilization, and the effects of good and bad government on the higher interests of mankind.

J. B. Peterson.

On the Printing of "The Century."

QUESTIONS have been asked and suggestions offered concerning the printing of THE CENTURY, which call for long explanations. May I ask you to print this as a general reply? These questions and suggestions are substantially:

1. Why do you not print THE CENTURY on the rough, hand-made papers now largely used for choice books? Etchings are well printed by Salmon on Whatman and Van Gelder papers. Why can't you print wood-cuts on the same or similar papers?

2. Why do you go to the other extreme and print on dry and smooth paper, which has, at times, an unpleasant glitter, and which does not hold ink as well as damp paper?

Hand-made paper cannot be used because it costs too much. The unprinted paper for one number of the magazine would cost much more than the thirty-five cents now paid for the printed and bound number. All publishers of books ask for copies on hand-made papers from three to five times more than for copies on smooth ordinary paper.

Rough-faced or plain-surfaced machine-made papers could be used for plain type-work, but not for printing the wood-cuts. A print on sail-cloth must be coarser than on satin; a print on rough paper cannot show the fine lines of relief engraving as well as a print on smooth paper. Seen through a magnifying glass, rough or plain paper has a surface on either side made up of fuzzy elevations and depressions, not unlike that of cotton cloth, but on a smaller scale. It is not a truly flat surface. But every wood-cut is as flat and smooth as skill can make it. A light impression against a wood-cut allows the elevations only of the rough paper to touch the cut. This makes the broken or "rotten" lines and spotty or "measly" blacks detested of all engravers. Full impression presses these elevations around the lines; it jams the paper in the cut; it thickens light lines, chokes white lines, and muddies color everywhere.

American printers of wood-cuts do but follow the lead of engravers on wood, who should be permitted to decide what kind and state of paper is best fitted to show their work. Whether printed on India paper by rubbing or on plate paper by press, the paper for the engraver's or "artist's" proof is always smooth and dry. American type-founders prefer to have their specimens of types printed on dry, smooth paper.

The reference to the successful use of Whatman's paper by Salmon is not to the point. Salmon's method, the copper-plate process, is entirely different. The etching is printed on a small sheet at the rate of six an hour; the profusely illustrated magazine sheet, more than four times as large, at the rate of six hundred an hour. The etching is printed from lines sunk below the surface of the copper-plate; the wood-cut from lines raised above the surface. The ink that makes the print in an etching is confined in little ditches that will not allow it to escape under pressure; the ink that makes the print of a wood-cut is spread in a thin film over the surface of the cut, and will spread or get thick from over-pressure.

The relative values of papers cannot be determined by their roughness or smoothness. The teachings of Art on this subject, as expounded by amateurs of printing, are contradictory. The rough, half-bleached, but honest linen papers in the books of the early Flemish and German printers were not esteemed in their own time. The book-buyers of the fifteenth century judged them vastly inferior to the smooth vellum of old manuscript books; and buyers of this day prefer the smoother paper and printing of the old Venetian printers and the French printers of missals and devotional books. At the end of the last century the Whatman mill was making excellent paper, but there were English bibliophiles who went to Bodoni

of Italy to get smooth paper and printing which they thought could not be had in England. The papers in the books of Baskerville, as well as in those of Dibdin and the Roxburghe Club, are below the standard of roughness now in fashion. When rough papers were common, the smooth paper was preferred. Now the tide has turned. Smooth papers being common enough, rough paper is "artistic." Price has something to do with artistic preferences. A spotty and cloudy smooth Japan paper is of more value than the rough hand-made linen; the wriggling vellum, too often greasily smooth, is highest of all in price. Is it the perception of really meritorious qualities in paper, or the intent to have what few can get, that makes the buyer at one time prefer, and at another reject, a smooth surface?

The opinion that dry paper does not hold ink as firmly as damp paper must have been obtained from some special or unfair experiment. Under the unwise and entirely unnecessary process of dampening the leaves (which will make them stick together), and of scrubbing or scraping these leaves together by violent beating under the book-binder's hammer, the ink will set off. Under this treatment any strongly printed work will lose its color, smear, or set off. But this is not a fault of printing, but of book-binding. Before leaving the bindery each copy of THE CENTURY magazine is tested by a direct (not a scraping) pressure of not less than a thousand pounds to every square inch of surface. Under this pressure any moisture or oiliness in the ink would at once be apparent. Twenty years ago the few black wood-cuts in books and magazines were faced with tissue paper to prevent smear. This tissue paper is no longer needed, although black wood-cuts are more frequently used, and are always printed with more ink and more clearness.

The best results are had from dry printing. Prejudice has nothing to do with this conclusion. The printers whose experience teaches them that dry and smooth paper has the best surface for wood-cut printing prefer dampening when the cuts are to be printed on rough paper. If an American printer were required to produce a facsimile of an early book on rough paper, he would surely dampen it. But the water that softens a rough paper is injurious to smooth paper.

The dampening of any paper is a practical admission that it is, in its dry state, unfit for press-work. Then come the questions: Why should it be unfit? Is it not possible to make paper printable by giving it from the beginning a faultlessly smooth surface? These questions have been fairly answered by the paper-makers of THE CENTURY. The paper they furnish is printed without dampening, yet with a sharpness of line on cuts and type, with a fullness of black, and a uniformity and firmness of color, impossible on damp paper.

Wood-cuts of unusual fineness and shallowness, with a delicacy of silvery tint heretofore rated as "unprintable," have been shown in this magazine (see pages 701–720 of the last volume of THE CENTURY), with the blackest of backgrounds, and without any loss of engraved work. If there be any printer who thinks he can get as good a result from damp paper, I am sure that I can not.

The publisher selects smooth paper, not because he thinks it luxurious, but because it yields better prints. He gets from it the result he seeks. It enables him to show a breadth, a beauty, and variety of engraving that cannot be shown by any other paper. He accepts the gloss on it in the same spirit that the book-collector accepts the specks and dinginess of India paper, the smoky cloudiness of Japan paper, the uneven thickness and variable color of vellum. He cannot get all the good qualities in any one fabric. He does not seek gloss. If he could get smoothness without gloss, he would have it.

Theodore L. De Vinne.

Recent Inventions.

IN the application of electricity to industry the tendency of recent work appears to be towards the construction of new forms of self-acting or self-controlling appliances. The opening or closing of a circuit at one point may cause the movement of an armature at a distant point in the same circuit. This is the underlying idea of the telegraph, fire and burglar alarms, and many other industrial applications of electricity, and a great number of inventions have been brought out seeking either to make the closing or breaking of the circuit at the transmitting end of the line, or the movement of the armature at the receiving end, automatic — self-acting, self-controlling, or self-recording. For instance, the rise of the mercury in a thermometer may close a circuit by touching a wire suspended in the upper part of the tube of the thermometer, and thus sound an alarm-bell. This idea is used in several forms of thermal alarms, and for another purpose in thermostats. The thermometer may be in a dry room or cold-storage warehouse, and the bell in a distant office, and serve a good purpose in reporting a dangerous rise in the temperature. The objection to such an alarm system is that it is too narrow in its range. It only reports the rise of the temperature to a known point, and tells nothing of the movements of the mercury above or below that point. One of the most recent inventions in this field seeks to make a self-reporting thermal indicator that shall give on a dial every movement of a thermometer at a distance.

For this purpose a metallic thermometer is used. It consists of a bar composed of two metals, having different rates of expansion and contraction, brazed together and twisted into the form of a spiral spring. By means of simple mechanism the bending of the bar, under the influence of heat and cold, is made to turn an index on a dial marked with the ordinary thermometer scale. In converting such a thermometer into an electrical apparatus for transmitting indications of the thermometer to a distance, a shaft moved by the variations in the instrument carries at one end a short arm. A sleeve, slipped over the shaft, carries the index of the thermometer, and also two arms placed one on each side of the arm on the shaft, and each connected with the line wire leading to the distant receiving station. There is also on the sleeve a toothed wheel, the arms and the wheel being insulated from the shaft. The receiving instrument consists of a shaft carrying a toothed wheel of the same size as the first, and also an index moving over a dial having a thermometer scale. On each side of the toothed wheel in each instrument are electro-magnets having armatures, that