ESSENTIAL FACTS ABOUT PAPER

H. V. Clulow.

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ESSENTIAL FACTS ABOUT PAPER

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TO PRESS ROOM, ETC.

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FOREWORD

The United States is the largest producer of paper in the world, making annually a tonnage larger than that of any other five nations combined.

Over seven hundred mills are engaged in the production of this commodity in our country, and the uses for paper have become so extensive as almost to baffle enumeration, and to require a high degree of specialization in its purchase and distribution.

Long training and efficient organizations are requisite to maintain familiarity with both the sources and the market. The large variety and quantity of stock sufficient to satisfy the diversity demanded in the trade has made the Paper merchant a permanent and necessary economic factor.

In the conduct of this business we recognize intelligence and service as prime factors for winning and holding a satisfied clientele. Many of the old school merchants operated on the basis that the less their customers knew about paper the better it was for themselves, as that would make them more dependent upon them. We feel that the reverse is the case, and that the more helpful information we can give, the better we are serving. It is with this thought and wish that we have had this book of ESSENTIAL FACTS ABOUT PAPER prepared, and present it to our friends with the hope that they may find its contents useful.

CHAPTER I

PRINCIPAL RAW MATERIALS

Fibres which comprise the chief raw material in paper making are invariably some form of cellulose. These cellulose fibres differ in purity, form, and length as they exist in the raw state. Consequently the paper maker selects them in reference to the use for which the paper he makes is intended. The purest form in which cellulose fibres naturally occur as raw material available for paper making is in cotton and linen cuttings and rags. Such fibres are practically pure cellulose, their impurities consisting mainly of sizing and dyes.

Cotton Fibre

Cotton fibre is long and tubular and when dry collapses and twists spirally, thus in the mass of paper effecting especially good adhesions, one with the other. Papers made exclusively from cotton fibre are strong and flexible excepting, of course, specialty papers such as blotting.

Linen Fibre

Linen fibre like cotton is tubular, but has thicker walls which are jointed like a cane or rush. They are long, strong, and flexible and form compactly, making a strong, hard paper of great durability. A noted English Authority, Mr. J. W. Wyatt, says, "With long and careful manipulation in the pulping engines, taking precautions to draw the fibre and

not to cut it, new cotton will give a stronger and much closer paper than new linen. The linen fibre, under the beating-rolls absorbs water more readily than the cotton fibre, and works up into a more 'greasy' and wet state necessary for a stiff, firm sheet of finished paper, but it does not with that necessarily develop strength.

"After numerous trials to obtain a strong machine-made paper, the strongest was produced with new cotton intimately mixed with about one-fifth or one-sixth of its bulk of new linen."

The quality of rag paper varies according to the newness and condition of the rags or cuttings used in their making as well as in the manipulation of the stock. Hence, the percentage of rag in paper is not a positive criterion of the quality. Color and strength must also be considered.

Hemp

Hemp derived from ropes, course bags, etc., yields a very strong fibre, Manila hemp giving the best quality.

Jute

Jute, which *is* the *fibre* of an Indian plant, also *yields* a very strong *fibre,* but neither of the latter two fibres are easy to bleach and would consequently not be used for white paper.

Esparto Fibre

Esparto fibre is extensively used in England and is derived from a grass grown in Northern Africa.

It is not available for American manufacture, but produces a raw material on a par with the best bleached sulphite pulps.

Ground Wood Pulp

The lowest grade of wood pulp consists in the ground up fibres of spruce logs from which the bark has, of course, been removed. Containing as it does considerable non-cellulose material, it is not suitable for papers of permanent value, both because it grows brittle, and becomes discolored through the action of light and air.

Chemical Wood Pulps

Chemical wood pulp is virtually pure cellulose fibre obtained by the chemical treatment of wood chips, whereby the non-cellulose constituents are eliminated. The yield of cellulose from wood is almost 53%.

The strength and quality vary with the wood used and the process employed. A soft pulp is obtained by the "Soda" process from aspen and poplar wood and is known as "Soda Pulp." A strong pulp is obtained from spruce or other coniferous wood by digestion in sulphite or sulphate liquor. Sulphite pulp for white papers must naturally be bleached, though in cheaper grades the unbleached sulphite may be used in combination with whiter fibres derived from old papers worked over and "Soda Pulp." Sulphate pulp is particularly strong and is used exclusively in wrapping papers.

Waste Paper

Waste Papers form an important source of paper making material. In cheap grades where color is of no importance they are used just as they come in the bale. The better grades of waste must necessarily be sorted. White Shavings come first in value as they are suitable for repulping after having been dusted. Books and magazines must be sorted, dusted, and cooked with alkali to render the ink soluble. Then follows a process of breaking, washing, and bleaching to make a pulp suitable for white paper. Newspaper and other stock containing much ground wood cannot be successfully de-inked, and is hence valueless for making into white paper.

The proportionate use of the various fibres in the United States is approximately as follows:

Wood Pulp	61.6%
in the following proportions:	
Ground Wood, 47%; Sulphite, 42%; Soda, 11%.	
Waste Papers	21.4%
Rags	7.8
Straw	6.6
Manila (Rope)	2.6

With the steady diminution of the pulp wood supply in the United States, the saving of Waste Papers is becoming increasingly more profitable and important.

Filler

Many kinds of paper contain some form of mineral filler. Especially is it necessary in order to make smooth surfaced paper or to increase the

RAG ROOM—CRANE & CO,

opacity. It is used principally in book papers and bristol boards, and coated papers.

China Clay is the best grade because it is powdery and soft. A cheaper substitute, Talc, is crystalline in structure and papers containing considerable percentages are much harder on the cutter knives and more wearing on printing plates. Clay is the principal component of coating mixtures in combination with casein as an adhesive.

Sizing

Rosin size is prepared by cooking rosin with alkali to form a soap which when added to the stock in the beating engines, renders it less absorbent. Starch and Silicate of Soda are similarly used.

Animal size is prepared by cooking clippings of hides, hoofs, etc., and is applied to the surface of the paper which passes through a size vat during its manufacture. Its use is confined to papers intended for writing.

Color

The vast majority of dyes now used in the Paper industry are anilines. Some of them are non-fading and others are not—exposure to sunlight will quickly determine which is the case. Some colors, like buff, are produced with a mineral. The mineral colors are apt to give a slightly lighter shade on the under side of the sheet as the action of the suction boxes on the machines subtracts a portion of the mineral.

CHAPTER II

PAPER MAKING—THE BEATER ROOM

It should always be borne in mind that the processes of Paper making are difficult to carry on with precision because so much must be left to the judgment of the men directing its successive steps. The sorting of the stock, the manipulation in the cooking—the beating, and on the paper machines is susceptible of producing great variation, both intentional and unintentional, in the finished product.

In other words, the human element enters most decidedly into the manufacture of paper. This is recognized in the prevalent trades customs, which specifically provide for a reasonable variation in actual weight from the weight specified by the customer. But as experienced "paper men" know, the variation is not confined to weight alone, and involves also formation, color, and finish. Strict attention to business is the prerequisite for uniform paper making. Scientific management and constant painstaking work all along the line determine who is the dependable paper maker, and hence what brands may gain pre-eminence, in the confidence of buyers and the satisfaction of customers.

FIVE MAIN STEPS IN MANUFACTURE

1. Separation of paper making fibre (cellulose) from its natural state.
2. Conversion of cellulose into "half stuff" or pulp.
3. The Beating of the fibres and their blending with other necessary constituents into paper making "stuff."
4. The manufacture of stuff into Paper.
5. Processes of finishing.

It is not essential here, to dwell upon the first two steps. The third step is the most potent of all in determining results.

The physical action of the so-called beating of the fibres is capable of producing divergent results, as it causes subtle chemical changes as well as physical changes in the fibre. For example, by beating the fibres quickly with sharp "tackle" the maximum absorbency is obtained, as is desired in blotting papers, whereas a prolonged beating with dull "tackle" attenuates the fibres, leaving them with frazzled ends which helps to give strength, and also "hydrates" the cellulose so that it works up into a harder, denser sheet.

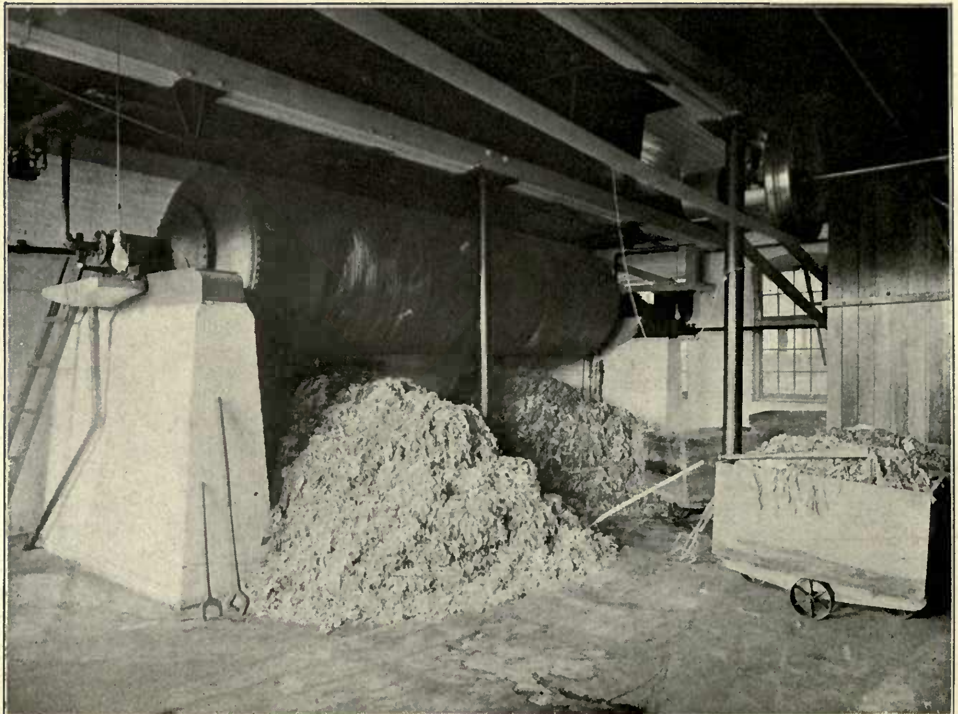
The Beating engine consists of a large, oblong tub divided into halves by a partition which stops short of the ends, thus leaving a channel. On one side of this partition, located about two-thirds of the way from one end, is a large roll just the width of the channel. This is shod with iron bars running parallel to its axis and protruding about an inch from the surface all around the roll. A so-called bed plate similarly imbedded with bars extends across the tub just under the axis of the roll. By mechanical means the roll may be raised off the bed plate as the judgment of the "beater engineer" dictates in order to regulate the length of fibre, as the stock circulates in the tub and passes between the roll and bed plate.

It is usual to begin by partially filling the tub with water, then adding a suitable quantity of pulp. When this is partially broken up, other ingredients

required, such as color, size, and filler, are introduced and the circulation of the mixture is maintained for the proper length of time. Whereupon a valve in the floor of the tub is opened and the stock pours into one of a pair of reservoirs or "chests," from which it is pumped up to be passed through a "Jordan" engine which refines the pulp and regulates the length of fibre on its way to the machine chest. While one "Jordan Chest" is being emptied, the other is filled, hence a constant supply of stuff is maintained in the right condition for paper making.

It should be explained that the mill superintendent supplies the beater man with a formula called the "furnish" for each run of paper. This indicates the exact amount of each kind of pulp, the quantity of filler, size, color or whatever ingredients are required for the order. The manipulation of the stock is handled by the beater man in accordance with the practise of the mill.

Again it should be noted that the beating lasts any where from an hour to several hours according to the kind of paper being made, and the judgment on the part of the man in charge. It is an "old saw" in the trade that "the paper is made in the beaters," which means to say that the character of the finished sheet is very greatly influenced by the manipulation of the stock at this stage. Naturally, the length of the fibres cannot be altered after the beating process is completed, nor can any of its ingredients, except color, be modified. The consistency, however, is alterable by the control of water



RAG BOILER—CRANE & CO.

on the paper machine itself, and this introduces another variable factor for which the machine tender is responsible.

CHAPTER III

PAPER MAKING—THE MACHINE ROOM

In order to understand the physical structure and characteristics of paper, it is necessary to see how the thousands of little fibres comprising it are united to form a homogeneous sheet, and a clear understanding of paper structure may be of great advantage to the printer.

First let us see what a paper machine is like and then it will be easy to grasp the essential facts about the making of a sheet of paper.

Paper machines all have what is known as the "wet end," and the "dry end." The function of the wet end is to receive the volume of water in which the fibres and other components are suspended as it comes from the beater room, and form them into a moist web. The function of the dry end is to expel the moisture and impart the desired finish.

The Fourdrinier Machine

There are two principal kinds of wet ends, the Fourdrinier and the Cylinder. The Fourdrinier part consists of a long frame across which lie a level series of closely spaced "table" rolls about four inches in diameter. At either end is a much larger roll, the first of which is called a "breast" roll, and the last a "couch" roll. In the lower part of the frame are a number of rolls called "guide" rolls and "stretch" rolls. An endless woven wire cloth, technically called "the wire," is stretched over these rolls and kept taut by the lower rolls which are ad-

justable. Near the couch roll a couple of suction boxes are introduced between the table rolls, and on a level with them, so that the wire cloth passes in close contact with them. Immediately under the wire is a long pan or "save-all" to catch the drippings, which are pumped back to the "flow box." The couch roll may be of the suction type, which exhausts the water from the web of paper by a vacuum process, or it may be of the double type, i. e., a pair of rolls, the bottom one about which the wire turns, and the top jacketed with felt to squeeze the water out of the paper web on its passage between the rolls. In order to control the width of this web and prevent the stuff from running off the sides of the machine, there are endless rubber straps on each side of the machine called "deckles." They run over pulleys attached to the frame in such a position that the bottom part of the strap rests upon the wire and travels with it. These straps may be set at any distance from one another according to the dimensions required by the paper order. Just back of the deckle straps extending across the wire are two adjustable "slices" which hold back the paper making stuff so that a so-called "pond" is formed where it first flows onto the machine. There is a joint in the first part of the frame to permit of a lateral shaking of the frame, which assists in interweaving the fibres and counteracts the natural tendency for them all to point in the direction of the flow of the stuff along the machine.

When the paper maker is ready, he throws in a lever starting the couch roll which supplies the trans-

mission power for the "wire." Next he opens the valves of the flow box that supplies the paper making stuff, which wells over the breast roll covering the entire width of the machine, and a rapidly forming felt of paper is carried forward on the wire. As remarked above, the slices hold back the stuff in a "pond," and the lateral shake of the frame underneath this pond weaves the fibres as the passage of the water through the wire cloth into the "save-all" is depositing them upon the wire.

All the way along the course of the wire to the couch roll, the water may be seen draining from the moist web into the save-all. The suction boxes are used to assist in getting rid of the water, for after the fibres are set by this filtration of water through the wire cloth, the problem of the paper maker is to get rid of the excess moisture by draining, suction, pressure, and finally evaporation.

The action of the couch roll gives the web a sufficient adhesion to allow it to be passed over the small intervening space to the first set of press rolls, through which it passes on an endless felt, and so on to a second, and sometimes a third set of press rolls, which squeeze out as much water as is possible without injuring the texture of the paper. Then it is in condition to be dried.

Let us pause here for a more detailed consideration of what has been happening on the wet end. In the first place, let me remark that a cellulose fibre has a tremendous thirst, and will absorb water until it is distended and limp. The expulsion of its water content has the opposite effect, the fibre shrinking

BEATER ROOM—HAMMERMILL PAPER CO.

its diameter, twisting and becoming strong again. This is the reason for the steadily increasing cohesion of the web as it passes along the machine, gradually acquiring the dryness natural to paper.

We have so far omitted mentioning the dandy roll. This is a skeleton cylinder some ten inches in diameter, and may be covered with a plain woven wire cloth or with a special weave like the seat of the ancient paper makers' molds, to impress the mark known as "laid" into the paper. The dandy roll is located on brackets between the suction boxes and the couch roll, and as it rests upon the wire it is automatically rotated when the machine is running, and makes an impression upon the moist paper. If water marks are desired they are produced by soldering a wire design upon the surface of the dandy roll. Hence a depression corresponding to the design is indented in the paper and the consequent thinning makes the paper more translucent, thus giving visibility to the mark.

The faster a machine is run the less is it possible for the shake to effect a cross weaving of the fibres. The tensile strength of the sheet is greater with the grain, and consequently there is a greater difference between the tensile strength with the grain and across the grain of a fast made paper than with a slow made paper. Whether the physical difference between these papers is sufficient to compensate the printer for the greater cost of a slower production depends upon the precise exactions of the work in hand. Naturally, the grain of any machine-made paper is quite marked, and has an important bearing

on the working and binding of paper, which will be discussed in another chapter on the physics of paper, but it is appropriate to note at this juncture that the grain is more marked the faster the paper is made, as a comparison between news print paper and a good book paper will demonstrate.

The Cylinder Machine

The Cylinder wet end, while operating on the same principle as the Fourdrinier, namely the deposit of fibre by filtration, is entirely different mechanically and produces a different sheet physically.

It consists of an oblong trough or mold containing a large skeleton cylinder some three feet in diameter which is covered with a woven wire cloth. The mold has two compartments, a rectangular narrow one into which the "stuff" is introduced, and a large one with a concave bottom closely conforming to the periphery of the cylinder. There is a packing at either end so that the water from the smaller compartment must pass through the wire covered mold inside to escape through a sluice at one end of the mold. A long endless felt runs tangent to the top of the cylinder and is kept in contact by the pressure of a couch roll. The felt passes between squeeze rolls, and couch rolls, and over a suitable series of guide rolls. Its transmission comes from the couch roll. The paper forms on the outside of the cylinder owing to the filtration of water from the smaller to the larger compartment, and as the web encounters the endless felt, it is picked cleanly off of the cylinder, and carried along to be pressed.

Single Cylinder machines are used for making tissue and light wrapping paper. Heavier stocks, such as cover or bristol board, are made by a series of cylinders rigged tandem, some machines for producing the heavier boards having as many as six in series. Blanks are made on such machines as the dark, cheap middle can be made from the intermediate vats. Duplex papers can be made by varying the color of the stock in the outer vats. There being no shaking arrangement for such a machine, the fibres lie largely in the direction of rotation of the cylinder. Consequently the grain of a cylinder made paper is very noticeable.

We have purposely described the two main types of wet ends before passing to a description of the drying and calendering, because the dry ends of both types of machine are the same with the exception of the "Yankee" machine, which will be described later.

The paper maker naturally strives to expel as much water as possible by drainage and pressure, as the evaporation of the remaining moisture is a direct tax on his coal pile. The drying apparatus consists of a series of steam-heated cylinders 36 or 48 inches in diameter, and the web of paper is passed over the series being held in contact with the dryers by a duck "dryer felt." The number and size of the dryers varies in accordance with the kind of paper for which the machine was built. Size tubs are introduced at the end of writing paper machines as will be described later. After the dryers, is placed one or two stacks of calenders, which consist of a

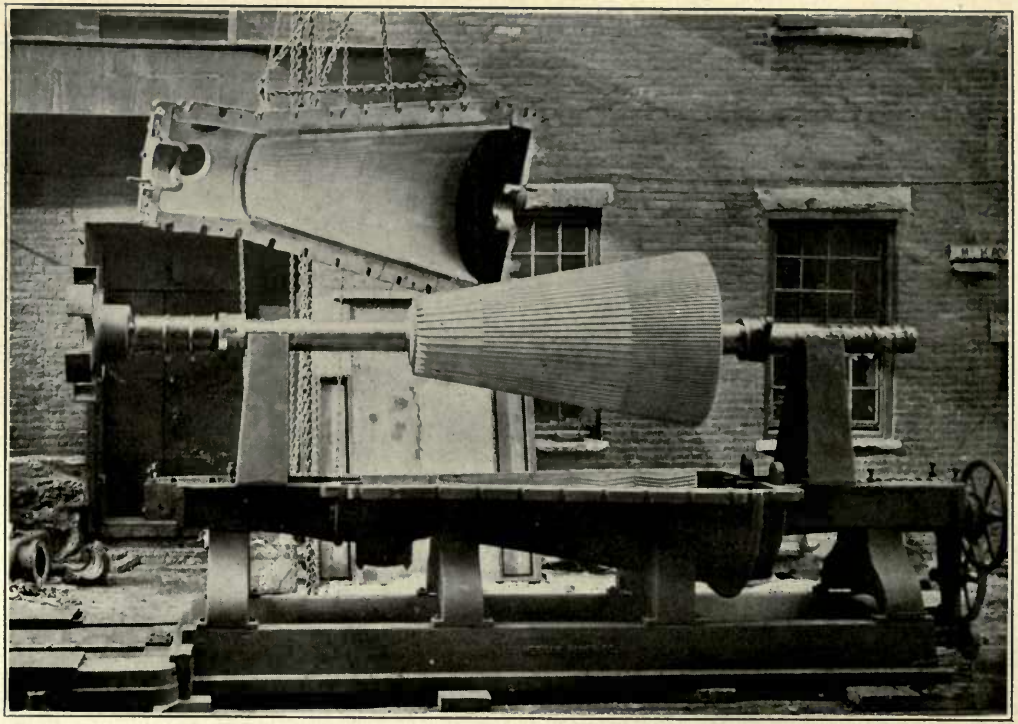
number of chilled iron rolls between which the paper is passed if a smooth finish is required. According to the amount of finish required, the paper is passed through one or more "nips" of the calenders. Emerging, it is wound up on a reel. There are usually two reels to a machine and sometimes three, so that as one is being filled the paper from the other is being passed through slitters set to divide the web into desired widths and is wound into rolls. In some instances, of course, the paper is given the precise finish desired on the machine itself, and is shipped in rolls. In others, a special finish is required, necessitating operations to be described later, or perhaps it only remains to cut the rolls transversely into sheets.

The Yankee Machine

The "Yankee" machine mentioned previously consists of a "Fourdrinier" wet end and a single dryer of large diameter. It is particularly constructed for making so-called "machine glazed" tissues, and specialty wrapping papers. The peculiar effect of this machine is to produce a paper which is glazed only on the side that comes in contact with the face of the dryer.

Before passing to the chapter on Finishing, let us review the technique of paper making on the machine, sufficiently to explain the principal effects and defects which result.

The formation of a sheet of paper is to be judged by looking through it. When its appearance is even and of equal translucence all over, it is said to be "well formed." If the "look through" is blotchy



MECHANISM OF A JORDAN ENGINE—KIMBERLY-CLARK COMPANY

or cloudy, the paper is said to be "wild." In other words, the fibres are not uniformly deposited in the making, and consequently the sheet is not "level," but is characterized by areas of varying thickness.

In a wrapping paper or a paper for ordinary printing, this is of little importance, but for "offset" work or for printing requiring an even impression from plates, it is obvious that a level, well-formed sheet is necessary. This quality is determined both by the stock and by the skill with which a machine tender handles his "wet end," and the proper beating of the stock. The position and distribution of the fibres naturally being determined while the water is draining through the wire, no amount of calendering can alter the position in which the fibres are deposited by the water.

The grain of the paper, meaning the direction in which the fibres mostly point, is also determined at the same juncture, and while a majority will naturally lie in the direction the paper runs over the machine, a skillful adjustment of the shake, and the maintenance of a reasonable speed improves the weaving, and counteracts this natural tendency to point with the stream. The impression of the wire cloth is naturally imparted to a more or less degree upon the under side of the paper, and where refinement in this respect is desired the paper maker must use a closely woven wire of fine strands. This adds a bit to the cost as a fine wire will not last as long as a coarse, and more time is lost in changing wires.

The difference between a wove and a laid paper is determined by the kind of dandy roll used. The

"laid" is practically a paper water marked with fine parallel lines, intercepted at short intervals by coarser lines running at right angles. These coarser lines always run with the grain.

A cylinder made paper is always "wove," and never watermarked. No light weight printing papers are made on such machines. There is, however, a tendency in the heavier printing papers to show a "wire" side, though this can be eliminated by certain arrangements of the molds. All cylinder papers split noticeably with the grain, and fold badly across the grain unless scored.

The pressing of paper is an important link in its making for unless the rolls are maintained in proper condition the water may not be uniformly expelled, in which case a damp streak will ensue and such portions of the web will take a brighter finish in the calenders than the adjacent areas, thus resulting in a blackened section. Such parts of the web as receive a greater pressure would become thinner. This is the cause frequently for soft ends in roll papers.

The weave and cleanliness of the felt used for conveying the paper through the presses is also of prime importance as the weave impresses itself into the surface of the paper. During the process of manufacture, felts become filled in spots from material squeezed out of the paper, and after that the water will not pass through so quickly. Hence, moist spots may be left, and in calendering show up blackened in the finished paper, or as a cockled surface in lightly calendered paper.

Drying

Coming to the drying stage, uniformity of conditions all the way across the machine are again requisite to produce uniformity of product. Furthermore, it is important not to over-dry the paper, both because it makes for brittleness and because it produces an unstable condition in the paper, which naturally contains a small percentage of moisture varying with atmospheric conditions. Paper which has been dried much below its normal moistness immediately seeks to absorb its natural moisture content from the air, and wavy edges result. Over-dried paper is also more prone to becoming troublesome from static or frictional electricity.

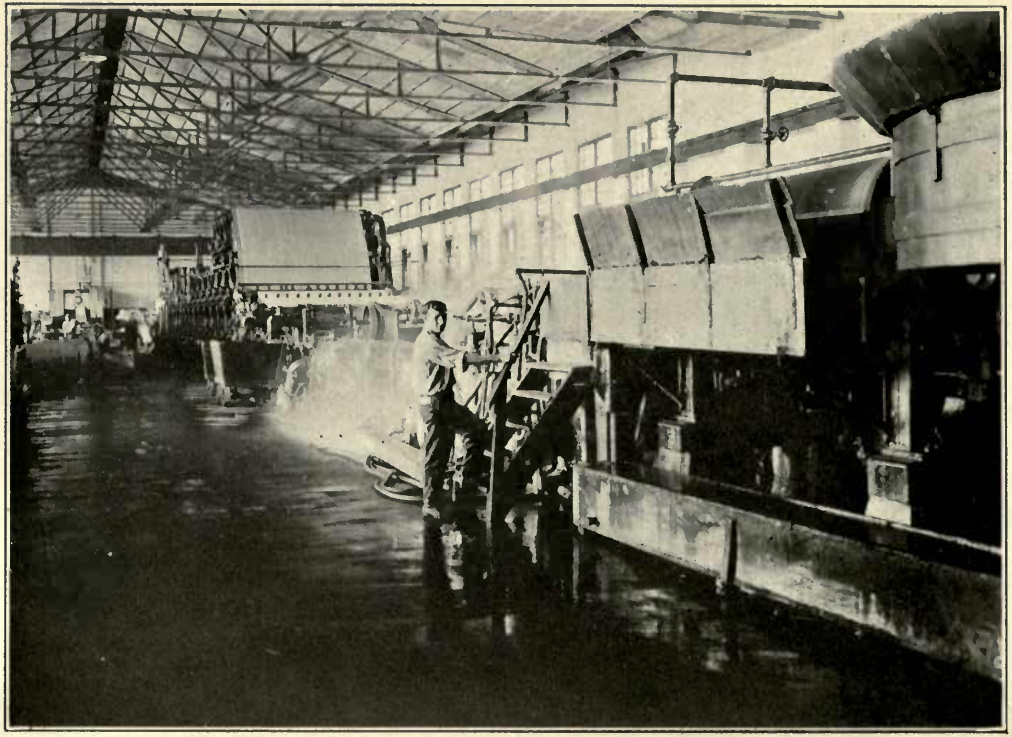
Calendering

The process of calendering is to modify the natural "egg shell" finish of paper as it comes from the dryers, which natural finish has been obtained from the felts in the presses. The usual finishes of book papers are the Antique Wove and Laid, and the Machine finish. A medium finish often known as "Text" is produced with lighter calendering than "M. F.," which requires rolling by the whole stack of calenders instead of a few "nips." English finish is a smooth, velvety machine finish, and requires a paper of very close formation and containing 15 to 20 percent of mineral filler.

Surface Sizing

Reference was earlier made to sizing apparatus for writing paper machines. The higher grade writing bond and ledger papers besides being sized

in the beaters, are surface sized by passing the web through a vat of warm size, and then between rolls which squeeze out the excess size. The webs which have been slit by rotary slitters located before the size vats, are now cut off by a sheet cutter and piled up on a "lay-boy." Afterwards they are removed to a drying loft and hung over poles in quires to dry. Not a few machines have an arrangement of skeleton dryers immediately after the size vat, and instead of slitting and cutting the web for loft drying the paper, it is dried by passage over the air dryers and slit like book paper, at the end of the machine, preparatory to subsequent finishing processes. Loft drying is traditionally considered to be preferable to the air drying method described, but it is difficult to see any reason why this should be true, and personally, I fail to see the advantage of this old and more costly method.



WET END OF FOURDRINIER MACHINE—HAMMERMILL PAPER CO.

CHAPTER IV

PAPER MAKING—FINISHING

Finishing processes are many and various according to the class of paper.

Book Paper

Book Papers with the exception of Supercalendered, receive the desired surface on the paper machine, and it only remains to cut and sort the sheets or to pack in rolls. Sheet cutters are built so as to cut a number of sheets simultaneously from different rolls. In the case of cheaper papers, such as the ordinary M. F. and S. & S. C., as many as six or eight rolls may be sheeted together. The disadvantage of this is that any variation in weight which may easily occur in the making, results in a corresponding inequality throughout the ream composed from so many different rolls. This may be reflected in an unevenness of presswork. The better grades of book paper are cut only one or two rolls at a time, which insures a more uniform result as well as more careful sorting, for uncoated book paper gets no closer inspection than the oversight of the individual in charge of the cutter, whose duty it is to pick out imperfect or faulty sheets. Coated paper, being prone to more surface imperfections, is sorted sheet by sheet.

Super Calenders

Super-calendering gives the highest finish obtainable to uncoated stock, and is a process separate from the machine. The paper is taken in rolls from

the machine and run in a web through the stack. The calenders contain about nine rolls, the top and bottom being of chilled iron, but the alternating intermediate rolls are made of hard paper. An arrangement of compound levers admits of the application of several tons pressure. The paper is either run through a dampener and sprayed with water before calendering, or else passes over steaming boxes which are attached to the calenders. In this moistened condition, the paper can be rolled flatter and smoother. Quite naturally the bulk of such paper is less than machine finish paper of equal weight by about 10 percent. The "supered" rolls are sheeted or packed in rolls like the book paper.

Bonds, Ledgers, Writings, Covers

A considerable variety of finishes are given to Bond papers, the staple finish being regular, linen, and ripple. These are obtained on a Plater machine which consists of two heavy rolls. The paper is made up into "books," being interleaved with zinc plates, for a smooth finish, and rolled back and forth between the rolls. If a linen finish is required, sheets of linen are alternated with the paper and with a number of zinc sheets so that the squeezing of the plater impresses the weave of the cloth into the paper. Any suitable substance may be substituted for the linen sheets to impart other surfaces. Fancy Cover Papers and Pasted Bristols are surfaced in the same manner. Ledger papers are plated with zincs. The cheaper grades of Writings are finished in sheet calenders and in the web.

Bristol Boards, Blanks, Water Finish Wrapping

Mill bristol blanks and water finished wrapping papers receive their high surface on the calender stacks of the paper machine to which so-called "water doctors" are attached, which keep a number of the rolls lightly bathed so as to moisten the web before calendering, thus leading to a high finish.

Deckle Edged Papers, Specialties

In the ancient hand-made papers the four edges of each sheet had a feathered edge caused by leakage of the stuff under the deckle frame of the hand mold. Similarly, machine-made papers have feathered edges on each side of the web next to the rubber deckle straps. A similar effect running with the grain of the paper can be had by squirting a small stream of water at the desired points, but in making paper by machine in a continuous web, it is not practical to get a deckle edge crosswise. Thus one is enabled to tell machine-made from hand-made paper, as it has two smooth edges where it is cut off from the roll.

Pasted Papers, Bristols, Cover.

Wedding bristols, and double-thick Cover paper are made by combining one or more rolls over a pasting machine, and finishing as required in a plater. A Pasted Bristol can be identified by burning, as the glue will melt and the different sheets, or plies of which it is composed, separate.

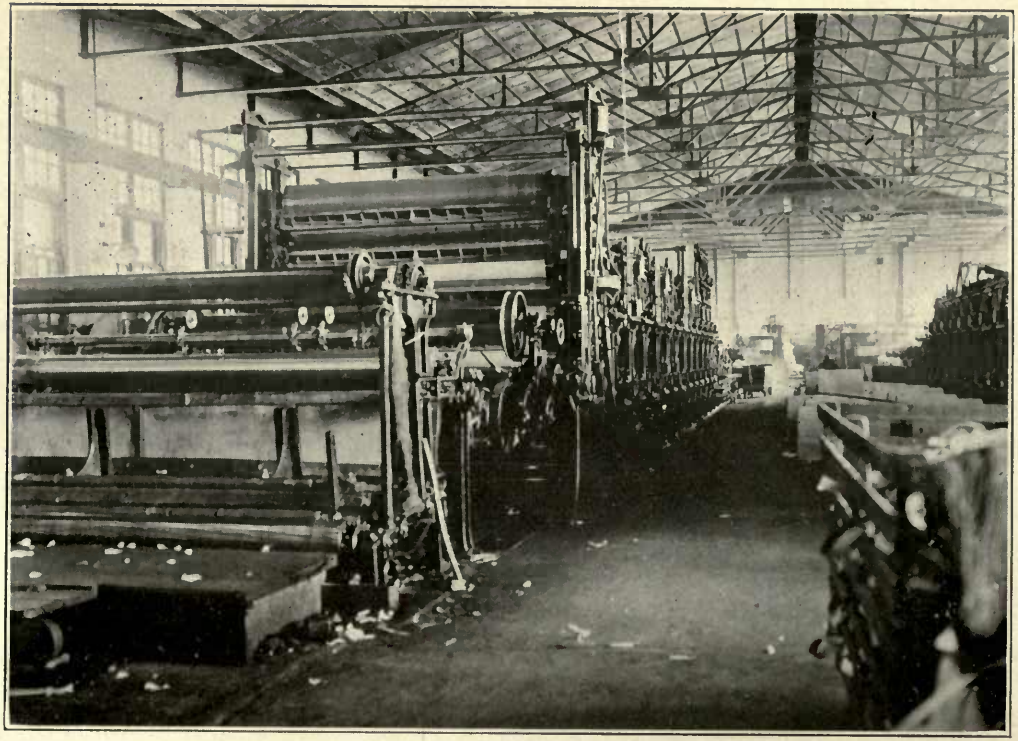
Coated Papers, Box Specialty

Coating is a conversion process, many coating mills buying their stock in rolls from different sources, particularly if their product is much diversified. A mixture is made usually consisting of China Clay, with casein as an adhesive and, suitably colored, this is brushed onto the web of paper by means of a special machine. As the paper emerges with its fresh coating, it is automatically caught up by sticks in a conveyor rack, which are so spaced as to carry it hanging in festoons through a long hot room to winders where it rolls up. Many specialties with metallic coating are similarly prepared. These rolls are finished as desired. Book Coated is run through super-calenders, Glazed Paper through a special friction calender which imparts the characteristic high polish, and "Flint" papers through a machine where it is automatically polished by a smooth flint stone, which gives the highest possible glaze. Another method is called brushing; the web in this, is subjected to a polishing by a stiff rotary brush. These latter papers are used principally by the box trade and for wrappers.

Wrapping Papers, Tag, Manila, Kraft, Glassine, Parchment

The principal factor in wrapping papers is maximum strength at minimum cost except in the specialty field.

Manila wrapping varies in grade, the cheaper having the larger percentage of ground wood. The strength is supplied by unbleached sulphite pulp.



CALENDER END OF FOURDRINIER MACHINE—HAMMERMILL PAPER CO.

Kraft Paper is the best grade of Wrapping, it is composed of sulphate pulp and no ground wood. Hence although more costly by the pound, its greater strength allows of using a lighter weight, so that on a basis of suitable strength and yardage cost, it has gained an important place in the wrapping field and makes a more sightly paper than the so-called Manila.

Tag stock varies in quality from a cheap so-called Manila to a stout Jute Manila suitable for rough usage.

Glassine Paper is comprised of straight sulphite stock either bleached, unbleached or a mixture of the two according to the appearance and transparency required. Its transparent and grease-proof qualities are entirely effected by special beating and super-calendering without the use of acids. It makes a particularly hygienic and attractive paper for food products, or for packages where protection and transparency are both necessary. Fancy patterns are also embossed in glassine, which renders it peculiarly attractive for dainty packages and special purposes.

Vegetable parchment is prepared by giving paper a sulphuric acid bath. The paper passes from the roll through the acid and between squeeze rolls which remove the excess liquor, then it is washed off with fresh water, neutralized of its acid and dried. The process not only strengthens the paper, but renders it grease proof.

CHAPTER V

THE PHYSICS OF PAPER

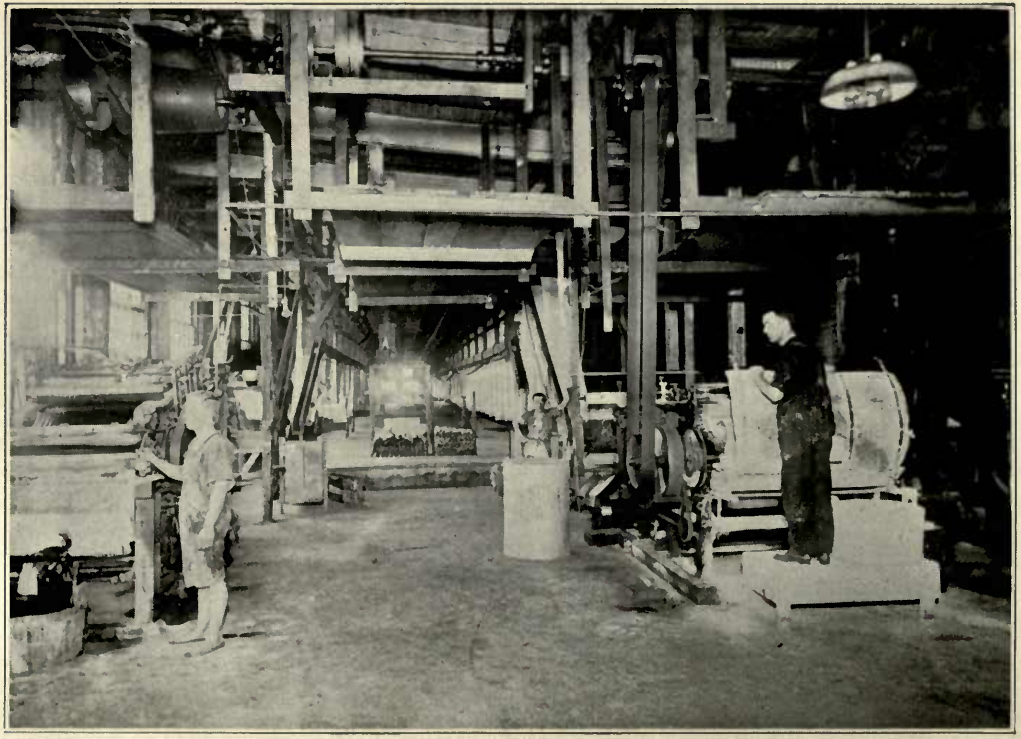
Effects of Moisture

No characteristic of paper is more important to appreciate than its sensitiveness to atmospheric conditions. Paper might be called "hygrometrical," if there is such a word, as it is susceptible to every change in the atmosphere. A certain percentage of moisture is normal to paper, varying with the relative humidity of the air. In absorbing moisture, cellulose fibres expand in diameter and in drying shrink, as has been mentioned in the description of paper making. It was also shown that a majority of fibres in machine-made papers lie parallel to the direction in which they are made. Hence as paper absorbs moisture it expands across the grain of the sheet, so that a distinctly pronounced stretch may be noted after a change from dry to damp weather.

This is the cause of poor "register" in printing. It also accounts for wavy edges, for as paper lies in a pile the interior is not exposed and remains constant, whereas expansion occurs along the edges, resulting in a cockled effect, often troublesome to printers if it occurs along the gripper edge.

The Grain

On this account it is usually preferable to have the grain run the long way of a sheet, but this rule has its exceptions, and frequently it is of slight importance. Whenever close register is required, however, the importance of grain direction is greatest.



COATING PAPER

In the binding of books, the moisture of the glue will cause a permanent cockle if the paper is "cross grained." This can be avoided by having the grain run parallel to the shelf back.

The fact that it is impossible to make paper exactly acclimated to various atmospheres, is the reason paper should be racked by the printer in anticipation of color printing, and thus given a chance to become seasoned.

Aside from the importance of grain direction in reference to atmospheric conditions, the folding requirements must be considered. Paper folds well with the grain, but thick sheets are likely to crack when folded across the grain. A book bound cross-grained is decidedly less flexible and opens less easily. English binders evince a preference for a cross-grained binding because the sewing passes around the fibres, and signatures are less likely to pull loose. It seems to us preferable to select stock sufficiently strong to withstand reasonable wear and tear, and to have the flexibility and freedom from cockling which can be insured by the grain parallel with the back.

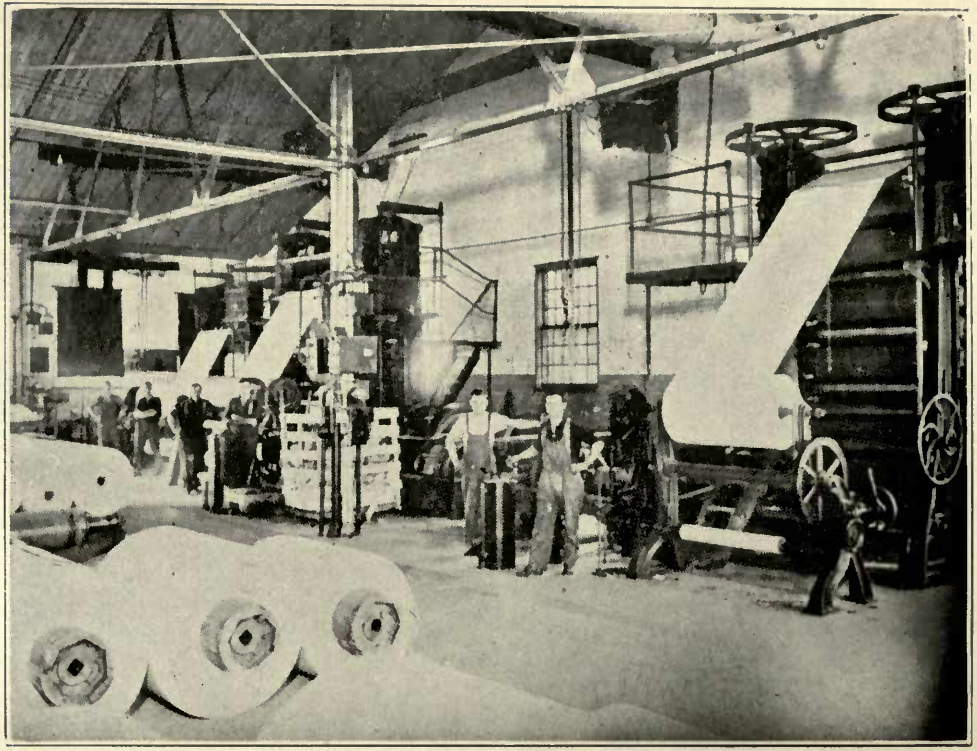
Some catalogs of large page size might be improved on the other hand, by the greater rigidity which results from having the grain at right angles to the binding.

In order to detect the direction of grain in paper two simple tests may be suggested. Cut out a small square and moisten one side. The expansion of the fibres will cause it to curl dry side in, and the axis of the cylinder thus formed will be with the grain.

Cut two narrow strips of paper, about four inches long either way of the sheet, place them so they coincide and hold by one end in a horizontal position. If the grain happens to be in the long dimension of the under strip, it will keep in contact with the upper because of its greater stiffness. Reversing the strips, the under one being now cross-grained, will sag away at the free ends on account of its greater flexibility. In cutting cards, it is important to see that the grain is the long way if a snappy card is preferred.

Static Electricity in Paper

The amount of moisture in the air has a marked effect on the behavior of paper in relation to static electricity, with which it often becomes charged by friction. This trouble is at its height in cold, dry weather, as there is then a minimum of moisture in the air, which under such conditions lacks in conductivity. The most simple expedient to avoid this trouble is to keep the press room warm, and to humidify the air, which may be done by opening a pet cock in a steam radiator. There are two well known devices for neutralizing electricty on printing presses. One consists of a gas pipe with frequent small jets of flame close to which the sheets must pass in transit to the delivery board. The heat skims over the ink, minimizing the likelihood of offsetting and the flame provides a conductor for electrical charges. The other apparatus is called an electrical neutralizer. An alternating current is discharged from points onto the sheets of paper as



SUPER CALENDERS—APPLETON COATED PAPER CO.

they pass, and as static charges are both positive and negative, they naturally select the current of the opposite polarity from the discharge of the neutralizer, and are destroyed. Consequently, the sheets reach the delivery board in a neutral condition.

CHAPTER VI

QUALITY AND TESTING

The basis of quality in paper can scarcely be defined other than to say it is the maximum suitability for its intended use. As between several suitable papers there is to be considered the appearance, strength, and composition.

Appearance

To the eye of a beginner the finer distinctions in appearance are elusive, and only after continued observation do they become apparent. Among the more noticeable are even sidedness, cleanliness, brightness of color, and uniformity of surface. A constant comparison of samples is the only way to acquire discrimination.

Strength

Strength may be assessed by the practiced hand by tearing in both directions of the grain. Crumpling a paper repeatedly and observing how easily and numerously holes occur is also a very practical test.

Folding backwards and forwards is another good method in the absence of any precise testing machine. Any well equipped laboratory is supplied with machines which accurately record the bursting strength, the tensile strength, and the number of folds a paper will withstand at a given tension.

Composition

Tests for determining the kind of fibre and other constituents can be but roughly performed outside of a chemical laboratory, or by other than trained analysts.

It is frequently desirable to detect the presence of ground wood and this may be ascertained by a drop of phloroglucine, which leaves a red spot on paper containing ground wood, the intensity of the shade being in proportion to the quantity present.

Strong nitric acid will show a brown reaction in the presence of ground wood, but this test is less delicate.

A rough idea of the mineral content may be had by burning, as the quantity of ash is proportionate to the amount of the non-combustible filler.

Experience is the best guide in these matters, and above all only such tests may sensibly be applied as are significant for the purposes to which the paper is intended. A bursting test, for example, is decidedly appropriate to container board which must withstand thrusts and contusions, but is far less significant of the qualities of a printing paper.

Dependability

In our Purchasing department these points are always carefully taken into consideration in the selection of our stock goods, and further than this we know from experience what mills may be depended upon to maintain uniformity of production and reliability of standards.

The papers we sell under the mill brands are well

known for their high standards and reliability. We are no less careful in the selection of manufacturers for such brands as are made especially for us, and sold under our private trade names.

It is our business to be discriminating and careful in the selection of all the papers we regularly stock, as we fully appreciate that "re-orders" are the final test of all successful papers and a paper that cannot hold its own in the estimation of our customers will not long survive.

The many years that we have been in the paper business are the best proof of the dependability of our stock which represents only the survival of the fittest, which is after all the ultimate test of quality in paper.