

## AMERICAN INDUSTRIES.—No. 37.

## THE MANUFACTURE OF BOOK PAPER.

It is a remarkable circumstance that paper made from rags should have replaced parchment, papyrus, and the whole range of substances used for making records, and come into general use just at the time of the invention of printing, and it is singular that nothing but paper will answer the requirements of the printer.

It is impossible to place definitely the date of the invention of paper. It is one of the things that originated in the remote and hazy past, and like many other things connected with human economies it has been gradually developed and perfected until every condition and requirement in its use seem to have been fulfilled.

It is probable that the first paper from pulp was made in China, and that from thence the art spread over the world. It is not even known when or where linen paper was first made, but it was generally in use about the middle of the fourteenth century.

Until within about a hundred years all paper was made by hand by a slow and laborious process, the supply was naturally limited, and the quality necessarily lacking in uniformity; but the trade was completely revolutionized by the invention of the Fourdrinier machine, by Louis Robert, an employe in the paper manufactory of Francis Didot, in France, in the year 1798. The credit of making the machine practically useful belongs to the Messrs. Fourdrinier, of London, from whom the machine takes its name. The machine was improved in various ways until, in 1806, it was so far perfected as to reduce the cost of paper to about one quarter of the former price.

Within the last fifty years many important improvements have been made in the manufacture of paper. These include the pulp dressing machine; the steam driers attached to the Fourdrinier machine; the rotary cutters which cut the web into any required width, and many other minor yet essential improvements which conduce to the present perfection of paper-making machinery.

Another comparatively recent improvement is the machine for supercalendering, consisting of four paper rolls and four well polished iron rolls, arranged in alternation and placed vertically one over the other. These machines are used for glazing fine papers such as ledger, flat, writing, and fine printing papers. In some instances chilled iron calender rolls are attached to and form a part of the machine, but this arrangement is used only for the lower grades of paper.

Space will not permit of a detailed history of the paper making industry; we have therefore chosen a representative establishment to illustrate the development of this branch of manufacture.

The Albion Paper Company, of Holyoke, Mass., was organized in 1869, when they bought the old wooden mill formerly owned by the Hampden Paper Company of the same place. The mill then had a capacity of 3,500 lb., which was soon increased to 5,000 lb. daily, and the product was used in the manufacture of paper collars. About eight years since the product of the mill was changed to supercalendered book paper; and in 1878, a parcel of land with water power adjoining the old mill was acquired, and a new and extensive brick structure was erected and supplied with the most modern and improved machinery, capable of turning out five tons of paper daily. A year later a second mill similar to the first was built, and filled with the same kind and amount of machinery, excepting that three engines more were added and a few improvements were made. These buildings are shown in the bird's-eye view at the left of the large engraving.

The main mill is 330 feet long by 34 wide and two stories high, with basement and attic. The bleach boilers and rag engines are in the first story, while the second story and attic accommodate the arrangements for sorting and dusting rags. From this building two wings, each 34 feet wide, containing the machine rooms, extend forward 104 feet, and connect with a building parallel to the main mill and forming the street front of the whole structure, which is thus in the form of a quadrangle inclosing an open court. The front building is 210 feet long by 34 deep and two stories high, with attic. The front is relieved by a square tower in the middle, and a similar tower at the rear of the rear mill contains stairways and elevator.

The buildings are so planned that neither stock nor finished paper has to pass over the same ground twice. The Holyoke and Westfield Railroad discharges rags and other materials at the rear, which, in the process of manufacture, pass forward to the finishing room, from which the paper is shipped.

The equipment of machinery, all of which is made in Holyoke, is very complete and modern. Five steam boilers are used to supply the four rotary bleach boilers, each of which, 21 feet long, has a capacity of five tons of rags. The engine room, besides these bleach boilers, contains thirteen 1,000 pound engines and two Jordan engines. There are two Fourdrinier machines, one of 84 and the other of 86 inches; four stacks of supercalenders, 36 inch face, 9 rolls to the stack, one stack, 40 inches face, and a stack of sheet calenders; seven Hammond cutters, and two Cranston trimmers.

The water power from the second level canal is utilized by several of the Holyoke Machine Company's Hercules Wheels. The mill employs 265 hands. It makes some engine-sized flats, but is run mainly on fine book paper, all of which is supercalendered. The buildings are provided throughout with the new automatic sprinklers, which, in

case of fire, floods the rooms the instant the heat becomes sufficient to melt the solder which holds the valve.

The material from which the paper is made, in its course through this manufactory, follows a regular order constantly advancing from the place of the entrance of the raw material to the place of exit of the finished product.

The stock is carried by elevators to the attic, where it is first put through an opener or duster, which whips out the greater portion of the dust contained by the rags, opens the folds, and puts them in condition to be examined and assorted. From the attic the stock is dropped to the floor below, where it is placed in baskets and distributed to women to be assorted and divested of buttons, hooks and eyes, pins, etc. After this it is spread out upon large tables and looked over carefully, and pieces of wood, rubber, and other substances likely to injure the paper are removed. The department in which this work is done is represented by one of the views in our engraving.

The stock is now carried forward to the cutting machine (shown in one of the smaller views), which rapidly cuts it up into small pieces, after which it is dusted and let down through hoppers in the floor into huge bleach boilers (shown in the engraving), where they are sealed up and subjected to the action of lime and steam for twelve to eighteen hours. These immense boilers are constantly revolved at a slow speed to bring all of the stock under the action of the bleaching agent.

After this operation the stock is conveyed to the washing engines, where it is washed for six or eight hours, according to the quality; it is then bleached by the application of bleaching powders, after which it is allowed to run through valves in the bottoms of the washers to brick drainers in the basement, where it is allowed to remain from two to four weeks.

The half-stock, as it is now called, is put into the beating engines, where the fiber is brought out to the required length. Of these machines the Albion Paper Company have six, also seven washers, making a total of thirteen engines. The lower view in the engraving represents the long row of engines used in the establishment. In these engines the rags are drawn between the cutters on the large revolving cylinder and the stationary cutters in the bottom of the vat, and are torn into the finest filaments. The stock goes round and round in this machine, being acted upon by the cutters again and again, the huge cylinder carrying the cutters being meanwhile gradually lowered by the mechanism seen at the side of the vat, until the stock is reduced to a fine pulp. The thin pulp is allowed to run out of the engines into wooden chests, whence it is pumped up into the tank of the Fourdrinier machines. From this tank the pulp flows into a small chamber, where it is kept in constant agitation until it flows out over a channeled plate—upon which extraneous matters of greater specific gravity than the pulp are arrested—and is delivered to an endless wire cloth apron, which is continually agitated to insure an even distribution of the pulp fiber. The wire cloth apron is supported on a series of small rollers, and the width of the paper is governed by deckle straps at each side. The wire cloth apron passes over a box in which a partial vacuum is maintained, which withdraws a part of the moisture from the paper as it passes over the box.

The paper is delivered by the wire cloth apron to a felt apron, which conveys it to the first pair of press rolls which expel the moisture and deliver it to an apron which carries it forward to a second pair of press rolls, where more of the moisture is removed and the web is still further compressed; it is then passed to another blanket which delivers it to a series of steam-heated rolls. These rolls, as well as the other portions of this machine, must move in absolute harmony, and the mechanism must be of the most perfect character to handle the thin and extremely tender web of moist paper. The paper, as it is delivered by the machine, is in rolls. This mill has two Fourdrinier machines, one producing paper 76 inches wide, the other 79 inches wide. These machines are of Rice, Barton & Co.'s make. The paper is cut into different widths, as it is delivered to the reels, according to the requirements.

The finishing room adjoins the machine room, and all of the paper is passed through the calender rolls until a high finish is obtained.

The machinery of the Albion mills consists of 13 (1,000 lb. each) engines; two Jordan engines; four rotary boilers for rags having a capacity of five tons each; two Fourdrinier paper machines (84 and 86 inches wide). The calenders consist of four stacks having 9 rolls each, 36 inches wide; one stack 40 inches wide; one stack for calendering sheets.

The capacity of the mills is twelve tons of book paper per day.

The water supply, which must of necessity be pure and clean, is derived from driven wells, 115 in number.

The officers of the company are as follows: Calvin Taft, President; Edward C. Taft, Treasurer and Agent; A. H. Page, Clerk. These gentlemen also comprise the stockholders of the company. The entire mill is under the management of Mr. William Reardon.

## Habits of Fishes.

It has been long known that fishes return to about the same place in the same rivers each year to spawn, but it is a recent discovery that they go up the left hand side of the stream and coming down take the opposite side. Fishermen may be benefited by remembering this.

## Correspondence.

## The Value of Vaccination.

To the Editor of the Scientific American:

Your issue of March 6 contains a letter from an English correspondent upon the subject of vaccination. Without going over the immaterial portions of his letter, those only of importance are, first, in relation to bovine and humanized lymph. Are they equivalent, and is vaccination performed with one considered equally protective by those who believe in vaccination as that performed with the other? He smites the air vigorously to establish what no one denies, namely, that they are equivalent and equally protective. Having gained this important vantage ground, he proceeds, in the second place, to show by statistics from various hospitals of Great Britain, that during ten years, irregularly and imperfectly observed, 37,636 cases of smallpox occurred, and that 28,468 of these were reported as vaccinated. This he brings forward as irrefragable proof that vaccination is an "unparalleled failure."

Now, this is the statement which in some form or other has been put forward as the strong argument against vaccination ever since agitation of the subject commenced.

Simply stated, it is this, that three-fourths of all the cases of smallpox treated in the hospitals of Great Britain have been vaccinated, consequently vaccination is valueless. Let us examine this statement, and in order to do so it is necessary first to determine what constitutes vaccination. In the January number of the *Popular Science Monthly* for the current year is an article entitled "Vaccination in New York." It is a statement of the methods and results of vaccination as practiced in this city, in contrast with the statements of Mr. Moncure D. Conway regarding the results, as he pictures them, in Europe, and especially in England.

I have there given the careful and exact methods of vaccination as practiced by the vaccinating corps of the Board of Health of New York, and a large class of intelligent practitioners of medicine, and the results obtained in the way of protection.

These results concisely stated are as follows: Vaccination, in order to be protective, should be done with eight-day lymph, either from a healthy infant or from the calf. The vesicle should be characteristically perfect on that day. The vaccination so performed should produce a similar perfect vesicle upon the eighth day and run its normal course.

Those who have given their attention almost exclusively to this subject for the past ten years, in connection with the Board of Health and in public institutions, recording cases and noting their behavior when subsequently exposed to smallpox, unhesitatingly declare their belief that such vaccinations are a perfect protection against the disease; at least to the same extent as though it had been experienced.

In support of this statement and belief numerous cases are cited, and the number could be indefinitely increased where, during the epidemic of 1874-5, among members of the same family, the unvaccinated, almost uniformly, when exposed, took the disease, while there is not a case of an individual who, having received the inspector's certificate of vaccination, subsequently contracted the disease, even though living for days in close rooms where it existed.

Another remarkable fact bearing upon this subject is the following, as reported by Dr. Taylor, Inspector of Vaccination. It was the custom, during the epidemic of 1874-5, where a mother having an infant at the breast was attacked by the disease, and was obliged to go to hospital, to immediately vaccinate the infant, and then send both mother and child to the smallpox hospital, a place at that time crowded with cases of the disease in every stage of progress. As a result of this procedure not a single infant so treated took the disease, notwithstanding the fact that the infant was nursed by the mother throughout her illness.

The belief of those who have been the most diligent students in this matter, is that one perfect vaccination protects through life; nevertheless a certain small percentage of those vaccinated in infancy only take the disease when exposed in later life. It is therefore advised that children vaccinated in infancy be revaccinated about the fifth or sixth year. So also as a safeguard against possible infection it is advisable that vaccination even in adults should be repeated, and especially at some time of unusual exposure, such, for instance, as must occur in epidemics of the disease.

It is not claimed that the rule of protection is absolute and without exception, any more than other rules and laws in the economy of nature. The fact of having once had smallpox is usually considered the best possible protection against future attacks; and yet cases occur where the disease is experienced twice and even more times by the same individual.

So persons who have been vaccinated according to the suggestions above laid down are considered thoroughly protected, though one case of smallpox in a very great number might possibly occur among them.

It is only persons who have been so vaccinated, and who have received all the protection which vaccination is capable of affording, who can properly be counted in arranging statistics upon this subject.

Now, what knowledge has your English correspondent concerning the 28,468 cases of smallpox which are reported as vaccinated? How many of these have ever really been vaccinated? How many of those really vaccinated have fulfilled the conditions necessary to thorough protection by the perfection of the virus used, a proper method of vacci-

# SCIENTIFIC AMERICAN

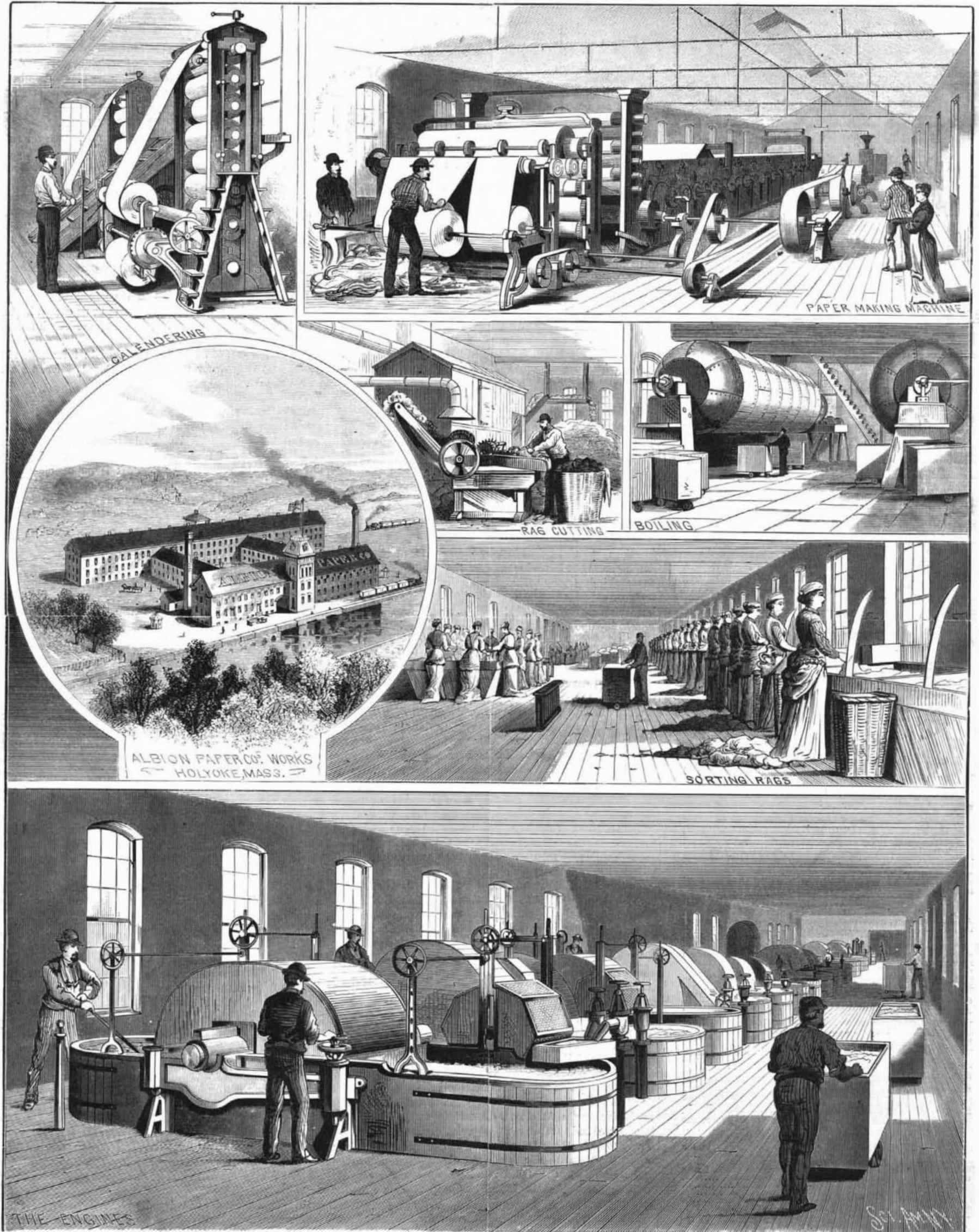
[Entered at the Post Office of New York, N. Y., as Second Class Matter.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY AND MANUFACTURES.

Vol. XLII.—No. 14.  
[NEW SERIES.]

NEW YORK, APRIL 3, 1880.

[\$3.20 per Annum.  
[POSTAGE PREPAID.]



THE MANUFACTURE OF BOOK PAPER—ALBION PAPER MILLS, HOLYOKE, MASS.—[See page 211.]