

Thesis,
A Sheet of Paper.
Jeanette Perry:
1898.

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The three staple articles of manufacture that are most essential to modern civilization, it is said, are food, clothing and paper. If this estimate of the importance of the paper industry is a correct one, then people generally are deplorably ignorant of one of the most familiar as well as most indispensable articles of our civilization. There are few people indeed who know anything of the processes through which a sheet of paper must go before it is ready for use.

It is very interesting to trace the evolution of writing materials from the light, smooth substances such as some barks or broad leaves anciently used to transmit short and simple messages, to the thin sheets of metal, ivory or leather, painted cloths, stones and bricks. Then as the wants of communities become more complex, the population increased, and materials for records as well as for messages were necessary, inscribed leaves strung upon threads for preservation, the bark of trees made pliant enough to be rolled, or thin strips of wood covered with wax, were all substituted for the more primitive materials. The industry developed little by little until parchment and papyrus used by the Greeks, the Persians and the Egyptians were superseded by the Chinese invention — Paper.

History shows that as man has grown out of his primitive and crude condition into higher civilization, he has appreciated and utilized more and more this article - paper, whose use is so necessary to intellectual advancement. The countries where education is the most universal, the average intelligence is highest and the desire for knowledge and information is keenest, have been found to be the countries which use the most paper per capita.

The popular idea that paper is made from rags is true only of fine writing paper and of a few book papers. Newspapers and most book papers are being made entirely from wood fibre notwithstanding the fact that the material is more perishable than the rags. Out of the thirteen thousand tons of paper manufactured every twenty-four hours in the United States alone, the larger part is made from wood and not from rags as many suppose.

The manufacture of paper may be separated broadly into two processes:

1. The preparation of the pulp.
2. The formation of paper from the pulp.

The cellular matter is destroyed by digesting the wood in chemical solutions - the spruce by sulphurous acid, the poplar by caustic soda.

Ground or mechanical wood pulp, so

called is made by grinding the ends of spruce logs against a revolving emery wheel under water. This makes a finely divided sawdust in which the wood retains all its natural gums and acids but has no fibre. This is the cheapest form of pulp and therefore is used only for newspapers and manilla wrappings and must be mixed with more fibrous material such as the chemical pulps before using.

Chemical methods used in preparing wood fibres are the:

- I. Sulphite Process and the
- II. Soda Process.

I. In the sulphite process, the spruce logs are split, the knots bored out and the logs fed into a chipper in which four knives are arranged at an angle of 45° to the center line of the machine. Each knife cuts off diagonal chips $\frac{5}{8}$ to $\frac{3}{4}$ of an inch long from the log.

A conveyor into which the chips fall carries them to the second story where an inclined oscillating screen removes the dirt and sawdust, then deposits them onto a traveling sorting table. All the shivers, large knots, etc. are picked out, then an inclined

conveyor at the end of the table carries them to a large storage bin above the sulphite digester.

The sulphite for treating chips in the digester is prepared by burning sulphur and drawing the fumes thru a series of tanks containing a solution of milk of lime.

The digester is filled full of chips, the acid is piped in and the cover of the tank is bolted on. Steam at eighty pounds pressure is introduced at the bottom, thus causing a continual circulation in the liquid, whose cooking lasts from eight to twelve hours.

During the cooking, the acid solution attacks and renders soluble the incrustating matter of wood, resin, lignose and cellular matter, dissolving it out, leaving only the pure fibre of the wood. When the fibre has cooked enough, a valve is opened and the contents are driven out into the "blow pit", a large wooden tank which has a perforated false bottom thru which the spent liquor containing the dissolved resinous and cellular matter of wood now drains off as waste. The sulphurous gas has bleached the pulp until it has a beautifully transparent appearance.

After the pulp has been thoroly washed with pure water, it is pumped up into a mixing box and

mixed with just enough water to give it the proper fluidity, and is then run into the Screen room.

Coarse screens first take out the knots and any uncooked fibre, and then the pulp flows into a settling box, where any particles of lime or dirt are removed by gravity before it passes finally out and is drawn down thru fine screens.

As it flows thru a copper cylinder the water drains away, leaving the moist pulp looking like half melted snow. Jets of water are continually playing upon the outside of the cylinder for the purpose of keeping the perforations from being choked up by pulp as well as of washing the fibre.

After a conveyor has carried the pulp thru the bleaching engine, in order to prevent the sulphite pulp at this stage from turning yellow, it is subjected to the action of chlorine for several hours.

A series of washings and drainings now fit it for the mills where it is to be formed into sheets.

II. The Soda process: —

The sulphite process as described above would not make good book paper if used alone because the stock is too hard, due partly to the quality of the wood used, and partly to the process of manufacture. The lack of flexibility and softness

necessary for taking a good impression in a printing office is overcome by using two different kinds of wood and two distinct processes in preparing the pulp and mixing the two grades in certain proportions according to the quality of the paper desired at the mills.

This softer and more flexible kind is known as soda pulp. It is prepared in somewhat the same way as the spruce, except that the poplar chips of which it is made are cooked in a digester with about ten percent of caustic soda instead of sulphurous acid. This cooking liquor is made by dissolving soda ash, then treating it with lime. Steam secures the circulation of the liquor in the chips, and after they have cooked about nine hours and have turned black, are blown out into iron blow pits.

A number of washing pits drain off the liquor and by washing in a weak alkali and hot water, the black pulp becomes pale buff in color.

Screens and strainers prepare the mass for the "wet press" where the surplus water is taken out by revolving felt rollers. It passes the reels of wood, and is delivered a solid roll of paper ready to be taken to another room where the cutting machines are busy making up sheets of the desired size.

If a high finish is desired after it comes

from the cutter it is pressed in strong hydraulic presses, then rolled or glazed under heavy pressure between highly-polished sheets of copper, zinc or brass. The product at this stage is little more than a sort of blotting paper until the porous and absorbent character is removed by sizing.

In the sizing process, a weak solution of gelatin or animal size is placed in a shallow box thru which the paper passes midway of the driers and the superfluous size is removed by the "squeezer-rolls".

This animal sized paper is sometimes dried by passing it over a series of wire cylinders exposed to currents of air; or it may be cut into sheets and dried by hanging it in a loft or drying room where a warm temperature is maintained.

While the wood pulps just described are useful as wrappings and as newspaper material, the one quality of durability is wanting.

The sheets are too weak to make paper of sufficient strength for many ordinary purposes. So where it is essential that the pages be suitable to resist both chemical and mechanical wear and tear, it is necessary to use the purer cellulose fibres such as cotton

and linen.

Books made in the middle ages when cellulose fibres were the staple raw materials for the production of paper, have come down to us and show evidence of their resistance to the natural processes of disintegration. Cheaper papers made from wood, esparto or straw soon become discolored and disintegrated under ordinary circumstances, thus showing that the use of these fibres is practicable merely where permanence is not taken into consideration.

One advantage to be seen in using the cheaper fibres of the wood is that the larger percentage of the matter published today is fit only to be destroyed, and the natural tendency toward disintegration in the paper serves a useful purpose in ridding us to some extent, at least of sheets of paper worse than worthless.