PAPER AND ITS USES

A TREATISE FOR PRINTERS STATIONERS AND OTHERS

BY

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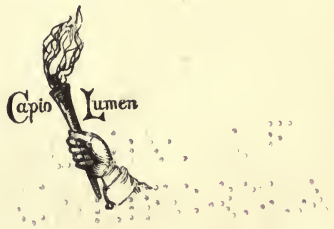
With 34 Samples of Paper



LONDON
CROSBY LOCKWOOD AND SON
7 STATIONERS' HALL COURT, E.C.
1914

Printed at
The Darien Press
Edinburgh

PREFACE

THE library of the papermaker is well furnished with excellent works on the manufacture of paper, but the printer, stationer, and student are not so well catered for. The present volume aims to present a concise and comprehensive treatise on the manufacture and use of paper, which shall be intelligible to the student, and at the same time sufficiently progressive to lead to the study of the larger works on papermaking.

The late Mr Richard Parkinson was responsible for a work which sought to fill the want in the printer's technical library, and by extensive study and research he was able to produce a clear and concise book on paper and its uses. An important feature of great practical value was a section of samples bound at the end of the work. By adopting the plan of this earlier volume, the Author feels that the utmost usefulness is obtained. This has been possible by the generosity of Mr R. E. Parkinson, who placed the rights in his father's work at the writer's disposal.

Reference to the Syllabus of the Examinations of the City and Guilds of London Institute for Typographic and Lithographic Students will show that a more detailed knowledge of the manufacture of paper and its use is expected than can be found in the text-

books on printing. It is believed that the sections dealing with testing papers, the prices and weights of papers, as well as the alphabetical list, will prove of value to students generally.

Illustrations of methods of manufacture and of various machinery have been kindly lent by the manufacturers to render the mysteries of the making, treatment, and testing of paper a little clearer. The wholesale houses have rendered valuable assistance by supplying the samples bound at the end of the volume, and with helpful advice. To all these and to other friends who have revised the proofs of the work the Author tenders his grateful thanks.

EDWARD A. DAWE.

WALLINGTON, 1914.

CONTENTS

LIST OF ILLUSTRATIONS

PAPER AND ITS USES

CHAPTER I

RAW MATERIALS

PAPERMAKING is an industry which is in many ways handmaiden to other industries. In the case of letterpress, lithographic, and plate printing it furnishes the supporting medium, without which the dissemination of knowledge would be more difficult. Long ago the printer appreciated the fact that the invention of the art of typography enlarged the sum of the world's knowledge, but perhaps he has not always been ready to give the papermaker a fair share of the credit. It must be conceded that while many things will serve as printing surfaces, the question of cost decides against their general use, and that paper is the principal material employed for written and printed books. It is with these uses that this work deals, while some others are touched upon.

The history of papermaking takes us back beyond the Christian era—the Chinese being credited with the production of paper from vegetable fibres about 80 to 150 B.C. The ancient Egyptians made paper from the stems of the tall reed which we know as the papyrus. By skilfully flattening out layers of the stems, forming them into sheets, and preparing the

surface for writing, the Egyptians provided themselves with excellent paper.

European papermaking dates from the eleventh century, and English papermaking from the fifteenth century. The colophon to Wynkyn de Worde's "De Proprietatibus Rerum" mentions the paper mill of John Tate at Stevenage in Hertfordshire. Early English papers were made from rag fibres, and rag papers still hold the premier place.

Cellulose is the substance of which the permanent cell membranes of plants are composed, and it forms the bulk of the tissues of wood and similar plant structures. In most cases the presence of colouring matter and various waxy and resinous substances taken up by the growing plant render the cellulose very impure, and it is desirable that, as far as possible, all impurities should be removed before the fibres are made into paper. Cotton is the purest form of cellulose found in nature, 91 per cent. of the natural cotton fibre being pure cellulose, while esparto yields only about 50 per cent. of its weight as cellulose. Notwithstanding the many different varieties of plants, the chemical composition of the fibres is practically identical. One of the principal characteristics of cellulose is its extreme permanence, which is principally due to the fact that it forms but few chemical combinations with other substances.

Vegetable fibres of all kinds may be converted into paper, but no new fibre threatens those now employed, unless it can be obtained in large quantities, responds readily to the usual bleaching reagents, and can be delivered to the papermaker at a price which enables it to compete successfully with the fibres at present in use at the paper mill. In some cases the plant fibres are reduced to pulp near the place of growth, in others the raw material is transported in its entirety. Other

sources of supply are the wastes of other industries, and wastes which have no other uses.

The classification may take place as follows: (*a*) *waste*—rags, sails, sacking, ropes, textile wastes, waste paper; (*b*) *plant stems and wood*—straw, esparto, bamboo, papyrus, hedychium; (*c*) *pulps or half-stuffs*—straw, esparto, delta cellulose (or reed pulp), bamboo, chemical wood, mechanical wood.

Rags are the cast-off fabrics of the civilised world. Having served their purpose in administering to the comfort of mankind, they are sorted, graded, and offered in the market for papermakers. For the manufacture of paper for bank-notes new linen cuttings are used, but this is an exceptional material for a special purpose. Sail cloth, bagging, sacking and ropes, made from hemp, jute, manilla hemp, having reached the waste market, are regenerated in the mill as paper. Waste paper of all kinds is sorted and re-made into paper or boards.

Esparto is the principal material that finds its way to the papermaker in its original state. It is a wiry grass, growing extensively in Spain and Africa, and is harvested and packed in bales for export. Straw is generally imported as half-stuff. Bamboo, papyrus, and hedychium are being used in quite a small way in this country, but may be extensively used in the future.

Straw, esparto, reed pulp, and bamboo are obtainable as half-stuff or pulp, that is, they are already divested of the portions of the plant which are non-fibrous, and therefore useless to the papermaker. Wood pulp is the chief material converted into paper, and may be prepared as chemical or mechanical. Chemical wood pulp is prepared, after removing the bark from the felled trees, and cutting the logs into chips, by boiling with caustic soda solution (soda pulp), with a mixture

of caustic soda and sulphate of soda (sulphate pulp), or with bi-sulphite of lime (sulphite pulp). Mechanical wood pulp is obtained by cutting the logs into short lengths, removing the bark, and grinding to pulp on a large grindstone, the surface of which is freely supplied with water. The water renders the reduction to pulp an easier matter, and also serves to carry the pulp forward for subsequent treatment.

In speaking of paper it is usual to refer to the material from which it is made, *e.g.*, rag, rope, esparto, manilla or wood papers. It does not always follow that the papers are composed entirely of those fibres, but the prefix of "pure" or "all" will generally indicate the genuine articles. Paper which is free from mechanical wood pulp is sometimes referred to as "free."

The strongest and best papers are made from cotton or linen rag fibres. Linen is made from the fibres of the flax. In the raw state the fibres are from 1 inch to $1\frac{1}{2}$ inches in length, and less than $\frac{1}{1000}$ of an inch in diameter. Examined microscopically the fibres appear to be smooth, cylindrical, with markings like the joints of a cane, slight cross markings, and a very fine channel running through the fibres. Papers made from linen are close, strong, and durable. Cotton is the seed-hair of the cotton plant, having a length of $1\frac{1}{3}$ to $1\frac{1}{2}$ inches with the diameter about the same as that of linen fibres. Cotton is tubular, has a large channel, and on drying the tube collapses and twists upon itself, as many as 300 twists in the length of a single fibre having been observed. This twisting assists in keeping the spun cotton together, and also makes the felting of the subsequent paper more efficient. Papers made from cotton are softer than those made from linen, and the tenderest rags, such as worn muslins, are employed for blotting papers. Hemp is obtained from

the stem of the hemp plant, and the papermaker receives it in the form of old ropes and string. The dimensions and properties of the fibre are similar to those of the fibre of linen. Jute is the inner bark of an Indian plant, producing fibres $\frac{1}{10}$ of an inch in length by $\frac{1}{1000}$ of an inch in diameter. The fibre is smooth, difficult to bleach, but the resulting paper is strong and tough. The fibre of the manilla hemp is not as long as the ordinary hemp, being about $\frac{1}{4}$ of an inch by $\frac{1}{1000}$ of an inch, cannot be bleached to a good white, so a white manilla paper is considerably lower in colour than other white papers. Manilla paper is, however, very tough and strong, and though a large quantity of "manilla" paper is made entirely of wood pulp, there is a great difference between the real and the imitation.

The fibres from straw are small, only about $\frac{1}{10}$ of an inch by $\frac{1}{2000}$ of an inch, and consequently straw papers are much weaker than those made from longer and broader fibres, but, as an admixture, straw still finds a place in writing papers, giving translucency and rattle. Esparto fibres are also very short and fine, about $\frac{1}{40}$ to $\frac{1}{10}$ of an inch by $\frac{1}{2000}$ of an inch, making a light bulky paper when used by itself, and blended with other materials—with rags for good writings, and with chemical wood for fine printings and litho. papers—to impart special characteristics, such as opacity and softness, which may be lacking in the other fibres. The well-known featherweight papers, used for bulky volumes of fiction, are frequently manufactured from esparto fibre alone.

The fibres of the various wood pulps vary considerably in length, breadth, and thickness, being from $\frac{1}{25}$ of an inch to $\frac{1}{8}$ of an inch long, and generally very thin. Fibres of various shapes are met with in wood pulps, some not unlike linen fibres, but many others so distinct as to be unlike all those that have been

already described. Broad, ribbon-like fibres, some pitted, and others perforated, all are very thin, lying closely together, so that a paper made entirely from sulphite wood pulp is rather harsh and fairly transparent. Papers produced from soda pulp are softer and more opaque than those made from sulphite pulp. Mechanical wood pulp is made up of little pieces of wood with all the resins and other impurities of the original wood, and when examined carefully, the fragments of wood can be seen, and the splinters appear to be held together by the plant cells. Mechanical wood pulp possesses very little felting quality, and requires the addition of larger fibres, such as chemical wood, in order to make paper successfully.

From the foregoing list and descriptions it can be seen that papermakers have a variety of fibres at their command, and it is by selecting, sometimes by blending, fibres of different characteristics, that the manufacture of the large variety of papers is possible. Some of the demands made by the world of paper users are for papers which are very strong or very soft, absorbent, resistant to grease or water, very light, very dense, and the selection of the fibres and their treatment call for special knowledge and skill on the part of the papermaker.

In addition to fibre, most papers contain sizing, sometimes loading or filling. Sizing may be animal or vegetable, the animal size being gelatine or glue obtained from various animal substances, and the vegetable size being made of a combination of resin with soda. Alum is used to assist in fixing the size in the paper. Mineral matters are employed for filling or loading; china clay is the principal, others being barium sulphate (barytes, blanc fixe), calcium sulphate (gypsum, terra alba, annaline, pearl hardening, crown

filler), satin white, magnesium silicate (asbestine, talc, agalite). Colouring matters are required for the majority of papers. For white papers small quantities of blue and red colours are used, while for coloured papers aniline dyes are employed in a large variety, as well as the various pigments.

CHAPTER II

REDUCTION TO PULP

WHATEVER material may be used for making into paper it has to undergo stages of preparation which can be divided into removing all foreign matter and dirt, reduction to fibrous state, bleaching, beating, and lastly converting what is the pulp into paper. If the material has already been manufactured, as in the case of rags, ropes, sails, sacking, and other textiles, the first process is somewhat simpler than in the case of really raw materials, such as esparto, bamboo, or wood. But here again the first and second operations may have been carried out before the papermaker handles the material, for wood, esparto, and bamboo are imported as pulp boards. In the case of esparto the quantity so imported is very small, but the quantity of wood pulp is enormous. It will be advisable to take the materials in order, so that the difference as well as the similarity of treatment may be traced.

Rags are purchased already graded. There are some twenty to thirty grades of rags regularly quoted in the market reports, and the layman might fancy that the papermaker could unpack the bales and proceed to make paper from these graded rags. Unfortunately he finds a large quantity of undesirable material, such as silk, wool, buttons, elastic, and dirt, that must be removed. First the rags are sorted, and cut into pieces of uniform size, the undesirable parts mentioned

being put aside as useless, and the seams cut open or thrown out. Standing at a bench, the top of which is wire netting, the sorter takes rags from a pile, and cuts them on a scythe-like knife which stands out obliquely from the bench. A large amount of dust escapes through the netting, and the rags are sorted into bins as more suitable for one class of paper than another. The rags are next taken to the willow or dusting machine, where they are subjected to violent treatment, the teeth of the machine carrying the rags against other teeth, giving them a thorough shaking and loosening the dust, which falls away. As they are cleaned, the rags are taken to the top of the building by a travelling band and dropped into the mouth of a boiler prepared to receive them. For rags a special spherical rotary boiler is employed, and when a charge has been filled in, a definite quantity of a solution of caustic soda in water is added. The lid is securely fastened, steam is passed in, and the boiler is kept rotating slowly for about eight hours. When the dirt in the rags has been thoroughly loosened the rotation is stopped, steam is shut off, the dirty water is run off, clean water is run in. The boiler is again revolved, the rags rinsed, and then the lid is removed and the boiler emptied by continuing the revolution.

Next comes the washing and breaking, both of which may be carried out in the beating engine. The beating engine, of the Hollander type, consists of a large vessel with rounded ends, with a central division running down the length of the engine. Two cylinders revolve: one, a very heavy cylinder known as the beating roll, reaches to the bottom of the engine and bears a number of knives on its surface, which knives, in conjunction with a bedplate also bearing knives, break the rags into smaller fragments and open the threads,

loosening the fibres, and allowing dirt to come away. The second and smaller cylinder is employed as a washing drum. It is covered with wire gauze, through which the water passes, and as the drum revolves the dirty water passes into the interior, where a number of bucket compartments carry the water and pass it through the axis of the drum to the waste pipe. When the rags are filled into the beating engine clean water is run in, the beating roll is kept out of contact

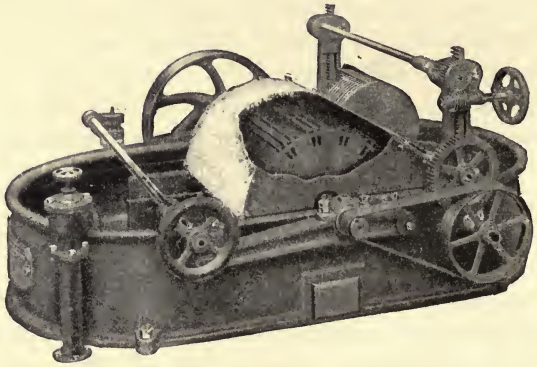


FIG. 1.—Beating Engine, with covers partially removed to show interiors of Beating Roll and Washing Drum.

with the bottom knives, and the rags are kept in circulation. The washing cylinder is in action, and the roll being gradually lowered the dirt is eliminated. When this stage is reached the washing drum is lifted, the beating roll lowered, and the rags are gradually reduced in size until they attain a state of fibrous pulp, being known technically as "half-stuff." In most instances the next process is bleaching. There are special drawing papers, of which "O.W." and "Unbleached Arnold" are examples, which are the colour of the original rags, no bleaching having taken place. But

usually a weak solution of bleaching powder (chloride of lime) is let into the engine and thoroughly mixed with the pulp. When the bleach is thoroughly incorporated the half-stuff is let down into large tanks, made of stoneware or cement, having perforated bottoms, and there the bleach completes its task, and the pulp is allowed to drain.

Next comes the beating, at which stage the blending of different fibres may take place. The object of beating is to reduce the bleached pulp to fibres, and to reduce the length of the fibre in accordance with the requirements of the paper to be made. The rags are chosen according to the class of paper desired—softer rags for soft papers, and, of course, stronger rags for strong papers. For blottings, filter papers, and lithographic papers, soft rags, sharp beater knives, quick beating are adopted. For dense, hard papers, such as ledger, typewriting, bank, imitation parchment papers, duller knives, slow beating, with a gradual lowering of the beater roll is the order. The normal time for beating the pulp for an ordinary rag paper may be taken as eight hours.

To take the next material, esparto, and to follow it in the same way. Esparto arrives in bales, fastened either with ropes of esparto or with iron bands. Esparto travels through the mill in the same way as rags, that is, from the ground floor, where it is unpacked and dusted, upwards by means of a series of claws, along a travelling band where pickers remove foreign substances. In its travel broken fibres and dirt escape, and the grass arrives at the mouth of an upright cylindrical boiler, stationary, and so arranged that the boiling liquor is vomited over the mass of esparto. The boiler is filled, and a fairly strong solution of caustic soda is run in, the manhole is fastened down, and steam under pressure introduced. After several hours boiling the

siliceous and waxy substances taken up by the growing plant are dissolved, the dirty water is run out, small quantities of clean water let in to wash out as much soda as possible. Most of the soda is recovered, but that process, though of great importance to the paper-maker, need not be treated here. The washed esparto is conveyed to the breaking engine for treatment similar

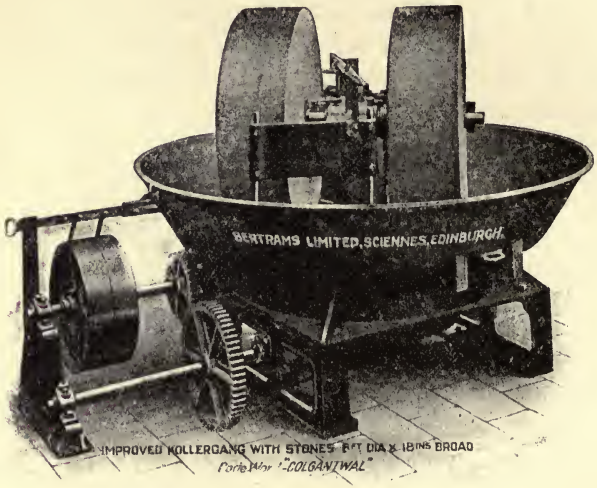


FIG. 2.—Edge Runner or Kollergang.

to that given to rags, being washed, broken, and bleached. In many mills the half-stuff is carried over strainers, and by the use of the presse-pate machine (a paper-making machine with only a "wet end") made into sheets. The half-stuff in sheets is filled into trucks and stored or taken direct to the beaters. Owing to the small dimensions of esparto the reduction to the fibrous state is easily accomplished, and very little beating is necessary.

Wood, chemical or mechanical, usually finds its way to the paper mills in the form of pulp boards, and is known as chemical or mechanical wood pulp. No boiling is necessary, but the boards are fed into the breaking engine, and reduced to half-stuff, a little bleach liquor added to chemical wood, and the contents of the engine, when sufficiently reduced, are let down to the draining tanks for the bleach to expend itself. Then the pulp is ready for the beating engine, where it is reduced to the necessary degree of fineness.

Some materials are more effectively reduced to pulp in the edge runner or kollergang. This machine is similar in appearance to a mortar mill, but the arrangement is slightly different. The pan of the machine is stationary, and the stones revolve and travel round the pan. Only a small quantity of water is used with the pulp, and waste papers which require rubbing apart only, and strong wood pulps of which the fibres are drawn out, and not in any way reduced in length, are treated in this machine more economically and more effectively than in the beating engine.

CHAPTER III

MANUFACTURE OF HAND-MADE AND MOULD-MADE PAPERS

ENGLISH hand-made paper is still looked upon as the best paper obtainable. Some fourteen firms still make paper by hand, and although the number does not increase, there is no sign of its diminution. The reduction of the rags to fibre was treated in the last chapter. Before leaving the beating engine the colouring matter is added; in the case of a white paper a small amount of blue is necessary to counteract the grey appearance which the natural pulp usually assumes. This is merely equivalent to the blueing which is resorted to for giving linen a bright appearance, and is not sufficient to tint the paper. If the paper is to be blue laid, azure, or yellow wove, smalts is the colouring matter used. This is an indestructible blue, being cobalt glass reduced to extremely fine powder, and is used for the highest grades of papers, but many hand-made papers will be found to be coloured with ultramarine, which is a very good blue, but not quite so durable as smalts. Coloured papers require different additions, some in the form of powders or dry colours, others in chemical solutions, which by combination produce the desired colour in the pulp. When thoroughly mixed, the pulp is let down to the stuff chests and kept in constant motion by revolving paddles. The vat at which the paper-

maker—the vatman—stands is kept supplied with pulp, diluted to a regular consistency, kept in motion by an agitator, and a constant temperature is maintained. The mould used is a wooden frame, strengthened by ribs across its width, and a wire top of laid or woven wire. In the case of laid papers the wires are laid side by side, tying wires about an inch apart are superimposed, and fastened to the laid wires by very fine brass wire. These wires make an indelible impression upon all paper made upon the mould, and distinguish laid from wove papers, the latter being made upon a woven wire mould. Watermarks are the results of designs in reverse fastened to the mould, the design being formed with wire upon the mould, or else an electrotyped mark is soldered to the mould. Watermarks may be simply small designs or lettering, or they may take the form of elaborate pictorial designs, but their purpose is to add distinction to the paper, and in some cases to prevent forgery of valuable notes or documents. Upon the mould is laid an open frame, known as the deckle, which serves to confine the pulp to the mould. For all papers two moulds are used in order to continue the cycle of operations uninterruptedly.

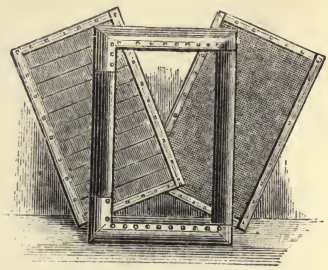


FIG. 3.—Hand Moulds and Deckle (Laid and Wove Moulds).

The vatman takes a mould, places the deckle upon it, dips the mould into the vat of diluted pulp, and lifts just the quantity of pulp necessary for the weight of paper being made. A slight shake is given to the

mould, a small side shake and a greater shake backwards and forwards, something like the shake given to a type case, but less violent, the object being to cause the individual fibres to cross and felt together. The mould is kept perfectly level, or the sheets are thinner at one edge than at the others, the mould is pushed

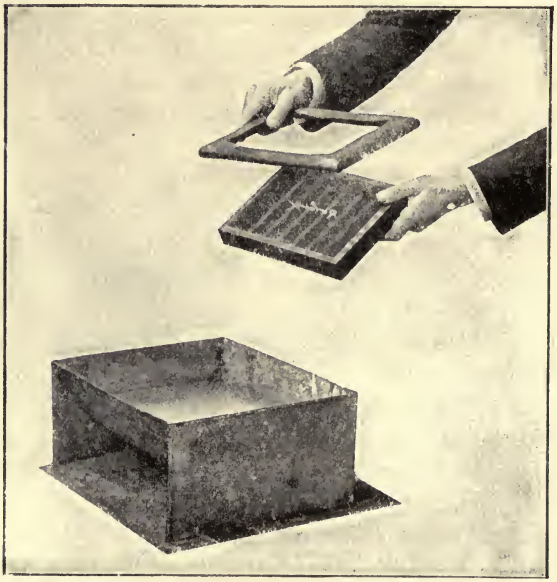


FIG. 4.—Method of Making Small Sheets on Hand Mould.

along a support by the side of the vat, the deckle removed, and the operations of moulding repeated with the second mould.

The coucher who places the paper upon the felts ready for pressing, or couching, stands to the left of and facing the vatman. He takes the mould, stands it at an angle to drain, and places the mould face downwards upon a felt; the paper remains on the felt,

and the mould is returned to the vatman. The felts are woollen cloths of close texture, resembling that of machine blankets, and are larger than the paper placed upon them.

Upon each sheet of paper a third worker places a felt, and the papermaking proceeds. When the pile of felts and paper is sufficiently high, it is transferred to a hydraulic press, and considerable pressure is applied in order to remove as much water as possible by squeezing, and, more important, to couch or press the fibres together and to close the sheets. The pile is removed, the felts taken out, the pile of paper given further pressing, and for some papers the paper is turned, rebuilt, and pressed again, to improve the closeness of the sheets. The paper is then taken to the drying loft, hung on ropes of cow hair, which material possesses the virtue of making no marks or stains upon the tender paper. Loft-drying is carried on at an even temperature, in order to permit of even shrinkage of the sheets. At this stage the paper, which is unsized, is known as waterleaf, and unless it is to be used in the unsized state, requires further treatment, as described in the next chapter, before being ready for use.

Mould-made papers are made by machine as far as making the sheets is concerned, other operations being carried out as for hand-made papers. The moulding or forming of the sheet is carried out in different ways on different machines, but the construction of the machines being kept secret by their users, it is not possible to give a description here.

CHAPTER IV

PAPERMAKING BY MACHINE

THE Fourdrinier machine bears the same relation to the hand mould that the rotary press does to the hand press. Instead of making paper sheet by sheet, it makes it in a continuous web, on an endless band of woven wire. The machine in a much simpler form was invented by a Frenchman, Nicholas Robert, the first machine being made in 1799, and so rapidly did the machine find favour that in fifty years over 150 paper-making machines were at work.

Papermaking by hand involves the processes of transferring a certain and regular quantity of pulp from the vat to the mould, shaking the mould to felt the fibres and to remove the water, couching the paper and drying the waterleaf. Machine-made paper follows the same processes exactly, everything being done by the one machine, including sizing. Viewing the paper-making machine, it appears to be a collection of machines carrying out the separate functions in proper sequence. The different parts of the machine can be controlled and driven at different speeds for special reasons. Thus a definite and regular quantity of pulp is taken, shaken, the water removed, the soft paper couched, pressed, dried, and a finish given to the surface of the paper, all in the compass of the one machine.

The pulp as left at the end of Chapter II. was merely beaten fibre, and if an unsized paper were

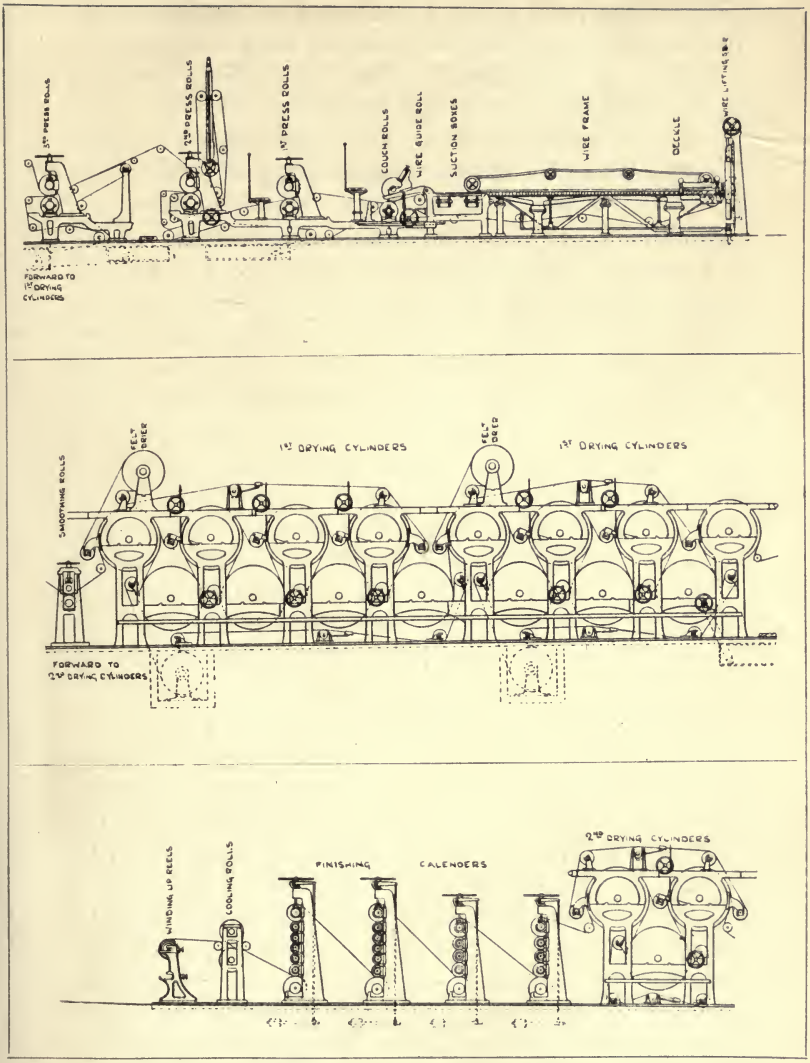


FIG. 5.—Diagram showing elevation of Papermaking Machine. Shown in Sections. Total length of machine 144 feet.
(Built by Bertrams Limited, Sciennes, Edinburgh.)

required the pulp would be let down to the stuff-chest; but usually other things are added before the pulp is ready for the machine. Filling or loading, colouring matter and sizing material, are mixed with the pulp, thoroughly incorporated, and then the engine is emptied.

Paper can be made without filling or loading; in fact all-rag papers seldom contain mineral matter, and many excellent papers are made from other fibres without loading. The purposes of loading are to fill the spaces between the fibres, to give opacity to papers, such as those made of sulphite wood pulp, which would otherwise be very transparent, and to enable the paper to take a higher finish than would be possible in a paper without loading: a smoother and more absorbent, even if a little weaker, sheet resulting. In a blotting paper mineral matter is an adulteration; in writing papers 5 per cent. is sufficient for improvement of surface; in printings 10 to 16 per cent. is as much as is permissible. In an imitation art paper as much as 25 per cent. may be added, and yet a serviceable paper result; but of course the tenderness of imitation art paper will be present.

China clay is the usual material used for filling or loading. It is mixed with water, and strained before filling into the beating engine, and the colour is added, either to produce a coloured paper, or to correct the tendency to greyness in the finished paper. In the latter case, a little blue and perhaps a little red is added, while in the former case the colour may be added, or formed *in situ* by the mixture of different chemicals in the beating engine. Dry colours, whether pigment as ultramarine or aniline colours, are mixed with water (dry patches being difficult to deal with in the pulp), and then added to the pulp in the engine; when the colours are thoroughly mixed, alum is put

in. Alum serves to mordant or fix the colour, and also serves to precipitate the resin size which is next added.

There are various prepared sizes on the market to take the place of the size prepared by the papermaker from resin and a solution of soda. The resin is melted and added to the soda solution, and boiled until the solution is complete. The size solution is added to the pulp in the beating engine, and thus we get a clue to the meaning of E.S., or engine-sized paper.

The pulp now consists of innumerable fibres, to which and in which are fixed small particles of china clay, colouring matter, and resin. In many writing papers a small amount of starch paste is added, and that also adheres to the tiny fibres. The engine is emptied by gravity into the stuff-chest, where the revolving arms keep the fibres in the mixture from precipitation. Then there is a short journey to the machine, during which the pulp undergoes great tribulation, first being diluted with a large quantity of water, then passing over sand traps which intercept grit, metallic fragments, and such matter that is heavier than the pulp and so tends to sink, and then through strainers, which retain foreign matter, unbeaten particles, and knots of fibre. The flow of pulp is governed by a system of valves, which can be quickly manipulated to alter the substance of the resulting paper.

The wet end of the machine consists of an endless band of woven wire, some 40 to 80 meshes to the inch, from 48 to 205 inches wide, and a total length of 40 feet or more. The length of wire in use at one time as a paper mould is less than half its total length. This woven wire corresponds to the mould of the vatman in hand-making. Deckle straps, the substitutes for the vatman's deckle, are thick endless rubber bands, square in section, which rest on the wire cloth, and, following

the travel of the wire, return over pulleys, serving the same purpose as the deckle, namely, to confine the pulp to the wire surface. The wire cloth is supported by a number of rollers—tube rolls—which keep the wire from oscillating, and assist the passage of the water through the wire. The end of the wire nearest the stuff-chest is kept shaking backwards and forwards to cause the

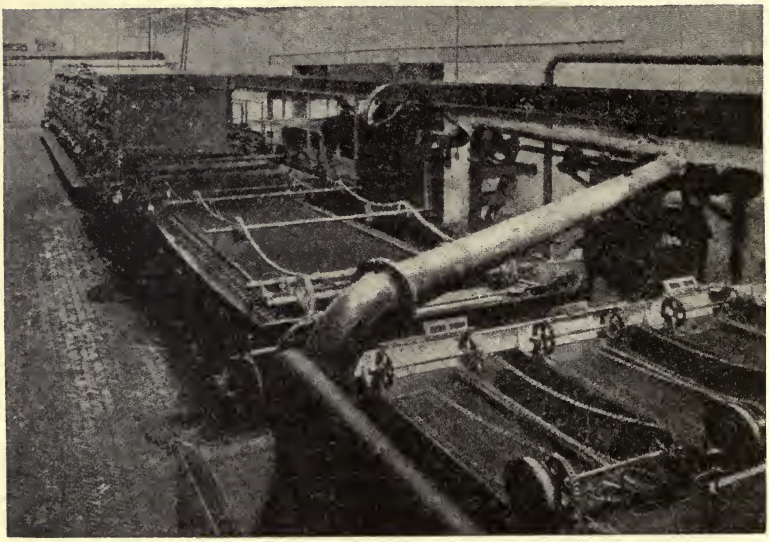


FIG. 6.—Front View rom Strainers ot 94-inch Papermaking Machine.
(Built by Bertrams Limited, Sciennes, Edinburgh.)

fibres to felt before the water has passed through the wire. The pulp passes from the strainers under a slice, which distributes the pulp evenly, over a rubber apron, on to the machine wire, and near the end of the wire will be seen a cylinder of wire above, and square boxes below the wire.

The cylinder is the dandy roll, which closes the surface of the paper with slight pressure, and if a watermark is required the soft pulp is impressed with the design upon the surface of the roll. If the paper is to be "laid" the cylinder will be covered with laid wires, with tying wires at regular intervals, but a wove paper has a woven dandy roll which leaves no mark beyond any watermark that may be on its surface. A dandy roll on which the tying wires run the length of the roll instead of round the circumference is known as a spiral laid dandy roll.

The boxes beneath the wire are suction boxes, open mouth of pumps which suck the remaining water from the paper. The wet end is well named, as for every ton of paper nearly 20,000 gallons of water are used for the dilution of the pulp, so that it may flow evenly and regularly. This water passes through the wire, most of it falling into the save-all and is used again for diluting the pulp.

Passing under the dandy roll and over the last suction box, the wire carries the web of paper through the couch rolls, where the paper is couched or pressed by a felt-covered roll for the same reason as hand-made papers are couched: to consolidate the paper. The wire returns to perform its operations continuously, and the limp paper is carried forward to the press rolls, where it is further pressed by polished rollers, first one side, then the other, to remove the wire and felt marks. Then the paper goes forward to the drying cylinders—massive rolls heated by interior steam; but the heat is so regulated that it is gradually increased, and the speed at which the web of paper travels is arranged so that no undue tension is placed upon the paper, or thinning might result, or the web be broken, and delay caused. The drying section of the

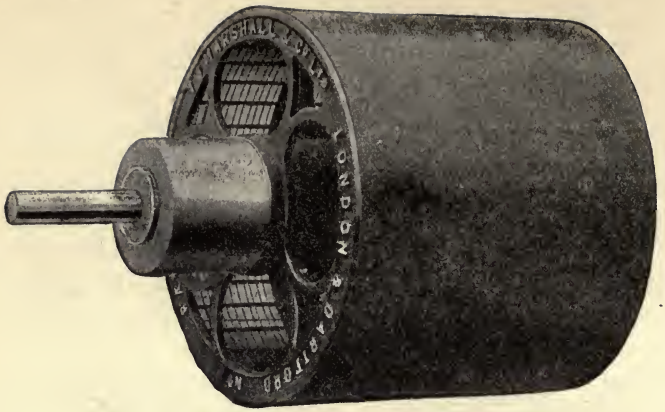


FIG. 7.—End of Wove Dandy Roll.

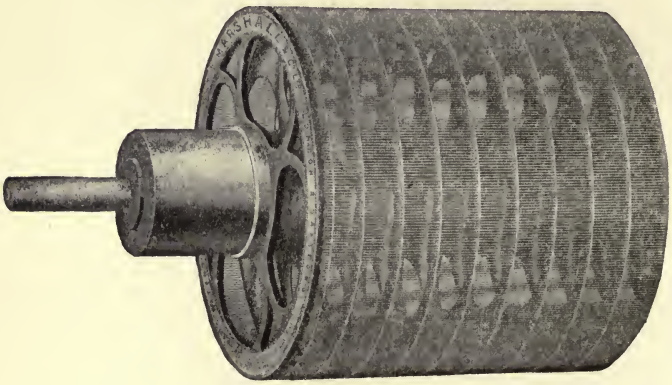


FIG. 8.—End of Laid Dandy Roll.

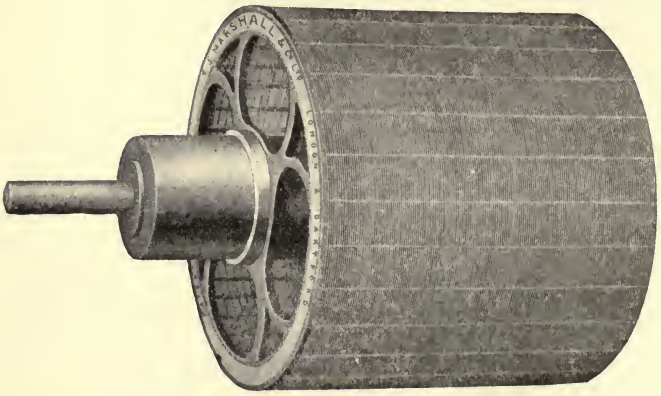


FIG. 9.—End of Spiral Laid Dandy Roll.

machine is a very quiet place compared with the wet end.

At the end of the machine are stacks of rolls through which the paper is led if it is to receive what is known as "machine finish." If, however, the paper is to be super-calendered, it is led past one or more of the stacks of rolls, and as it is reeled off a fine spray of water is projected upon the paper. There are various means of producing a misty cloud, but the object is the same in every case, to restore some of the moisture which has been driven off, and to prepare the paper to receive the finish at the super-calenders. If the paper were finished bone dry it would not be possible to impart the required surface by super-calendering, and, too, the paper would at the first opportunity absorb moisture from the atmosphere, and various troubles would arise. The paper, now reeled, is ready for the finishing department, to which the next chapter is devoted.

Papermaking on the Yankee or single cylinder machine is conducted in the same manner as on the ordinary or Fourdrinier machine as far as the wet end is concerned, but the series of drying cylinders is replaced by a single cylinder of large diameter, as much as 10 feet in some instances: the paper passing round this heated cylinder is dried, and glazed on one side, hence the term M.G., or machine-glazed paper.

Mill numbers survive from the time when all mills were registered, and when paper was a dutiable article. The duty was repealed in 1861, but the mill numbers remain, and are additional to watermarks in distinguishing between papers of the various makers.

Watermarks have been used from very early times to serve as marks of distinction. The watermark used by John Tate of Stevenage in 1494 was an eight-

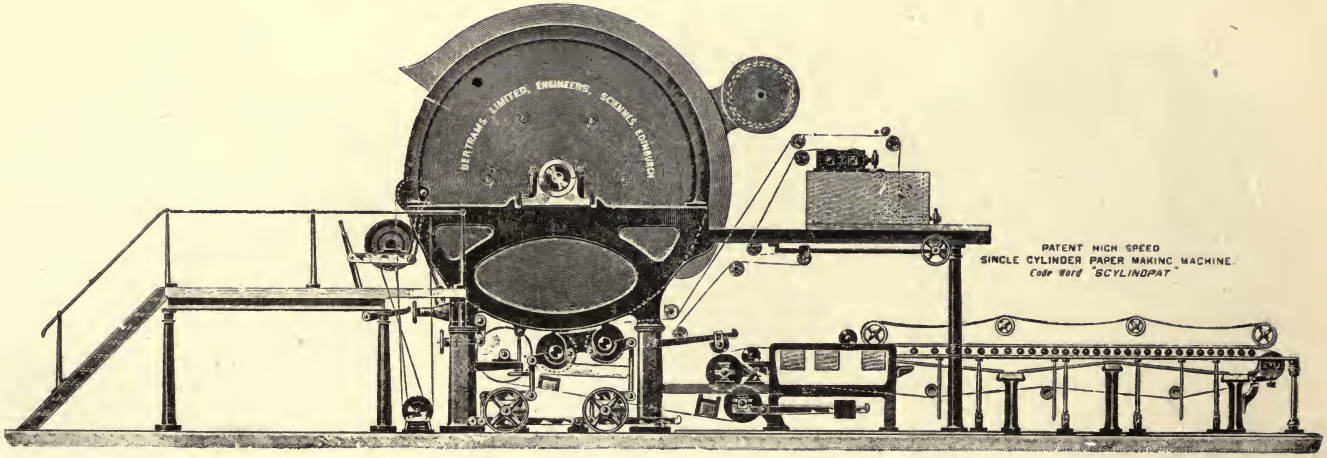


FIG. 10.—Single Cylinder or Yankee Papermaking Machine.

petalled flower. The cap and bells, post horn, crown, fleur-de-lis, and tankard have been associated with foolscap, post, crown, royal, and pott respectively, but the connection between size and watermark is not very close. At present foolscap papers frequently bear the figure of Britannia, and royal papers a shield, with bend sinister, surmounted by the fleur-de-lis. The register of watermarks consists of a large number of names which are intended to make the papers bearing them proprietary articles, and as the quality of the paper is maintained by the papermaker, there is almost an indirect virtue in watermarks. Special watermarks are sometimes designed for special editions or for paper for special purposes, the dandy roll being made in length and diameter to suit the size of the paper to be made. Watermarks on hand moulds are placed in position on the moulds, and there is no difficulty in cutting the paper to obtain register of the marks, as in the case of machine-made papers.

CHAPTER V

FINISHING

PAPERS which have reached the stage described in Chapters III. and IV. still have much to be done to them before the consumer, stationer, or printer can receive them. Finishing varies with different papers. Hand-made paper requires sizing, drying, glazing, sorting, counting (sometimes cutting), and packing before it is ready for despatch. If the machine-made paper is for writing, it may be gelatine sized, followed by drying, re-reeling, glazing, cutting into sheets, sorting, counting, and packing into reams. Printing papers are finished with "machine" or with super-calender or water finish, and other papers with friction-glazed or flint-glazed surfaces, the other operations following as for other papers after glazing.

Tub sizing always means animal sizing. Some mills still prepare their gelatine from hide cuttings, parchment cuttings, and other materials which yield gelatine, but the tendency is to eliminate this process and to buy the gelatine in sheet form ready for use without any process other than reduction to a solution of such strength as is necessary. The tub or vat of size is prepared and kept at an even temperature, the paper is dipped or allowed to stand in the size, or there are machines which carry the paper slowly through the trough of gelatine. The size must permeate the paper in order to make the sizing effective. On emerging, the paper

is squeezed to remove the excess of size, and the sheets are separated to prevent the paper from becoming a solid block.

The second visit to the drying loft prepares the paper for the last stages of manufacture. The drying is conducted at a moderately low temperature (for papermakers), not exceeding 80° Fahr., and when dry the paper has its bulk reduced and its surface improved by plate rolling, unless it is a drawing paper with a "not," that is, a rough surface. Plate rolling necessitates building a pile of paper, alternated with zinc plates a little larger than the paper, unbuilding and building of piles proceeding simultaneously as in the case of taking out set-off sheets and interleaving newly printed work. One girl takes the glazed paper, a second removes the plates, a third feeds the unglazed paper to the plates. When the pile is high enough it is lifted to the pressing rolls by a man who feeds it between the rollers, where great pressure is given, and the pile automatically returns to the front of the machine, and it is turned and placed for pressing the other way of the sheet. From two to a dozen pressings will be given according to the degree of finish required, and also to the hardness of the material.

Sorting, counting, and packing will complete the cycle of operations included in finishing, unless cutting to size is also necessary. Girls stand at long benches lighted with large windows, and have piles of paper before them for sorting into three classes—good, middling, bad—according to the degree or absence of defects. The middling paper showing slight defects is known as "retree," the reams are marked × ×, and the paper is sold at 10 per cent. reduction on the price for good paper. Bad paper, showing glaring defects, is called "broke," the reams are marked × × ×, and it is

either sold at a further reduction or is returned to be repulped. If the order is for specially watermarked paper, or is for all "insides" or good paper, the "re-tree" and "broke" will both return for re-making.

Machine-made writing papers which are to be sized with gelatine are usually first sized with resin, so do not come forward as waterleaf. The sizing room is long, high, comparatively narrow, containing a small sizing machine and numerous drying cylinders. The reel of paper is mounted on brackets in front of the sizing trough, the web passes between metal rollers, beneath the surface of the warm size, out and between squeezing rolls which remove the excess of gelatine, and then forward for drying. Up to the roof, and down to the floor, over skeleton drums, the web of paper travels until it is thoroughly dried, in a temperature equal to that of the drying lofts. At the end of the room the paper is reeled again, and when in a fit state goes either to the super-calenders, or, if the paper is to be plate-rolled, it is cut and the surface imparted as described for hand-made papers.

Papers which are merely to have "machine-finish," that is, the surface imparted by the calenders of the paper machine, receive no further treatment before being cut into sheets. Those papers which are to be super-calendered (S.C.) pass through a large super-calendering machine, consisting of a number of chilled iron rolls and rolls of compressed cotton or paper alternately. The weight of the rolls is enormous, and although extra pressure can be applied, it is not often necessary. A very high degree of finish can be given by means of the super-calenders, and the majority of papers with a glazed finish have passed through this machine.

Papers which are to receive a water finish are

given a film of water on the surface just before the web passes between the rolls of the super-calender, and

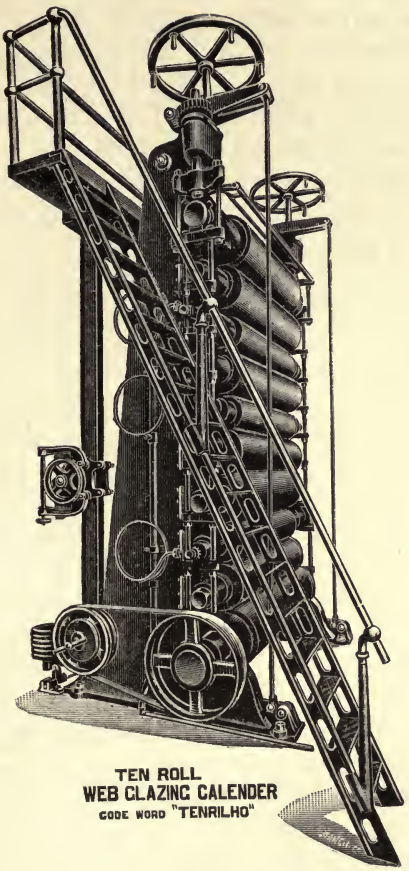


FIG. 11.—Web Glazing Calender or Super-Calender.
(Built by Bertrams Limited, Sciennes, Edinburgh.)

as a result the mineral constituent of the paper is brought to the surface, and a very level finish, with a high degree of polish, is imparted to the paper.

Friction glazing produces a higher polish than the processes already described. The machine is simple in construction, consisting of a pile of three rolls, one of cotton between two of steel. The paper passes between two only, and the top roll, being driven at a higher speed than the others, burnishes the side of the paper against which it is driven in a much more effective manner than the super-calenders.

Flint-glazed papers are actually burnished by the surface of a stone passing rapidly backwards and forwards on the surface of the paper as it emerges from the rolls, giving a hard brilliant polish. The same degree of finish is imparted to some papers by the use of a number of brushes oscillating rapidly upon the paper as it travels over a large cylinder.

Cutting the reels into smaller widths and then into single sheets is the function of a number of ingenious machines. If a watermarked paper is to be cut to register, a single reel is mounted at the cutting machine, and the web is advanced the necessary distance and the division into sheets takes place by a knife. A boy watches the travel of the paper, and when the water-mark travels beyond or short of a pointer, a turn of a screw brings the next sheet into register. Single sheet cutters are used for other papers, the reel is mounted, run forward between slitting knives, and a swinging knife divides the paper into sheets. Another make of machine will take from one to seven reels, and the paper passing between the slitters is cut into sheets by a revolving cutter, which makes a clean cut the whole width of the web, and the sheets are dropped on a travelling felt, carried forward to the front of the machine, and knocked up by boys or girls. An automatic "layer" replaces the boys in some mills, keeping the piles knocked up. To prevent waste in

cutting out blanks, envelope papers are cut at an angle, this being accomplished by swinging the frame carrying the revolving knife to the desired angle, and the papers are delivered in sheets ready for the envelope maker.

From the cutting machines the paper is taken to the "salle"—the sorting and packing room of the paper mill. A number of girls rapidly examine every sheet of paper, withdrawing those sheets which fall below the papermaker's standard of perfection, sorting into retree and broke proceeding as in the case of hand-made papers. Counting, cutting, and packing take place very quickly after the paper is sorted. The nimble fingers of the counters turn up the edge of a quantity of paper, the fingers of the other hand run down the edges quickly, counting into reams with extraordinary accuracy. Some papers are trimmed before packing, while others are cut from double to single sheets. Wrappers are carefully folded round the paper, and fastening is done by means of string, tape, or paper tape according to the size and weight of the reams.

As will be seen from "Paper Trade Customs," on page 135, the number of sheets to the ream is a varying quantity. A ream may consist of 472, 480, 500, 504 or 516 sheets.

In hand-made papers a mill ream consists of two qualities of the same paper, whether the paper is bought as good or retree. If the paper is good it will consist of 18 quires of insides or best paper, each quire containing 24 sheets, and two quires of outsides or slightly inferior paper, the quires containing 20 sheets each. "Retree" paper is marked on the outside by two crosses × ×, and the mill ream will be 472 sheets, whether the paper be good or retree. The price of

a ream of insides is usually 10 per cent. above the price for a mill ream.

Machine-made paper is good, retree, and outsides, the prices being 10 and 20 per cent. less for the second and third qualities respectively. Paper is usually supplied in inside reams of 480 sheets, that is, all good paper, but the papermaker may supply mill reams of 480 sheets, but with a quire of outsides at the top and bottom. The ream of 480 sheets is also known as the stationer's ream—writing, drawing, cartridge, and fancy papers being packed in that quantity. Paper classed as news is packed in 500's, envelope papers in 504's, and many printing papers in perfect or printer's reams of 516 sheets.

The variety of reams suggests that it might be well to move for a standard ream of 500 sheets. The present system makes for confusion in giving out paper, keeping stock, estimating and pricing out, and a simplification should be welcomed.

CHAPTER VI

MANUFACTURE OF BOARDS

THE manufacture of boards is varied, ranging from Bristol boards to millboards, and including ivory boards, pasteboards, triplex boards, strawboards, and pulp boards.

For pulp boards the description of papermaking will serve in its entirety, as the boards are made on the Fourdrinier, being engine-sized, reeled at the end of the machine, well rolled later, cut into sheets, sometimes plate-glazed after this, and then sorted and packed. There is one point of variation only, and that is in speed. As there is much more "stuff" let down to the wire, a greater thickness of material for the water to drain from demands more time, and so the output is relatively slower than when paper is being made.

For ivory boards, two or more sheets of fine paper made on a Fourdrinier, or else on a cylinder machine, are brought together at the couch rolls, and the sheets are pressed and rolled together without the use of paste.

Cylinder machines are invariably used for duplex, triplex, and boards of several layers other than paste boards and those already described. Instead of a travelling wire, a wire-covered cylinder is the means of forming the film of pulp. The cylinder revolves in a vat of pulp, takes up a thin layer of the fibre, and, pressing against a travelling felt, leaves its film of

paper, and as there are several cylinders, each in its own vat, producing paper in the same way, the several webs are brought together, rolled, dried, and reeled. In the case of a duplex board the pulp may be the same colour, or of two different shades. In triplex boards, the outsides are frequently thin and different in colour, compared with the middle sheet. Cylinder machines with as many as seven vats are in use, and forty to fifty drying cylinders are necessary to complete the extraction of the water.

Pasteboards are made up from middles and pastings. These are obtained from mills making specialities of these lines, the middles very often consisting of a moderately thick paper of poor quality, but the outsides are of fairly fine paper. The papers are not glazed, but after pasting together the web is thoroughly rolled and the surface obtained by subsequent calendering. Bristol boards are made from the finest materials, all-rag, tub-sized papers, the same paper throughout pasted, pressed and surfaced by hot-pressing. Other boards supplied under this title are made of good drawing paper for outsides, and cartridge for middles. The best boards are made by hand, and take considerable time and care in manufacture.

Millboards, the thicker kinds of box boards, slate boards, leather boards, portmanteau boards, and carriage panels are made on a special board machine. For leather boards a large percentage of pulped leather is sometimes employed. For the other kinds a large variety of materials finds its way to the machine, but it is waste in the form of flax, ropes, coarse rags for the best qualities, and for the lower grades waste papers of all kinds. The stronger materials are boiled and beaten, bleaching being unnecessary. Waste papers are simply steamed and pulped. All materials are strained, diluted

with water, and forwarded to the vat or stuff-chest of the machine. The board machine is comparatively short, consisting of a cylinder which lifts the film of pulp, delivers it to the endless felt, and a cylinder at the other end of the machine receives the web, which continues to roll round until the desired thickness is attained, when the wet board is dexterously slit by the attendant and taken off to the pile. Here the boards are alternated with sheets of felt or canvas, and the water is pressed out. The boards are hung up singly to dry in a heated chamber, and are afterwards damped slightly, rolled heavily, and cut to size.

CHAPTER VII

WRITING PAPERS

A LARGE variety of papers falls under the heading of writing papers: account book, bank, bond, cheque, ledger, loan, and typewriter papers being placed in this category. The printer uses writing papers of all kinds, some as superior printings, and others he prepares as stationery, or prints some part of a document upon them for subsequent filling in or completion.

Writing papers must be smooth and hard-sized to fulfil their purpose of bearing writing ink, and other qualities will depend upon the use for which they are destined. The fibres used include rag, chemical wood, esparto, and in the poorest qualities, which but few printers or stationers will stock, mechanical wood. Writing papers of the highest class are all-rag, tub-sized, air-dried, and plate-glazed. Every variety of writing paper may be wove or laid without alteration in quality; in fact, most mills make woves and laids from the same stuff, merely changing the wove dandy roll to one which makes the laid marks on the paper. This first class of paper is used for the best stationery, for printed and written documents of the highest importance which are required to stand a good deal of handling, and for ledgers and similar books subject to hard wear. Bank-notes are printed on hand-made paper, while the papers for stamps, cheques, postal orders, and money orders are usually machine-made.

Bank-notes, loans and banks demand the use of the strongest rags, such as linen, duck, and sail-cloth. The fibres are drawn out rather than cut up, the resulting paper being hard and resistant to wear. Bank-notes are cream wove; banks, cream wove or blue wove; loans are cream wove. Being hand-made the sizing, drying, and finishing are carried out as described in Chapter V.

Ledger or account book papers may be hand- or machine-made, and are usually azure or blue laid. If machine-made, the characteristics of the hand-made papers are as far as possible retained: strength, hard tub-sized surface, opacity, moderate finish, both sides alike in surface. To attain these qualities the same materials are employed, an all-rag furnish with a fair proportion of strong linen, prolonged beating to draw out the fibres, a shake to ensure good felting, slow drying to allow gradual contraction, tub-sizing, air-drying over skeleton drums will attain the desired end. The finish of ledger or account book papers is not quite so high as that for loan papers, but it must be equal for both sides of the sheet, in order that writing may be done easily on all pages of the books. The sizing must be thorough, or the ink will sink through the paper, and if erasures are made, the abraded surface will not take ink without spreading.

Machine-made bond or loan papers are not always all-rag papers, and are not essentially tub-sized, but the best of the class will be all-rag, tub-sized papers. One paper mill carries an enormous stock of high class engine-sized bond and bank papers in eighteen colours, and each of these in six substances. Bank papers are thinner than bonds, the usual substances being foolscap 7 lb., large post 11 lb., medium 13 lb. Here again the best papers are all-rag, tub-sized,

and while a very good chemical wood, tub-sized, super-calendered bank paper is obtainable, papers of the best quality, such as "3009 Extra Strong," always command a high price, being extremely strong and durable. Typewriting papers are similar to bank papers, but usually have a matt finish to prevent the smearing that may always take place on a highly polished paper, as the typewritten characters are not indented into the paper, but the colour is on the surface. Watermarked typewriting papers are well known, and the prices vary according to the substance and fibrous constituents of the papers, thin papers (8 lb. large post) costing nearly twice the price per pound for which 16 lb. large post can be purchased.

Cheque papers are strong, even in texture, and present a good surface for printing. There is a fair range of papers to choose from for cheque printing, without taking into consideration safety cheque papers.

As the same pulp may be wove or laid, so may the colour be varied without changing the quality. Cream wove, blue wove, yellow wove, cream laid, azure laid, blue laid, or tinted papers may be made from the same stuff, the colouring matter added giving the necessary difference in tint, the description of the paper varying accordingly. There are, of course, certain cases where one or other is preferred, but the quality is neither indicated by the colour of the paper nor by the pattern of the dandy roll employed. The surface may be rough (antique), moderately smooth (machine finish, vellum, ivory), or highly glazed (super-calendered or plate-glazed), each being attained by the different treatment in finishing the paper. Papers made entirely of rag will always be tub-sized, air-dried, and frequently plate-glazed, but papers which are only partly rag, and even chemical wood papers, are sometimes tub-

sized, but as a rule papers which contain no rag fibre are sized in the pulp, that is, engine-sized. The large variety of high-class engine-sized papers now obtainable is at once creditable to the enterprise of the manufacturers, and a sign that papers of this description fulfil the requirements of a large body of consumers.

A good deal of writing paper is used for printing, from which it might be inferred that there is a close resemblance between printings and engine-sized writings. The sizing of writings is harder than that of printings, and the materials used are manipulated to give a firmer handle to the paper, but there is no reason why all writing papers should not be used as printings in work of the character of booklets, magazines without illustrations, and a large part of the jobbing work which keeps to leaflet and pamphlet sizes. The nature of writing papers makes them less absorbent than printings, so that the ink does not sink into the paper quickly. This is desirable in the case of writing, but not in the case of printing, where a fair absorbency aids the rapid drying of printed work.

Drawing papers are made in various qualities. The best kinds for water-colour drawings are made from strong rags, chiefly linen, only boiled to remove dirt and other impurities, and reduced to pulp without the use of bleach or other chemicals. Hand-made papers are the best, being tub-sized, air-dried, and the surfaces—rough, "not" (matt), or hot pressed—obtained by pressure, not by rolling. A few high-class mills are responsible for machine-made drawings similar in furnish and finish to those made by hand. Engine-sized drawing papers are more like cartridge papers, but some of the cheaper varieties resemble thick toned printings. Cartridge papers are made from long-fibred stuff which is only partly bleached. Some cartridges

are tub-sized, and the papers serve as substitutes for drawing papers. Being very strong they make excellent cover papers for books and lists of various kinds. Crayon papers are coloured or tinted drawing papers used for crayon and water-colour work.

CHAPTER VIII

PRINTING PAPERS

THERE is considerable variety in printing papers, as regards fibre, sizing, and surface. As generally understood, printings are papers of good colour, not too hard-sized, of good surface, even in texture, fairly opaque, showing a clear look-through, free from specks and spots. The fibrous composition will depend largely upon the price. An all-rag paper is a splendid white paper, soft to print upon, pleasant to handle, very durable, and a type of moderate colour printed with a good black ink gives a very rich appearance on such paper. Hand-made, Dutch hand-made, mould-made, and machine-made rag papers are the papers for very special editions. Special moulds or dandy rolls are sometimes made for these papers to secure a distinctive appearance.

High-grade printing papers are produced from a mixture of rag and esparto fibres, a soft paper, taking a good finish, being produced. A blend of chemical wood and esparto, skilfully manufactured, produces a very good printing paper for all ordinary purposes, and papers composed entirely of chemical wood may be good or indifferent according to the treatment and skill devoted to their production. Sulphite papers tend to be harsh and transparent, but a mixture of soda pulp partly counteracts these faults, and even if it is not quite as soft as an esparto mixture, excellent results in print-

ing can be obtained if the fibres have been carefully beaten and blended. Papers containing mechanical wood are classed as common printings, and are suitable only for common work. A small proportion of mechanical wood may not be noticeable in the finished paper, but when a large proportion is used, greyness of colour and poorness of appearance are sure indications of the low quality of the material. Hand- and mould-made papers have no mineral filling in their composition. For machine-made papers the addition of a small proportion enables them to take a very good finish. The amount of china clay present in the finished paper should not exceed 10 per cent. of the total weight.

Hand-made and mould-made printings are tub-sized and plate-rolled, without giving a high glaze to the paper. Machine-made printings are engine-sized, hard or soft according to the use to which the paper is to be put, and sometimes the surface will govern the sizing, some papers being hard-sized and super-calendered, others soft-sized and with only machine finish. As a matter of fact, super-calendered printings are used largely for illustrated work, and with half-tone blocks the ink must dry thoroughly and fairly quickly, so the paper is not hard-sized. All thin printings require to be well sized to prevent the ink sinking right through the paper, and most papers with machine finish, excepting the commoner news, are usually well sized, and coloured printings, too, incline to hard-sizing.

The best Bible papers are made of rag fibres with a fair amount of loading, and some starch to ensure opacity and good printing qualities. The Oxford India paper is still manufactured under special conditions which are kept secret, but there are many imitations which serve excellently for the purpose of thin paper editions. The graphic demonstration of the difference

between the thickness of the " Encyclopædia Britannica " printed upon India paper and ordinary printing paper will be fresh in the minds of most readers.

Toned papers are made of the same materials as white paper, the creamy colour being obtained by the addition of a small amount of colouring matter to the pulp.

Featherweight papers are made entirely of esparto, very little sizing is added, no loading is used, the paper is treated so that the wire and felt marks are not easily visible, and the drying and finishing are carried out so as to retain the bulkiness of paper. It must always be remembered that all papers made under such conditions are not durable, and therefore should never be used for work which must withstand any considerable handling.

Coloured and tinted papers are made of the same materials as white printings, but usually the fibres will be chemical wood and esparto, all chemical, or a mixture of chemical and mechanical wood pulps. The variety of tints in which papers can be obtained is very extensive, and this is impressed upon one when trying to match up some particular shade, when it appears as though makers have many substitutes for the desired colour. The colours of papers should be fairly fast to light, and with the large variety obtainable by the use of the pigments and dyes now on the market, paper-makers manage to offer a long range of fast colours. Although it may not always be so, fastness usually follows the price of the paper, the cheapest being the most liable to fade quickly. Delicate tints are more expensive because of the necessity of a better quality of paper to take the colours evenly and cleanly. Coloured printing papers should be fairly well sized, well finished, and free from spots and specks.

In addition to possessing the good qualities of

printings, lithographic papers must be firm and free from permanent stretch. In letterpress printing, only a portion of the paper is pressed by the printing surface, but in lithography the whole of the paper is brought into contact with the stone or other surface. If the printing surface is full or solid, as in the case of printing a ground tint, the pull on the surface of the paper is heavy, and unless the paper is well made the surface will pluck or pull up in patches, or even all over the sheet. The pressure exerts a stretching influence on the paper, and the moisture from damping induces expansion of the sheet. Lithographic papers require special care in selection of material and manufacture, so as to introduce and preserve all the necessary qualities of easy printing, perfect register, and quick drying.

Esparto fibre is short and soft, prints easily, and experience has proved that esparto papers stretch less than most other papers, and therefore litho papers usually contain a large proportion of this useful material. An all-rag litho. paper is the first quality ; then rag and esparto, all esparto, chemical wood and esparto, mark the various grades of paper for lithographic printing. While the papers should not be hard-sized, they should not err on the other side, or absorption of moisture may cause trouble when registering. Soft materials, beaten quickly, dried gradually, not drawn too fast by the drying cylinders, are necessary to produce a satisfactory paper. The surface must be perfectly smooth, and this is obtained by super-calendering or plate-glazing, both of which tend to reduce the liability of the papers to stretch. The latter method is the better but more expensive method of producing the desired surface, and by turning the piles of paper and rolling in each direction of the sheet, subsequent stretch in working is reduced to a minimum.

Plate papers are fine papers, soft-sized, lightly rolled, usually having one side only with a smooth finish. Thick plate papers are made by rolling two or more webs of wet paper together, and finishing as usual. The softness of the paper enables it to take all the ink from the finest lines of the steel or copper plates printed upon the surface.

Poster paper for lithographic or letterpress printing is made with a rough back to enable pasting to hoardings to take place more easily. These papers are made on the single cylinder machine, and, having only one side glazed—the printing side—are known as M.G. poster papers.

Imitation art papers are distinctly between super-calendered printings and art papers in printing quality, but they lack strength, owing to the method of their manufacture. Art paper has a mineral coating, while imitation art has a large percentage (about 25 per cent.) of china clay mixed with the pulp. China clay, having no cohesion, does not assist in felting the paper in any way, but tends to weaken its resistance to wear. That weakness or tenderness is one feature of imitation art papers. After leaving the paper machine the paper is super-calendered, receiving a water finish, that is, the paper is just wetted on the surface immediately before entering the rolls of the calender. The loading is thus brought to the surface, and a very smooth level sheet is produced, only a little inferior, as a printing surface, to art paper. Being opaque, suitable for half-tone printing, and of good appearance, imitation art is used largely for illustrated magazine work, and serves the purpose well, but it should be remembered that the large proportion of mineral matter renders the paper liable to disintegration from frequent handling.

CHAPTER IX

COATED PAPERS AND BOARDS

COATED papers comprise those to which, after manufacture as paper, a mineral coating, white or coloured, is applied, in order to produce a smooth unbroken surface for the reception of fine printed work. Art, chromo, enamel, and surface-coloured papers are all coated after the body paper is made.

Art papers may be made of rag, esparto, chemical wood, or chemical and mechanical wood, or a mixture of any of the fibres. The body paper is carefully made, its ultimate state being kept in mind, and it is fairly well sized, but without a high glaze. The surface is kept so that the coating will cover properly and the adhesive be fully effective in holding the mineral. The operations comprise coating, drying, and finishing. The coating is carried out on a compact machine. A mixture of china clay, glue, and water is supplied at a constant level to the feed trough of the machine, from which it is transferred to paper by means of a roller and felt; oscillating and stationary brushes rub the coating into the paper, filling up all inequalities and leaving a smooth film on the surface. The purpose of the coating is to give a perfectly smooth surface, obliterating entirely the marks of the machine wire and felts, and to do this effectively the consistency of the mixture is regulated so that it may enter the minute depressions and deposit sufficient matter to take

a good finish. An ingenious overhead railway carries the web forward in a series of loops supported on a series of rods, hot air driven forward by mechanical fans effecting the drying. If the paper is two-sided art, it is reeled and the operations repeated on the other side of the paper. As the coating is slightly thicker at the edges of the web, these edges are trimmed off, and the web goes forward for one or more journeys through the super-calender rolls. Dull art and papers with a specially high finish receive slightly different treatment, the surface in all cases being made perfectly smooth in order that the finest half-tones may be printed successfully.

Chromo papers are usually coated on one side only, and the body paper is stouter than that used for art papers. Used largely for lithography, the paper must be as free from stretch as possible. This is obtained as described in the chapter on the reduction to pulp, by using soft fibres, sharp beater knives, and cutting up quickly, this treatment producing what the papermaker knows as "free" pulp, as distinguished from "wet" pulp, which, owing to prolonged treatment, combines with some of the water and actually becomes "wet." The surface of chromo papers may be dull or highly glazed.

Surface coloured enamelled papers are used largely by box-makers, for labels for packets of various commodities, and also as end papers for books. The coating and body paper are thinner than for art papers, the colour is obtained by the use of a pigment or an aniline colour, and the coating and after-treatment are exactly as in the case of art papers. Flint-glazed surface papers are used for the same purposes as surface-enamelled papers, and have a hard burnished surface obtained by a stone burnisher travelling back-

wards and forwards across the surface of the paper as it emerges from the calender rolls.

Boards may be coated in the same way as paper, provided the boards are not too thick. The thicker qualities are either coated on a modified machine, the looping being impossible, or coating by hand is resorted to. The boards are obtainable as one- or two-sided, with different degrees of surface, and with different coloured coatings. Coated boards are sometimes made by pasting coated papers to ordinary middles, and finishing by plate rolling.

Thin box boards for use as cartons for small goods, such as cigarette packets, are coated with a coloured coating in the manner already described.

Coloured cloth-lined cards are first manufactured as pasteboards, and are afterwards coated on the cloth side with the coloured coating, two applications being necessary in many cases to obtain the desired thickness and surface. Plate-glazing is the means of imparting the ordinary surface to this class of cards.

CHAPTER X

MISCELLANEOUS PAPERS

Blotting, Duplicating, Copying, Tissue, Cover, Gummed, Wrapping

There are so many varieties of paper which are only occasionally encountered that it is better to present the whole of them in alphabetical arrangement (see Chapter XVII.), and in this section to give a longer description of a few representative papers.

Blottings and filter papers are very similar in appearance and manufacture, their definite purposes being to absorb moisture, and to filter suspended matter from solutions respectively. The description of blotting paper manufacture will cover both varieties. The office of blotting paper being to absorb ink, the raw material is chosen with a view to obtain the most efficient fibre for the purpose, soft muslins, too soft for writing papers, making excellent blottings. The preliminary treatment of the rags has been described already. Beating is carried out as quickly as possible, sharp knives being used to cut the fibres into short lengths, and not to bruise or beat the fibres more finely. As many fibre ends as possible must be absorbing on a given area at one time, and the shorter the lengths to which the fibres are cut, the greater the efficiency of the blotting paper, within certain limits. Certain after-treatment of the fibre is resorted to, to produce as soft and absorbent a

fibre as is consistent with the necessary cohesion, but of course manufacturers prefer to keep special methods to themselves. At the paper machine little or no shake is given, and very light pressure is given throughout, just sufficient to smooth the paper down. Strength is not aimed at, but the paper must be strong enough to resist the handling it will receive in ordinary use.

Most blotting papers are made in demy, with a standard weight of 38 lb. per ream of 480 sheets. There are blottings made of wood pulp, but these are far below the rag papers in efficiency. Soda wood pulp makes a very fair blotting paper, but sulphite wood is not so absorbent as soda pulp paper. Wood pulp blottings are usually made in thin substances for interleaving diaries and similar books, where repeated use will not be required. Enamelled blotting papers are made by pasting enamelled (coated) papers to the ordinary blotting paper and rolling down. These blottings can be obtained in a variety of colours, both the blotting and surface paper being varied in colour. Coloured blottings are made of the usual ingredients, with added colouring matter.

Duplicating, impression, and multi - copying are different names for the same papers. They are used for the various duplicating machines of the cyclostyle and mimeograph patterns, where a number of copies of written or typewritten matter is required quickly. A very thin ink is used, and it is necessary that it should be absorbed very speedily. These papers are practically unsized, contain a large proportion of esparto for the better qualities, and a certain quantity of mechanical wood in the cheaper sorts. A very large range of these papers is obtainable: laid or wove, white, cream or tinted, with rough or moderately smooth finish. For copies produced by the same process, where

a signature has to be appended, or when the form serves as a blank for written additions, a half-sized paper is obtainable in similar qualities and tints.

Tissue papers are strong, thin papers, the best quality being made from hemp or rag fibre, well beaten, with no loading or sizing, made in blue or cream, usually double crown in size; other qualities are made from mixtures of rag, chemical wood, and straw, in various proportions and in various weights. Tissues serve a large number of purposes, as wrappings for high-class goods, therefore they must be strong and free from chemicals, for fly-leaves for the protection of engravings and prints, and also for the basis of carbon papers which are used for obtaining a simultaneous copy of written or typewritten documents.

Copying papers are similar in all respects to tissues, but some varieties have a small amount of mineral matter added to increase their efficiency. Made in cream wove, blue wove, and buff, put up in reams of 500 sheets, copying papers are used for press copying correspondence which has been made in copyable ink. Special typewriter ribbons are supplied, but most typewritten matter copies without trouble. The leaf of the copying book is damped, the excess of moisture removed by an absorbent sheet, the document inserted, the book closed, and pressed in the copying press. By this means copies of correspondence are preserved for reference. Copying paper is also made up in rolls for copying machines which carry out the damping and copying automatically.

Cover papers are obtainable in many qualities, colours, and sizes. The materials used in their manufacture run through the whole range of papermaking fibres, the best qualities having a good proportion of rag fibre, while the low grades have some quantity

of mechanical wood, but there should be little if any mineral matter present, as strength is an important feature. The finish of the papers is smooth, moderately rough, or rough; the colours tend to browns, greys, slates, and dark greens, but a fair number of more delicate shades can be obtained, and some of the reds are most effective. The substances of cover papers run from 18 lb. to 56 lb. demy per ream of 480 sheets, so there is sufficient variety from which to select paper to suit any job.

As covers for booklets, price lists, pamphlets, etc., cover papers are regularly used, and for other purposes there has arisen a demand for the darker shades. The army of photographers, professional and amateur, have employed cover papers as mounts, either in the form of cut mounts or as photographic albums. For these purposes the range of substances has been extended, the heavy papers being made in card thicknesses. In making papers for photographic mounts a very necessary quality is that the paper shall be absolutely free from chemical substances likely to affect the photographic prints mounted upon them. Colour prints are mounted on neutral cover papers for insertion in magazines or books, but when publications have extensive and growing circulations, the time and cost of mounting militate against this very effective method of displaying illustrations.

Embossed cover papers are made and finished in the usual manner, and run through special rolls having the pattern engraved upon them. Papers for embossing must possess good strength or the embossed design will not stand handling, or the paper may break when embossed.

Pamphlet cover papers are thick tinted papers, made in a very pleasing variety, serving as programme

papers and for much jobbing work, as well as for the purpose for which they were originally intended.

Covers for exercise books are usually glazed on one side only (M.G.). This should be the outside of the book, and any printing should be executed on the smooth side. "Pressings" are the papers usually employed for such purposes, a cheap cover paper obtainable in various colours, weights, and sizes.

Gummed papers are made in a variety of qualities, colours, and substances. The papers range from the thinnest printing to thick enamelled paper, and the thickness of the coating of gum is varied to meet all requirements. Many colours of paper can be procured ready gummed. To obtain a satisfactory gummed paper three things have to be studied: body paper, gum, and thickness of coating. The inherent fault of gummed papers is the tendency to curl, but the extensive manufacture of non-curling gummed papers has done much to remove this bugbear. By adopting a paper which is affected but little by atmospheric changes something is accomplished in the minimising of curling, but by an ingenious breaking of the gummed surface non-curling is secured. When the coating is dry, the paper is drawn over a steel edge to break the homogeneous film of gum into innumerable fragments. In absorbing or parting with moisture (the cause of curling) the small particles can only act as individuals instead of combining and curling. Any kind of paper can be gummed, but the thinner the paper the more effective its adhesion when used as a label. When a label, slip, or any printed matter has to cover other printed matter, the paper must be thicker and opaque enough to prevent the matter beneath from showing through.

Wrapping papers are of many kinds, of various substances and colours, and are varied, too, in surface.

The materials used range from the strongest to the weakest—from hemp rope to mechanical wood—and include jute in the form of old gunny bags or sacking, hemp refuse, old rope and string, waste card cuttings, old paper, and wood pulp refuse. The substance ranges from 38 lb. to 160 lb. per ream of 480 sheets in double imperial, the colour from "white" to a very dark brown, and the finish from highly glazed both sides to a rough air-dried surface.

Strong materials are boiled under pressure for several hours, lime being employed for hard papers, and soda for softer papers. The fibres receive but little washing, going on to the beaters, where the stronger fibres are first reduced and the softer materials added later. Loading, colouring, and size are added, and the paper made on the Fourdrinier. Air-dried browns are specially tough, very leathery, will stand a great deal of folding, and when packing and unpacking of parcels is required the extra cost is easily recouped. Cylinder-dried browns are dried on the paper machine, and the papers are not so elastic as air-dried papers of the same substance. Glazed browns are usually lighter in colour and cleaner in appearance than the ordinary wrappings, and usually contain a large proportion of wood pulp. Kraft browns may be described as glazed browns, as they are sometimes finished with a glazed surface both sides. A special kind of pulp is used for krafts, wood being digested at a comparatively low pressure with soda solution, the boiling being prolonged. The fibres are loosened, and reduction to pulp takes place in the edge runner (kollergang) instead of the beating engine. By this means the fibres are drawn out, not cut up, and very tough papers can be made, fully entitling the papers to their description as "kraft" (German for "strength").

Special wrappings which will not discolour the goods packed in them are necessary for packing such fabrics as cotton goods, this quality being made without added colouring matter. Ream wrappers are sometimes thick common papers, serving as protective coverings only, being heavy but with little strength. Some papers are packed conscientiously, the manufacturer or stationer recognising the fact that a valuable paper demands a good packing paper. The use of poor paper is strange, seeing that the printer is charged for the wrapper at the rate quoted for the contents.

CHAPTER XI

CARDS AND CARDBOARDS

In the chapter devoted to the manufacture of boards a brief description of the method of the production of each variety is given. Pulp boards, triplex (or multiplex), and pasteboards are there described, and coated boards of various sorts are included in Chapter IX.

Pulp boards are frequently looked upon as soft and flexible, and many may be so described, but for card index work a stiff snappy card, thin in substance, is required, and as pasteboards and other cards made up of layers tend to split when subjected to much use, pulp boards are essential for that class of work. The boards which most closely resemble ivory boards in appearance will be found the most suitable for system use. A smooth writing surface, free from spots and other imperfections, is required, but the cards should be easy to rule and print. It is impossible to manipulate successfully cockled or wavy boards in ruling, printing, or cutting, so time will be saved if the selection of boards for index cards is made from the kinds which can be obtained perfectly flat. The softer kinds of pulp boards are excellent for a great deal of advertising matter, folders, post-cards, and for jobs for which something stouter than the usual tinted papers is required. Where rigidity is demanded pasteboards will be found of service. Some boards are made with

grey middles and poor facings, but it is possible to obtain a good class of boards at a moderate price, and it is far more satisfactory to keep a stock of material of good appearance than to obtain the lowest quality possible. White cardboards should be rigid, of good colour, smooth, and should be so well sized as to be suitable for post-cards or similar work. Pasteboards can be obtained in various substances, being described as three-sheet, four-sheet, etc., but there is no point system in card thicknesses, as one maker's six-sheet will be the same as a four-sheet of another manufacturer. A very fair range of colours can be obtained in pasteboards, but if a special colour is desired a making order is frequently necessary to ensure sufficient of the special facing paper.

Triplex boards are not made in the same variety of thickness or colours as pasteboards. It is not possible to build up the substance in triplex and to dry the web successfully in the thickness of the heavier pasteboards, but it is possible to procure very good triplex boards with the attributes specified for pasteboards.

The better qualities of cardboards will be found suitable for most classes of printing, even for half-tone work, but if three-colour blocks are to be printed, coated boards are necessary. Chromo boards, one- or two-sided, are obtainable from three- to twelve-sheet in substance, and on these any class of work will stand well. Owing to the burnished surface of these boards show cards keep clean for a much longer period than when ordinary cardboards are used, and frequently varnishing can be dispensed with if enamelled boards are not exposed to weather. Coated boards must be handled with care at all times, as the surface is sensitive to grease and moisture, notwithstanding its

dustproof tendency. Cloth-lined and cloth-surfaced boards are used for club cards, being very durable and folding well. The white side should always be the inside.

Wholesale stationers keep a large and varied stock of cut cards, plain, round cornered, gilt edged, embossed, plate sunk, with fancy borders and fancy surfaces. A list of stock sizes will be found on page 140, but this list does not refer to every variety of card. Some kinds, such as ivory cards, are stocked in all the regular visiting and business card sizes and multiples of the same, and others in the usual ticket and correspondence card sizes. Reference to the stock book of any maker will serve as a guide in ordering for stock or for special purposes. Post-cards, plain and with printed fronts, are procurable in a variety of qualities, and often prove very useful to small printers.

The standard size for boards of all kinds is royal, 25 inches × 20 inches.

CHAPTER XII

DURABILITY OF PAPER

PAPER is used for many publications and jobs of an ephemeral character, and for these the permanence of paper is never in question. On the other hand, ledgers, leases, agreements, share certificates, must be upon paper which is to all intents and purposes permanent and capable of resisting a good deal of handling. Printed records, too, must be preserved on paper that will, with ordinary care, be indestructible.

The constituents of paper, as shown in the first chapter, are vegetable fibres, mineral filling, colouring matter, and vegetable or animal sizing. The fibres producing the paper which approximates most nearly to a pure cellulose material, with the minimum of chemical and mechanical treatment, are, of course, the best possible. Classified with that in view, cotton, flax, hemp, chemical wood, esparto, and mechanical wood is the order of merit. Cotton is, more than any other material, the ideal fibre. It contains 91 per cent. of pure cellulose, has a comparatively small amount of incrusting matter, and its fibre is easily bleached, and easily prepared for papermaking. Consisting as it does of seed-hairs, cotton is a free fibre from the first. It consists of a long tube, of dumb-bell section, with a tendency to twist upon itself. Prolonged beating produces numerous fibrillæ, and the softness of the original fibre is preserved until over-beating is reached.

The twisting, the division into fibrillæ, make for strength, good felting, and, with the softness in addition, the best and most durable papers are those of cotton.

The flax fibre is a bast fibre. Its yield of pure cellulose is 70 to 80 per cent. The fibre consists of a thick walled canal, which is easily seen in the unbeaten state. Beating tends to crush and remove the early characteristics. The fibres are regularly rounded or polygonal, and easily split into numerous fibrillæ, the ends of the fibres beat out into bunches of small fibres, and these, together with the nodules which occur on many of the fibres, produce strength in the paper. The flax fibre is straighter than the cotton fibre, and so linen papers are stiffer and harder than cotton papers.

Wood, produced as fibres by chemical means, consists largely of tracheids, long ribbon-like cells, which are easily broken into shorter lengths. It is not possible to subdivide the fibres longitudinally by prolonged beating. This only tends to shorten the fibres. Hence Mitscherlich,[1] or similarly produced wood pulp, gives strong tough papers, unattainable by those pulps which are strongly bleached and much reduced. The tracheids, being smooth and flat, do not tend to make soft papers. But, blended with rag or esparto fibres, excellent papers may be produced. Only 50 per cent. of fibre is produced from the original wood.

Esparto gives a smooth, cylindrical fibre, pointed, short, with small canal. Being small, the fibres do not receive much treatment in beating. Separation and cleaning are the principal ends of the preparatory stages. Esparto is, to the papermaker, synonymous

[1] Mitscherlich process : boiling for a long period under low pressure, afterwards disintegrating the fibres by means of the edge runner.

with bulky papers. The best of printing papers, litho. papers, and featherweights are composed largely of esparto. It blends well with the preceding fibres, and especially with chemical wood for printing papers. Unfortunately esparto is liable to deterioration, and thus is not suitable for permanent papers. Its yield of cellulose is low—42 to 47 per cent.

Mechanical wood is lowest in the scale of paper-making materials. Chemically it is impure; structurally it consists of chips and fragments, seldom complete fibres. Ground into short lengths, it consists usually of short bundles of short pieces of fibre. It does not felt well, and requires the addition of other fibrous material to hold the pulp together as paper. Ten to 40 per cent. of chemical pulp is usually added to mechanical pulp to make it more lasting and less brittle.

In 1898 a committee appointed by the Society of Arts reported upon the deterioration of papers after extensive investigation. Their conclusions hold good to-day, and may be summarised in the next five paragraphs.

The deterioration of paper may be by discoloration only, or disintegration may also occur. Discoloration may be caused simply by the action of the atmosphere, and is to be seen in the margins of books and in coloured papers. The outer margins of books are more susceptible to oxidation than the interior, and in gaslit rooms most books will in time suffer from discoloured margins. Chemical residues from the manufacturing processes, if left in the paper, will bring about changes in colour, engine-sized papers being more liable to change than papers which are tub-sized. Papers which contain esparto, straw, or mechanical wood, will in chemical laboratories certainly

become discoloured, as aniline and other coal-tar bases stain the papers yellow or pink. There are but few colouring matters which are absolutely fast, therefore most tinted and coloured papers will change in time.

Loss of strength may be due to impurities in paper, such as residues of the chemicals used in the preparation of the pulp, to the impurities in the pulp itself, or to the use of gas as the agent for lighting and heating. The use of china clay for the improvement of the surface of the paper and for the increase of opacity, tends to weaken the paper, not by any chemical reaction, but merely by rendering the paper less resistant to wear. The attainment of extreme whiteness by bleaching is sometimes obtained at the expense of durability, as products are sometimes left in the fibre which will cause deterioration and discoloration of the paper.

The classification of the fibres has been referred to, and the four classes are: (i) cotton, flax, hemp; (ii) chemical wood; (iii) esparto and straw; (iv) mechanical wood.

For written documents of permanent value the paper should be all rag fibre, without starch and loading, tub-sized with gelatine. For printed books to be preserved as of permanent value, not less than 70 per cent. of the fibre should be rag, the loading should not exceed 10 per cent. as shown in the ash of the paper, and the sizing should be effected by not more than 2 per cent. of resin.

The wearing qualities of paper are affected by the method of manufacture as well as by the constituents. Blotting paper, which is an all-rag paper, will soon wear away, owing to the fact that the fibres are cut short and loosely held together without sizing. If the paper were heavily rolled it would reduce its usefulness as an absorbent paper. Featherweight

papers are made entirely of esparto, finished to produce as bulky a paper as possible, consequently the fibres are not well rolled together, and the books printed on such paper are anything but durable. Imitation art papers give a mineral residue of 25 to 35 per cent. on ashing, and have very little strength, owing to the large proportion of china clay present.

Art papers do not fold or stitch well, as the mineral coating, although firmly fixed to the paper, behaves as a non-fibrous material might be expected to do, breaking down, and the paper beneath tends to give way too. If kept in a damp place art papers absorb moisture at the edges, and in the presence of a large amount of moisture the sheets will stick together. Rag art papers are procurable (the body being a rag paper), and possibly it will be found that such papers, kept from air and moisture, will be very durable.

Papers containing a large proportion of mechanical wood, whether coated or otherwise, are certain to deteriorate rapidly. A newspaper exposed to sunlight for a day or two becomes discoloured and brittle, the same result following in a longer time if exposed to light and air without the sun. For this reason papers containing mechanical wood should never be employed for work which is to last. Cheap reprints of standard works are sometimes printed on such paper, but it is a very doubtful economy on the part of the publisher.

CHAPTER XIII

DEFECTS AND REMEDIES

MANY users of paper look upon that material as being perfectly inert and stable, always of the same quality, and any defect which may arise remediable only by changing the paper. Unfortunately, the printer who uses the paper for letterpress, lithographic, or ruling purposes, finds that paper is not unchangeable, and when work has to be registered upon the paper difficulties often arise, and exchange is not always possible.

The principal difficulties arise from stretching, cockling, creasing, from the surface lifting or picking, from the paper being out of square, from electricity contained in the paper, and from loose particles coming away from the paper in the form of fluff. In addition there are difficulties in getting colour to dry upon certain papers, and in obtaining a solid impression or continuous line from printed or ruled matter.

Reference to the chapter on machine-made papers will serve to give the clue to some of the difficulties, and may suggest the remedy. The pulp, diluted with a large volume of water, consists of innumerable fibres, their length being at least 100 times their diameter, and as is the case of all water-borne bodies travelling in a fast stream, they take up the position in which their length is parallel to the direction of flow. The side shake of the wire alters the position of some of the fibres, and although the alteration is permanent,

the majority of fibres remain in a position parallel to the machine direction of the web of paper. Most machine-made papers are dried on the heated cylinders of the paper machine, the diameters of the cylinders being arranged to allow for the consequent contraction of the web, but the fibres are not given the opportunity to adjust themselves as in the case of air-dried papers.

When it is remembered that the papermaking fibres may expand in diameter to the extent of 20 per cent., but only one per cent. in length, it will be seen that the expansion will show itself chiefly in one direction, for the majority of fibres lie side by side. Fortunately the full expansion does not take place. Paper which is properly matured contains water equal to 7 per cent. of its weight. Without this moisture, paper would be brittle, and when this amount is exceeded the paper expands. But paper, as it leaves the calender rolls of the paper machine, contains less than 7 per cent. of water. It is essential that all the water should be dried out of the paper, and the paper is sometimes reeled almost bone-dry, but if the paper is to be super-calendered it is damped before reeling, and left until the paper mellows before calendering. Many papers are cut and packed without much opportunity for maturing, that is, as regards paper, attaining a degree of stability which should be maintained during its manipulation by the printer, and, it is hoped, during the remainder of its career.

All papers have some spaces between the fibres, sometimes partly filled with sizing and loading, but always containing some air space, the amount depending upon the density of the paper. Heavy or dense papers and light or bulky papers are the extremes, 30 to 70 per cent. of air space being examples of the two ends of the scale. The fibres, when expanding,

fill some of the air spaces between the fibres, and the expansion can never extend to the 20 per cent. mentioned. Experiments carried out on a litho. paper, 36 lb. royal, showed the maximum expansion from absorption of moisture to be 2½ per cent., but papers do not expand as much as this in working, or register work would be extremely difficult.

Expansion, or stretching as it is usually termed, is caused by absorption of moisture by the finished paper from the atmosphere. The atmosphere always contains some moisture, the amount varying not only from day to day, but from hour to hour. When there is an excess of moisture in the air, as on wet days or when fogs occur, paper will readily absorb the extra moisture, and the absorption will be accompanied by expansion of the sheet, principally across the web, or as it is generally termed, in the cross direction. This propensity of paper really points to the remedy. Paper should be matured and kept in that state, or to put it in other words, it should contain an amount of moisture which is neither increased nor diminished.

Few printers treat the machine-room, letterpress or lithographic, or the ruling-room as places where scientific conditions should be maintained. The use of the wet and dry bulb thermometers in other factories is for a definite purpose, to indicate the state of the atmosphere, and to guide in regulation of temperature and humidity, in order that the manufacturing processes may be carried out under scientific conditions. But the machine-room of the printer, closed for more than half its time, heated perhaps by hot water or steam pipes, sometimes hot, sometimes cold, in wet weather damp, in summer alternately very dry and damp, what wonder if paper expands, contracts, and causes trouble at machine.

The establishments where scientific conditions are

observed reap the benefit in increased output, because less work is spoiled by bad register, and less time is spent in getting work to register. Even with the regulation of atmosphere suggested by the use of the dry and wet bulb thermometers or hygrometer, the paper must be matured *in the machine-room*, that is, the paper must be exposed in order to allow it to absorb moisture if too dry, and to part with moisture if too damp, so that the paper may be as stable as possible while the condition of the machine-room remains constant. It is important that the amount of atmospheric moisture should remain constant, and printers'

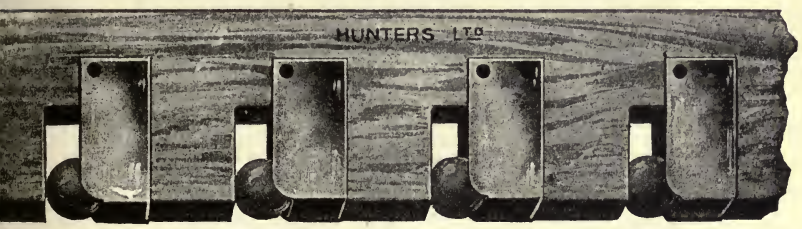


FIG. 12.—Ball Frame for Hanging Paper.

engineers will advise on the means of attaining this end.

Various methods may be adopted for suspending paper. In some cases the paper is hung over lines, about a quire at a time, exposed to the atmosphere and dust of the machine-room. Hanging frames are supplied by vendors of printers' supplies, in which the paper is clipped by a ball or swinging lever, and about a quire is held in each of the clips, a perpendicular position minimising the danger of dirt. By use of these frames a large quantity of paper can be treated in a comparatively small space. The "Swift" machine is another method of maturing

paper. The claim made for the machine is that it matures large quantities of paper in a short time.

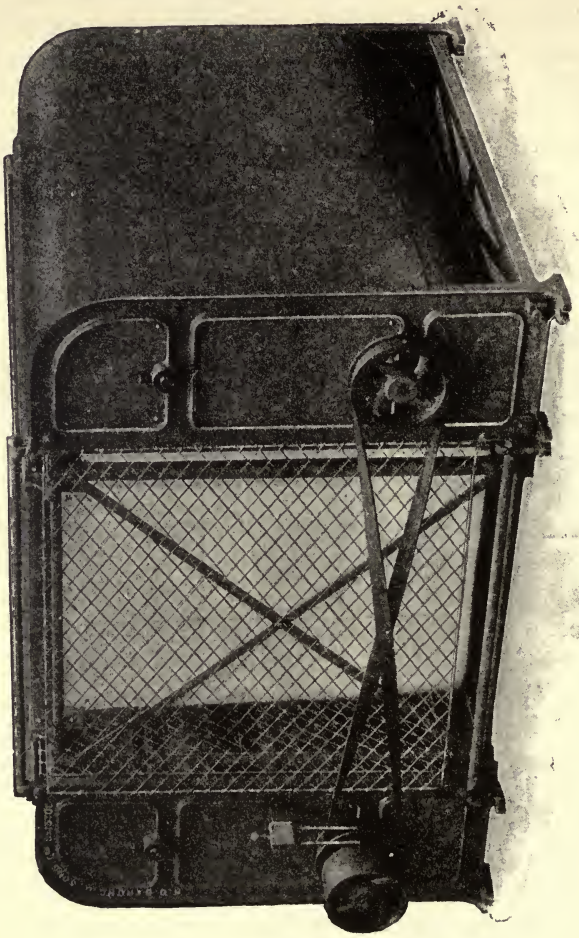


FIG. 13.—"Swift" Paper Curing Machine.

The machine consists of two sets of fans, enclosed by iron framing, driven by motor attached or by existing

motive power, some four to six reams of paper being suspended in ball clip frames in the space between the two sets of fans. The air of the machine-room is circulated by the fans rapidly through the paper, and maturing takes place in two or three hours.

All paper, after it has been matured, must be stacked, a board and a heavy weight placed on the top of the stack, and the edges protected from getting dirty.

Stretching takes place when paper is subjected to tension or rolling. All cylinder printing machines exert these strains, from the pull of the cylinder and from the printing surface. Difficulty in register will be experienced when a paper stretches much under tension, but it is not so great a trouble as the expansion already referred to. All papers are elastic, and if stretched just within the bounds of the breaking strain of the paper, will show some elongation, permanent or temporary. If the paper returns to its original length there is no permanent stretch, but that is seldom found in practice. The greater expansion of paper is in the cross direction, and the direction of greater stretch of the sheet coincides with that of the larger expansion.

Careful tests of good litho. papers on the Leunig Paper Tester show them to have a mean temporary stretch of $2\frac{1}{2}$ per cent. in the machine direction, with a stretch that is permanent of ·68 per cent. The figures for the cross direction of the paper are 4 per cent. and $1\frac{1}{2}$ per cent. respectively. It is the permanent stretch that may cause inconvenience, but the figures quoted must not be taken as an indication of what takes place when printing. A properly adjusted machine does not exert the tension that would be necessary to obtain the percentage of elongation

shown above. The fact that lithographers prefer papers cut with the cross direction coincident with the narrower dimension of the sheet is sufficient proof that it is not the machine tension that is dreaded in register work.

Writing and most printing papers, which may or may not be printed in more than one colour, are frequently cut two ways of the webs, that is, a 30 by 40 inch paper, if cut from a web of 70 inches net width, is cut without waste by cutting sheets 30 inches wide from one part and 40-inch sheets from the remainder of the reel. All papers on which register work is to be printed must be cut with the same machine direction. In ordering paper which is not generally used for work in several printings, the printer should be careful to point out the purpose for which it is intended, and ask that the instruction shall, if necessary, be passed on to the papermaker.

Cockling in paper is caused by the paper being drier or damper than the atmosphere, and shows that there is unequal expansion of the sheets, and exposure as detailed above should be tried as a remedy. Cardboards which are cockled may or may not improve upon exposure to the atmosphere. The thicker the cardboard the less likely it is to alter its shape. Usually the fault will have arisen through severe drying under tension, stretching the boards, and drying while unequally stretched. The cockling and wavy edges of boards are frequently found to be permanent faults.

Wavy edges to paper, if at the feed edge, will frequently cause bad creasing, from which damage to the printing surface may result. Creasing from defects of the machine, make-ready, or printing surface must not be visited upon the papermaker. If the paper will not respond to exposure to air, feeding the narrow way

of the sheet may overcome the difficulty, or, if the size of the machine permits it, cutting the paper in half and rearranging the forme or other printing surface and putting on an extra feeder.

Art and other coated papers which have the coating fixed to the paper with glue in addition to the liability to wavy edges, may be troublesome by reason of the surface lifting or picking. The latter fault is caused by the coating being insecurely fastened to the body paper, the trouble being temporary or permanent. Storing the paper in a damp place will weaken the adhesive properties of the glue, and the coating will not stand the pull exerted by the printing surface, but will come away in places. The paper may be improved by suspending it to dry off the excess of moisture, but if heated air is used, the temperature should not exceed 90° Fahr. Newly coated papers may cause trouble, owing to the adhesive not being quite hard, and keeping in stock for a fair length of time, a month or two, may result in an entirely satisfactory issue. But if the papers must be used, maturing as already described, with a careful use of heat, will usually remove the trouble altogether. Slight modification of the ink may be necessary, and should be tried before condemning the paper altogether.

It will be found occasionally that the coating is not properly fixed to the paper, owing to insufficient glue, or a soft-sized body paper being used. Damp the thumb and press on the coated paper, lifting it a few seconds after. If a large part or the whole of the coating comes away the coating is at fault. Crumple a piece of the paper, treating it rather severely, and note the amount of coating which has left the paper when flattened out again. A large amount of dust indicates bad coating. Comparative tests should be

carried out, a sample known to be satisfactory being tried by the side of the suspected sample.

Fortunately papermakers do not often offend by sending supplies which are out of the square. It does, however, sometimes occur that one edge of the paper is not quite true ; folding a sheet in half, with the short edges coincident, will show the extent of deviation from squareness. For ordinary purposes it may not be material if one edge of the paper is one-eighth of an inch out, but if the sheet has to be backed up, care must be taken to feed the longer side into the grippers and to place the side lay, when backing up, at the opposite side exactly at the same point as when first fed. This, of course, is the printer's rule, and in such cases it must be rigidly observed. When paper is fed to the narrow edge, as when two sheets of demy are laid on a double demy machine, the square edge must be the lay edge, or the register of the backing forme will be impossible. For colour work the only safe rule is to trim the two lay edges of all the paper, and, if necessary, to use a larger paper to allow for the trim.

Electricity in paper causes delay in feeding, the sheets sticking together, necessitating an undue use of the cylinder stop. As the paper is reeled at the end of the papermaking machine, electric sparks are frequently to be observed, owing to the electricity generated by friction of the dry paper. A large quantity of the electricity is extracted, but some thin papers with high surface will retain a fair amount, and sheets cling together. Paper which has been exposed for maturing will not give this trouble, and thick papers, even if electrified, do not usually call for special treatment. Elaborate methods have been suggested for discharging the electricity in the paper, but it is a difficult matter, and the most satisfactory plan is to set

aside the reams which are troublesome, and in time the electricity will disperse. The use of automatic feeding mechanism is sometimes quoted as a cure for this trouble.

Papers which are loose in texture are usually soft-sized, and thus, having comparatively little size to hold the fibres together, will give off fluff or dust, consisting of small fibres, as soon as the paper is subjected to friction, even of the lightest description. Such paper in its passage through the printing machine gradually deposits its fibrous dust upon the printing surface, the rollers take it from there to the ink distributing surface, and the whole of the inking and printing becomes foul. Such papers are extremely difficult for lithographic printing, and the letterpress printer consumes most of such papers. Soft papers with the mill cut are slightly rough and give off dust, and trimming a clean edge reduces the liability to fluff, but cleaning up at machine (forme, rollers, and ink slab or drum) will be necessary more frequently than is usual. When the machine is stopped for washing up, all parts of the machine carriage which can be reached should be wiped free from dust, as the accumulation will gradually find its way to the rollers when the machine is in motion.

The proper ink for the paper will prove the solution for difficulties in printing on hard papers, and also on very soft papers. It is outside the scope of this work to deal with printing inks, but in regard to coated papers it will be found that all such papers do not behave alike. Some take the ink readily and retain the fullness of colour, while others soak up the varnish and leave the dry colour on the surface. The latter fault is owing to the absorbency of the body paper, and ink must be treated so that the absorbency of the paper is satisfied, and yet the colour and medium remain more on the surface of the paper.

Ruling on papers with hard surface is rendered less difficult by the use of a small amount of gall in the ink. For hand-made papers the ink always requires such manipulation, while for other tub-sized papers a little gum arabic in addition to the gall will render even ruling more easily attainable. In ruling engine-sized papers a small amount of gum arabic and carbonate of soda (ordinary washing soda) will make the colours lie better. While all work can be done on the pen machine, papers with soft surfaces, blottings, duplicating, metallic, and coated papers generally, will give the disc machine opportunity to prove its superiority for this class of work. Cockled papers and very thin papers can be dealt with successfully at the ruling machine by a little manipulation of the pens and feed.

Although rolling, hot or cold, may be effectively used for giving finish to the printed work, the paper is subjected to such great pressure that it is liable to stretch. As pointed out earlier in the chapter, stretching of paper is not equal in both directions of the sheet, and it is advisable, in order to preserve the strength of the paper, to roll in the same direction as the paper was made and rolled in the papermaking machine. Discover the machine direction by the method described on page 86, and feed the paper to the rolling machine in the same way as it left the papermaking machine.

Tub-sized papers may contain or develop a fault which will not occur in engine-sized papers, that of unpleasant smell. A preservative of some kind is frequently added to the sizing solution, but if the gelatine has commenced to decompose the smell will be at least unpleasant. Coated papers contain glue in the coating mixture, and are liable to the same fault. Printers should be careful when buying job lots of tub-

sized or coated papers that the cause of the inclusion in the job list is not smell, for a customer cannot be expected to accept a big parcel of printed matter for circulation which is offensive to one of the finer senses, and therefore not likely to prove persuasive to the recipients.

Deterioration of paper has been dealt with already, but there are faults unwittingly developed in some paper which can be avoided by the application of a little forethought. The colouring matters of papers are affected by various things. Some blue colours are discharged (bleached) when acid in any form comes in contact with them, others behave similarly when alkali is encountered. Some buff papers are altered in shade or even in colour by the same agents, and other colours are affected by some but not by all acids. It is not proposed to examine the composition of the colours used by the papermaker, but to point to instances where care is required. When the printer or manufacturing stationer is covering strawboards, boxboards, or millboards with coloured papers, paste or glue may be employed as adhesive, and these are always liable to become acid. To avoid change of colour the use of freshly prepared paste or glue should be adopted. Strawboards frequently contain a certain amount of free alkali, and the colours of papers or cloth mounted upon them may be affected. It may be necessary to change the paper to one which is unaffected by the strawboard, and if this is not feasible, a change of board may be necessary. It is not practicable to neutralise the alkali, as fresh trouble may be caused, and an unsatisfactory result be obtained. Before starting on a big job, tests should be made with the actual materials so that no serious loss by spoilage or stoppage may occur.

All knives, whether circular or straight, must be kept keenly sharpened in order to produce clean edges. Soft cards and papers give more trouble than moderately hard stock when cutting in a guillotine. Some materials should be cut by the rotary cutter when exact measurements are essential, for although it may take longer, for index cards all supplies must be trimmed exactly to the same dimensions, and the very hard index boards are liable to be cut irregularly by the guillotine.

When sheets are ruled or printed, and are afterwards to be bound, the printed or ruled horizontal lines should coincide with the machine direction, or, as it is sometimes expressed, should run with the grain of the paper. The stitching and the binding which secure the leaves will then be fully operative, whereas if the paper is held with the back of the book parallel to the machine direction, the leaves are more liable to break away from the binding.

CHAPTER XIV

THE RIGHT PAPER

SELECTION of paper to suit a particular job calls for experience in handling both the finished work and the plain paper. Judging papers as being equal to patterns or samples, and forming an opinion of comparative values, are also to be gained only by long experience. A few guiding principles, without making a royal road, may render the journey somewhat less laborious.

The varieties of papers already described—writings, printings, coated, and other papers—are accompanied by indications of their general purposes, and the inexperienced should be kept from making bad blunders. Common sense will prevent the mistake which is still perpetrated of printing a half-tone block on a laid paper, or a paper with a heavy watermark. The laid lines and the watermark show up through the half-tone impression and spoil the picture. Half-tone work demands a perfectly smooth paper, coated or a good super-calendered paper being the best.

Very few papers are identical in finish on both sides of the sheet, and it should be the first thing taught to the apprentice that all one-sided work should be printed on the right side of the paper. A matter which is seldom referred to is the position of the watermark. When cutting paper, the paper should not be turned so that in a ream one-half of the paper has the watermark reading correctly, while on the other half it

is upside down. If the paper is ruled or printed in the sheet, the pens and type or transfers should be arranged to keep the watermark the right way. In the case of folded and stitched work this is not possible without special watermarking, but for all stationery these precautions should be taken.

When judging paper or cards it must always be remembered that a sheet may compare very badly with a small piece, therefore when making comparisons the sizes of the samples of paper or card should be cut to the same size. Only by adopting this practice can weight, colour, and texture be judged accurately.

Choosing a paper suitable for the work in hand is simplified when one knows what is used for similar work. For ledgers, account books, and all work of that character, a strong, tough, well-finished paper, capable of taking writing ink easily, and able to bear ink after erasure should be used. An opaque all-rag, azure laid, tub-sized paper, of moderate weight, 34 lb. in writing medium, is the most suitable paper. For loose-leaf ledgers a thinner, tougher paper is desirable, as the leaves must lie closely and withstand the strain of frequent handling. For cheap account book work engine-sized papers are obtainable, very fair in appearance, but not possessing all the qualities of the better paper specified, or the extra cost of the latter could not be justified.

The ideal paper for printed books is an all-rag paper, moderately sized, with antique or rough finish, excellent in handling and appearance, but the price precludes its use for any but the most luxurious editions. For ordinary bookwork, white paper with dull or machine finish, quite opaque, substance equal to 30 lb. demy, provides a serviceable paper where no illustrations, or line blocks only, appear. If half-tone

illustrations are included, a super-calendered paper, slightly toned, is very suitable. When half-tones of very fine grain are used, it may be necessary to print on art paper throughout, or the illustrations printed on art paper and the body of the work on a printing paper of exactly the same shade as the coated paper. Mixture of shades in books should be avoided as far as possible. The practice of printing sections of magazines on different papers is growing, but is to be deprecated.

For works which have to make bulky volumes for a comparatively few pages, featherweight papers are employed. These in 80 lb. quad crown will usually be chosen, wove or laid as fancy dictates. Some of the wholesale stationers state on the samples the thickness or bulk of a volume of a definite number of pages, this information serving as a guide in selecting paper to produce the thickness required in a volume. When a series of books is issued it is sometimes desired to have all the volumes of equal bulk. This is attained by adopting papers of different thicknesses; thus a book of 500 pages is printed on a paper about half the thickness of that used for a volume of 256 pages. The range of substances in which papers are supplied renders this arrangement comparatively easy.

The large variety of fancy papers for jobbing work calls for little comment. Avoid hard papers for programmes unless there is plenty of time for the ink to dry, or gloves will bear the printer's imprint. For outdoor functions coloured papers, if employed for programmes or similar jobs, must not be affected by moisture. Colour may decorate summer costumes if the programmes printed on coloured paper are sat upon. Art paper, too, is unsuitable for outdoor exposure in our changeable climate, and its use is to be dis-

couraged for sport programme work. Coloured poster papers must be unaffected by rain. Many coloured papers render printed matter exceedingly difficult to read by artificial light.

The incongruity of a common cover paper to a booklet printed on a good printing paper, or *vice versa*, is to be avoided. Select papers for the inside and cover bearing both in mind, and if expense is to be considered, a compromise in quality may be effected.

It is not always easy to persuade the consumer to select the very best paper for office stationery, but the choice should be made with a view to create a good impression. Remember always, too, that printing demands good paper to produce the most satisfactory effect.

For lithography the work in hand frequently dictates the quality of paper to be used. Offset printing, certainly, has enabled the lithographer to print on papers unsuitable for direct stone printing, but in all work the right paper produces the best result. Fluffy papers, such as featherweights, however, are impossible for lithography. Loose of texture, with a tendency to shed fibre, the paper clogs the printing surface, and in such circumstances the best work is unattainable. Charts and maps are printed on strong, durable papers, and the manufacturers' chart papers will be found to conform to the description given.

Colour work requires a paper which will give full effect to the colours superimposed upon its surface, white paper being most suitable for the purpose, the kind of paper employed being governed by the destination of the printed work. Chromo paper, litho. paper, M.G. poster paper, will be used according to the method of exhibition of the work, as calendars, labels, book illustrations, or posters. Work which is

to be varnished may be printed on litho. paper, which is sized and varnished after printing, or a varnishable paper, one that is hard-sized and finished in the manufacture, may be used, varnish being applied without previous sizing, as soon as the ink is dry. A thick litho. paper is seldom as strong as a thinner one, and with the greater thickness goes more liability for the surface to pluck.

The thinnest and commonest papers should not be chosen for set-off or interleaving sheets. Although many papers, when printed, absorb the ink and hasten the drying, it must be remembered that printer's ink, like paint, dries by oxidation, and the more freely air can reach the film of ink the quicker and more thorough will be the drying. A rough surfaced paper is most suitable for interleaving, as it will not stick to the printed matter, and it allows air to penetrate between the sheets. For interleaving colour work in which bronze is used at all, a paper of fair quality must be used, for common papers may contain chemical residues which will affect the brightness of the bronzed work. Paper equal to 24 lb. demy will serve admirably, and may be used repeatedly.

Proofs should be printed upon the paper which is to be used for the job, if that is possible. Galley proofs require a paper which is moderately sized, not too soft, or corrections made in ink may be undecipherable from the spreading of the ink.

It is not difficult to distinguish between the right and wrong sides of paper, and little excuse can be made for the printer who uses the wrong side. Flat papers are usually packed with the right side uppermost; if the paper is folded, the right side is outwards. There is a slight diversity of practice among papermakers, but the general rule is as stated. In a very

few cases of watermarked papers the watermark can be read from both sides of the sheet, but the general rule is that the right side of the sheet is that from which the watermark can be read. In machine-made papers it is the upper side of the paper as it is made, but in hand-mades the right side is the under side which receives the watermark. The watermark is in reverse upon the mould or the dandy roll, and is fixed on the impressionable pulp by slight compression or displacement of the fibres. In papers without watermarks it may be taken that the smoother side is the right side. The wrong side of machine-made papers bears the impress of the woven wire upon which they were made. The wire mark is fixed by various means, such as the pressure of the dandy roll, the action of the suction boxes, and the pressure of the couch rolls. Blotting paper, although not subjected to all these forces, shows the wire mark so plainly as to serve as a guide to what one may expect to find in other papers which are more highly finished. Looking along the surface of the paper will sometimes reveal this mark, when it is not possible to detect it by looking through the sheet. The wire for hand moulds is much coarser than the wire cloth of the machine, and as the pressure of the pulp is not great, and the fibre is moderately long, couching nearly obliterates the woven wire mark and makes it less easy to distinguish between the right and wrong sides of hand-made wove papers. In a laid mould the wires displace fibres, and the paper is immeasurably thinner at the places where the wires of the mould occur, but these are the only wire marks on the paper. A dandy roll makes the laid wire marks on the right side of machine-made paper in addition to the woven wire marks on the wrong side, so the distinction between right and wrong sides is easily

made in machine-made papers. The smooth side of M.G. papers is the right side. M.G. poster papers are rougher on the wrong side to make the posting of the bills an easier matter.

The wire marks assist one in distinguishing between hand-made and machine-made papers. It is clear that all machine-made papers have a wire mark on the wrong side, even if laid or watermarked. The watermark of the hand mould is fastened over the wire, so the watermark will never show wire marks. Looking through the paper, observe whether the watermark has any small woven wire marks ; if it has, it is undoubtedly machine-made. A laid paper which shows woven wire marks is of course the product of the machine.

Coloured papers may vary in shade on the two sides. This variation is more frequently seen in papers which are coloured by pigments than in those dyed with aniline colours. Blue papers, with ultramarine in their composition, tend to be slightly lighter on the wrong side of the sheet. The causes of this are different in hand-made and machine-made papers. In hand-mades the colour has a tendency to gravitate to the bottom of the mould, which is the right side of the paper, while in machine-made papers the action of the suction boxes is apt to draw some of the colour away from the under side, leaving the right side slightly darker. Thus difference in shade of the two sides is not a guide to distinguish between hand- and machine-made papers.

To recall the methods of manufacture. The mould of hand-made papers receives a shake each way, felting the fibres evenly. The machine wire receives a side-shake which is only effective for a short period—as long as the pulp is in a state of suspension—and as soon as the water has drained away the shake ceases

to take effect, consequently the majority of the fibres are parallel to the direction of the flow of the pulp. Some fibres are crossed or felted ; but taking the web of paper, it is more easily pulled apart across its width than in the direction of its length. The fibres are fixed and are dried in a state of tension, so that the fibres in the direction of the flow (known as the machine direction or the grain of the paper) are fully extended, and subsequently expand but little in length, but may do so in width or diameter.

The direction of the fibres serves to distinguish between hand- and machine-made papers. Tearing a piece of hand-made paper will result in ragged tears, very similar both ways of the sheet. A piece of machine-made paper shows a ragged tear in one direction, and a much straighter tear in the other. The straighter tear is in the machine direction. If a circle about three inches in diameter is cut from a hand-made sheet and thoroughly damped on one side, the paper will curl slowly and unbend again. If a similar piece is cut from machine-made paper and treated in the same way it will curl more quickly into a cylinder and remain rolled up for some time. This not only serves as a distinction between the two papers, but, in machine-mades, shows the machine direction which is parallel to the axis of the cylinder of paper. By marking the sheet before the circle is cut, the machine direction of the sheet can be determined.

Strips cut from the sheets, one from each way, 7 inches long by 1 inch wide, held between the finger and thumb and allowed to incline at an angle of 60°, will behave differently according to the method of manufacture. Hand-made strips will keep together, because the fibres are equally distributed, while strips of machine-made paper will separate, owing to the difference in

the direction of fibres. The strips should be inclined first to the right and then to the left to ensure correct conclusions.

Hand-made paper has four deckle edges, but imitation hand-mades also have these, and mould-made papers are similarly marked. Imitation hand-mades, being machine-made, are distinguishable by the means enumerated above, and comparison with the edges of known hand-made paper will be the quickest method of distinguishing between real and imitation deckle edges.

Mould-made papers are not easily distinguishable from hand-made papers. The deckle edges are not always alike on all four sides as they are in hand-made papers. Testing on the Leunig machine (see page 99), they will usually reveal a difference which it is not possible to discover from looking at the sheet. The German paper experts declare it impossible to differentiate with certainty between the two kinds of paper, while a papermaker who manufactures both varieties usually has but little difficulty in naming them correctly.

Comparison between Hand-Made, Mould-Made, and Machine-Made Papers

Tests made on Leunig's Machine (*see page* 99), *Papers of same size and substance*

Description of Paper.	Stronger Direction.		Weaker Direction.		Mean of Two Directions.	
	Tensile Strength.	Elongation.	Tensile Strength.	Elongation.	Tensile Strength.	Elongation.
	Lb.	Per cent.	Lb.	Per cent.	Lb.	Per cent.
Hand-made -	25·5	3·9	22·1	5·6	23·8	4·75
Mould-made -	26·8	4·8	20·8	4·7	23·8	4·75
Machine-made	26·5	3·7	16·0	5·7	21·3	4·70

The figures given are the mean results of five tests.

Tearing paper as a method of comparing strength is one of the simplest as well as one of the surest methods. Paper has to withstand tearing stresses, and the paper which ruptures with most difficulty is usually the most resistant to wear. Tearing will reveal whether the paper is composed of long or short fibres, and whether it is tough or brittle, and is a method of testing which requires no apparatus.

CHAPTER XV

THE STOCK ROOM

SELECTION of papers for stock purposes is not easy to undertake for others, therefore this section can only summarise the information of the earlier chapters and offer suggestions.

The stock room should not be an out-of-the-way room, dark and perhaps damp, but should be light, with ample room to move paper in bulk, so that issues as well as deliveries can be dealt with quickly. It should be possible to control the temperature and humidity of the paper warehouse if the paper is generally used for register work. A dry room is essential, or trouble will ensue, for in damp rooms tub-sized and coated papers will deteriorate, highly glazed papers will go back in finish, papers for colour work will be unreliable, and delay and loss will follow.

In a printing office where small quantities of paper are dealt with, the inconvenience of carrying paper in and out a few reams at a time may not be apparent, but considerable time is wasted and some loss in spoiled sheets results from such a method. Quantities of paper should be dealt with as expeditiously, and with as little handling, as possible. Transporter trucks require, perhaps, more room than is taken by a man or boy lifting reams, but it deals with thirty reams, instead of two at a time, and in up-to-date offices time is counted as valuable as currency.

Large stocks should be kept in stacks; the counsel of perfection being that no paper should actually touch the floor, but stand on boards with a space beneath. If paper is moved in and out of the warehouse by transporter trucks it will stand on the platforms supplied and be available for moving rapidly to the machine-room. Smaller stacks will be ranged in racks or on shelves so arranged as to be easily accessible, the larger papers nearer the floor, and the smaller papers, which can be handled more easily, on the higher shelves. The arrangement in classes is advised, writings, printings, coated, coloured papers having definite positions, the sizes also being arranged for ease of handling. Each section, size, and variety should be clearly marked to ensure accuracy and economy in issue as well as in keeping stocks up to correct strength. A new arrival should not be dumped down anywhere, but should take its place in the proper section, be considered as valuable material, and handled accordingly. Coated papers generally and imitation art papers mark and crease badly if carelessly handled, but if all papers are treated carefully it will not be necessary to give instruction for handling special papers.

Papers are received from different mills packed in different ways. If reams are received in bales, it is usual to unpack and to stack in single reams, as subsequent handling is easier in the lighter weight. Heavy papers and boards are packed in quantities smaller than reams to facilitate removal in and out, paper in half or quarter reams, and boards in packets of 100, 144, or 250. The method of packing reams or parcels is sometimes excellent, but at other times it leaves something to be desired. If the wrappers are not strong enough for the paper contained, they break as the reams are moved, and the edges of the paper are

likely to become damaged. Fastening is done with paper tape, webbing, or string, according to the size and weight of the parcels. Light and small sized paper may be fastened with paper tape, all sizes and weights with webbing or cotton tape, and heavy papers with string. If string be used, it will be necessary, before stacking, to see that the strings are not greasy. If soiled string has been used it must be removed and the reams again fastened, or the grease will penetrate and spoil a portion of the contents.

Broken quantities should always be tied up, preferably with webbing, and the quantity marked on the wrapper, correction being made as quantities are withdrawn.

Letterpress printers prepared to execute all classes of work must of necessity carry a more varied stock of papers than one who specialises in one or two lines. It is convenient to have printing papers in several qualities and weights, the sizes being governed by the sizes of machines available. With a double demy cylinder machine it is not wise to stock quad demy paper; but allowing that as the limit (a small one nowadays) printing papers in double demy, double crown, and royal will be safe sizes. Poster papers, both ordinary and M.G. finish, should be stocked in the full size of the capacity of the machines.

Super-calendered papers should be carried in comparatively small quantities, unless they are to be used quickly, as high surfaces deteriorate when stocked for a long period. Art papers are better for being stocked a reasonable time, as the coating becomes fixed and there is less likelihood of picking at machine. Tinted papers are accumulated gradually, the colours and sizes most in demand being placed in stock. Cover papers must of course follow the white papers for sizes: the cover for demy works is medium, and the

royal is cut larger (20½ inches × 25½ inches) to cover an ordinary catalogue. In this class of paper, too, sizes and colours are governed by prevailing consumption.

In making a selection of writing papers, unless one is a very large consumer, a safe course for the better classes is to make a selection of watermarked papers. There is no virtue in a watermark as such, but the wholesale stationer is able to keep known papers up to standard, and also is able to meet all reasonable demands from stock. The prevailing sizes for writing papers are foolscap, post, large post, double foolscap; for account book work, demy, medium, and royal (in writing sizes), and imperial. Writing papers in cream wove, cream laid, azure laid, yellow wove (another term for azure wove), blue laid, and blue wove will be required. It may be necessary to keep a small stock of hand-made papers for documents of importance. Banks in medium, large post, and double foolscap are stocked if required. Engine-sized writings are suitable for much printed work, but for stationery of good appearance tub-sized papers should be stocked. Large post writings in 18, 21, 23, and 27 lb. will be useful stock, with other sizes in equivalent weights. Double large post is desirable in all engine-sized writings, and frequently in tub-sized papers, when obtainable. The usual weights for bank papers are foolscap 7 lb., large post 11 lb., medium 13 lb., but thinner papers are obtainable. Bond papers are similar to banks, but heavier in substance, and experience will teach what substances and sizes should be stocked. Account book papers follow custom as to weight, 24 lb. demy, 34 lb. medium,[1] 44 lb. royal,[1] 72 lb. imperial, and these are

[1] Some mills make medium in 32 and 34 lb., and royal in 42 and 44 lb.; all hand-made papers are of the customary weights given above.

usually azure or blue laid, tub-sized, and air-dried. Hand-made papers are necessary for many books which are in constant use, to ensure the permanence of the records. Engine-sized account book papers are not recommended for stock, although the papers are suitable for much work of a temporary nature. Tinted writings can be obtained in great variety, and reference to the sample books of the wholesale houses will serve to guide in making a safe stock selection.

Only small quantities of gummed paper should be kept, demy being the usual size, and a paper weighing about 18 lb. per ream (ungummed) is a fair quality. Non-curling gummed paper is of course the kind to purchase.

Stock boards will usually be royal in size. Good qualities of pasteboards, two substances of ivories, a full range of pulp boards in various tints will be a useful selection. Thicker boards, useful for show cards, are stocked in royal and imperial, one-sided white boards, one-sided coated and two-sided coated, in 10- and 12-sheet substances, should be kept in small quantities.

The lithographer requires litho. papers of various substances and qualities in sizes to suit the machines of his establishment. The lithographer can frequently transfer several jobs on to one stone of the full size of the machine, and work more economically than by using papers and machines of smaller sizes. For black work a fair litho. paper in several substances should be stocked, for colour work a heavier paper in one or two substances only, and small quantities of plate, plan, chart and chromo papers will be required. All the writings and miscellaneous papers mentioned earlier will be included in the stock warehouse of the lithographer.

Stock accounts should be kept very carefully. Employers should insist that paper drawn for making ready, for proofing, and for set-off sheets be accounted

for as accurately as a ream of hand-made paper. It is only by adopting a system of accurate accounting that the balance between receipts and issues can be maintained. No issue for replacing spoiled sheets should be made without an entry to that effect in the stock ledger. Whether a card index system or a paper stock ledger with receipt and issue sides be the method of accounting, it should be possible to check the state of the stock at very short notice. The entries will be in this or similar form. Prices are kept separately, unless it is preferred to keep them with the stock details.

DESCRIPTION—*Printing Double Demy*, 40 *lb.* 480's.
STOCK NO. 25. *Purchased from* SPALDING & HODGE.

RECEIPTS.				ISSUES.				
Date.	Quantity.			Date.	Job No.	Quantity.		
	Rms.	Q.	S.			Rms.	Q.	S.
Jan. 1, 1914	200	0	0	Jan. 3, 1914	142	17	14	0
Mar. 1, ,,	480	0	0	,, 4, ,,	201	153	10	0

At the time of stocktaking it should not be necessary to close the stock room, but if done gradually, starting a few days before the end of the year (or other period), the stocks are taken and each stack as checked is marked, and issues up to the end of the year entered on special slips or cards placed in the stack. On the day of stocktaking it will not take long to adjust the book of balances with the additional entries. If a discharge has been given for every issue of paper, either by work sheet or by a requisition from the various

departments receiving the stock, the balances should be correct.

In order that sample sheets may be shown to customers, and to avoid frequent requisitions for single sheets of paper, a few sheets of all stock papers should be issued for a sample portfolio, and these folded to a convenient size, each sheet marked with stock number or description to prevent confusion. Reference to stock lists will furnish price, quantity in stock, and other necessary particulars.

A separate account should be kept of off-cuts, which accumulate rapidly. Some can be cut to useful sizes, and it is frequently more economical to trim them at once to the nearest regular size, to parcel them in reams, and to mark the contents on the wrapper. A corresponding entry should be made in the oddment book and issues duly noted. All jobs worked on off-cuts should be charged as though the ordinary stock for such jobs had been used, and the charge sheet and invoice should show that oddments have been issued, or it may be difficult to explain change of paper or price when repeat orders are executed.

CHAPTER XVI

PAPER TESTING[1]

A FULL scheme for the analysis and testing of papers will include the following: Checking the weight of the ream and sheet; the thickness of the ream and sheet; examination of the physical and chemical constituents — fibre, sizing, loading, and colouring matter; testing the tensile strength and elasticity, the resistance to folding or crumpling, and microscopical examination of the fibres. It is not necessary to carry out all these tests on every paper, but it is well to be prepared, if required, to compare two samples, using appropriate tests.

Weight.—The weight of the ream is checked on the scales, and variation should not exceed 4 to 8 per cent. above or below the nominal weight. (See various kinds of papers under "Variations in Weight," on page 136.) A sheet of paper is weighed on a balance which gives a direct reading for a ream of 480, 500, or 516 sheets. The demy scale is a very useful little balance. A metal plate is supplied with the scale, a piece of paper is cut exactly to the size of the plate

[1] It is more convenient to use the metric system of weights and measures, as small quantities and dimensions are dealt with, and the decimal method is easier to use. Metric equivalents are :—

1 millimetre (mm.)	= ·039 in.	1 in.	= 25·4 mm.
1 gramme (grm.)	= ·035 oz.	1 oz.	= 28·35 grm.
1 cubic centimetre (c.c.)	= ·035 fl. oz.	1 fl. oz.	= 28·40 c.c.

with a sharp knife. The piece is placed on the end of a hook, and the scale, marked for reams of 480, 500, and 516 sheets, gives the weight of a ream of demy of the substance of the pattern, and by reference to tables the equivalent weight in any other size can be found.

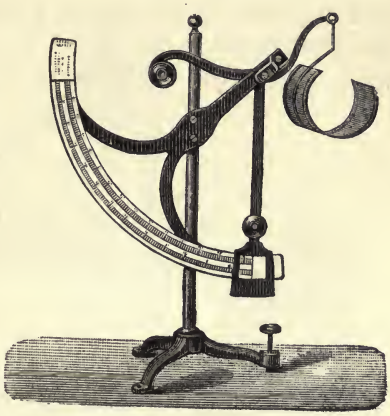


FIG. 14.—Paper Scale.

Size.—The size of the paper is checked, and the papermaker guarantees to be within one-half per cent. of the measurement ordered. The paper is tested at the same time for squareness.

Thickness of Sheet.—For testing the thickness of the sheet a micrometer is used. The screw micrometer is not so exact on a yielding material like paper as is the spring micrometer, which gives the reading on a dial in thousandths of an inch. Machines are obtainable in pocket or stand form, giving measurements as close as $\frac{1}{2000}$ of an inch. The micrometer serves to check the thickness of supplies of paper or cards, and to indicate the bulk of a volume consisting of a certain number of pages or leaves, enabling covers for books to be prepared before the printing is completed.

Tensile Strength and Elasticity.—These tests may be carried out on various machines. The method adopted is to cut strips of a standard width, clamp in the machine clips which are a definite distance apart, and to place the strip to be tested under tension by

turning the handle of the machine, until breakage of the paper takes place. The machine registers the strain put upon the strip, and also the elongation which the strip sustained before fracture. The Marshall machine takes strips of various lengths and widths, and registers the tension on a hydraulic pressure gauge, the stretch being measured exactly and calculated on the length of the strip used. Leunig's testing machine

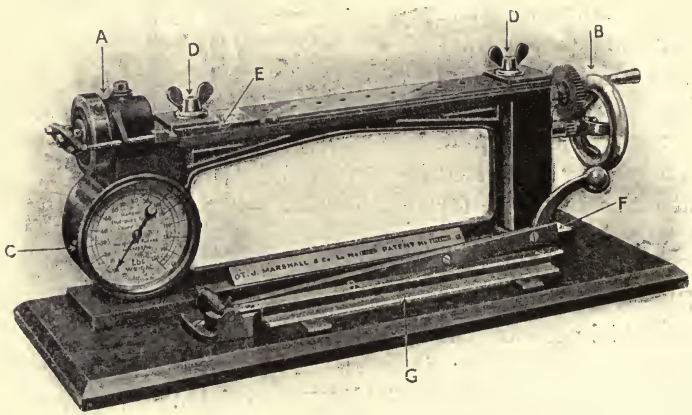


FIG. 15.—Marshall's Paper-Testing Machine.

A, Cylinder in which compression of liquid is produced by turning wheel B.
C, Registering dial.
D, Clips for securing slips.
E, Clips for registering stretch.
F, Cutting knife.
G, Cutting gauge.

registers breaking strain and stretch on two scales. The strip, $\frac{5}{8}$ inch wide, is clamped between twoclips 7 inches apart, and, by turning a handle, the strip under tension raises a weight at the end of a lever. The strain exerted by the weight is indicated on a scale marked in quarter-pound divisions. The stretch is registered at the same time by a pointer actuated by a separate rack. The stretch scale and pointer are

kept in unison with the strength lever, and the elongation at the time of fracture is registered. This machine, although expensive, is acknowledged to be the best for high-class papers where the narrow strip

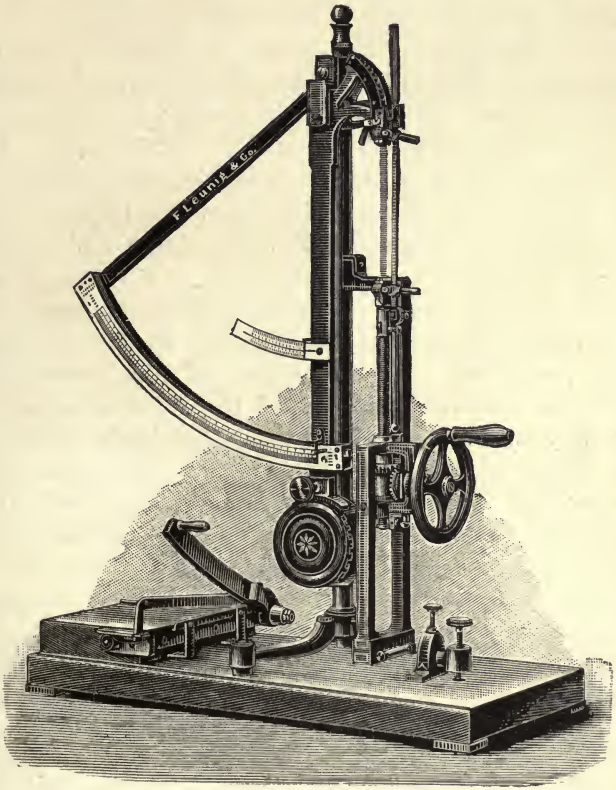


FIG. 16.—Leunig Paper-Testing Machine.

can be used. The Carrington machine for coarse papers takes a strip 2 inches wide and 7 inches between the clips, the strain is exerted by a weighted lever, and the reading is in pounds.

Bursting Strain.—For quick comparative tests there are a number of machines to choose from. The list comprises the Mullen, Southworth, Woolley, Ashcroft, Eddy, and Rehse machines. Testing on the Mullen machine is by hydraulic pressure which is communicated through the medium of glycerine to a rubber diaphragm. The paper is clamped over the diaphragm; the handle of the machine is turned, pressure being exerted until the paper bursts; the reading is given on the gauge in pounds per square inch. The Southworth gives a similar indication, but the fluid is oil, and a steel plunger punctures the paper. The Woolley machine is actuated by a spring and gives a comparative figure. The Ashcroft is a very compact machine, a very small plunger piercing the paper, the dial reading indicating the bursting strain in pounds per square inch. Two machines of this pattern are made, one for thin papers, and the other for papers of ordinary and thick substances. The Eddy machines are screw machines, also made for thick and thin papers, and the result is given in similar terms to other machines. The Rehse machine is a cylindrical machine; pressure is exerted by a spring, and the pressure in pounds is registered on one scale, and from figures given on another scale the stretch can be calculated.

These machines are exceedingly useful for rapid comparisons of papers, the tests being made at the same time. Slight variations in results can be obtained by turning the handles of the machines at varying speeds, but if a uniform rate is maintained, scarcely any other precaution is necessary in their use.

Opacity.—While it is possible to obtain apparatus for exact determination of the degree of opacity in paper, comparison can readily be made in a simple manner. A printed page is covered by pieces of the

papers to be compared brought edge to edge over the printed matter, and the comparative degree of opacity observed by the ease, or otherwise, with which the lettering can be seen through the papers.

Surface or Finish.—The degree of polish which is given to the paper may be compared by feeling with the hand, and also by looking along the sheet. The comparisons can be brought to a numerical basis, but apparatus which would seldom be used is required for that purpose.

Resistance to Wear.—An ingenious machine is made for testing the resistance which paper offers to wear as exemplified by repeated folding. A narrow strip is clamped at each end, kept under constant tension by springs, and folded backwards and forwards until breakage occurs. Some idea of the comparison can be seen by taking the following results :—

FOLDING MACHINE TESTS

Description of Paper.	Equivalent Weight in Demy.	Number of Folds before Breaking.		
		Strong Direction.	Weak Direction.	Mean of Two Directions.
Japanese vellum - - -	28	15,840	6,174	11,007
Manilla - - - -	80	5,783	5,448	5,616
Loan—hand-made - -	37	2,581	1,416	1,998
Ledger—mould-made - -	39	1,344	1,023	1,183
,, machine-made -	39	1,243	1,123	1,183
Bank—hand-made - -	12	1,036	846	941
Typewriting—machine-made, all-rag	9	763	413	588
Blue-laid—machine-made, air-dried	29	510	394	452
Blue-laid—machine-made -	28	94	86	90
Printing paper - - -	17	15	9	12

The tests by the folding machine, being conducted on a very narrow strip, are only moderately reliable.

To compare papers a more primitive method may be employed. It has the virtue of simplicity, and yet it gives a fair index to the amount of wear which the paper will withstand. Take a piece of the paper to be tested, about 6 inches square, roll it into a ball, then spread it out flat; repeat the performance, and notice how many such treatments the paper stands before perforation takes place. Papers which are very resistant, such as all-rag papers and air-dried browns, will assume a cloth-like appearance as they become softer, and it will be a long time before perforation takes place.

Sizing.—To test papers for efficiency of sizing write rather heavily upon the surface with ordinary pen and ink. Red ink is usually more penetrative than black, so it is better to use a good black ink as a standard test. As some papers, such as account book papers, have to stand erasure, they should be tested for ink bearing after abrasion of the surface.

To test for gelatine sizing cut up a small quantity of paper and boil for a few minutes in a beaker containing sufficient water to cover the paper. Pour off into a test tube, cool, add a few drops of a 2 per cent. solution of tannic acid. A flocculent precipitate indicates that the paper has been sized with gelatine. Heat the liquid, and the precipitate will coagulate and cling to the sides of the test tube. A comparative test is made by taking an equal quantity of each kind of paper, boiling in similar quantities of water for the same period, and adding the same amount of tannic acid solution, and comparing the results.

Resin sizing is determined in a different manner. A comparatively large quantity of paper is extracted in a small quantity of liquid. Take a strip of paper, about 8 inches by 1 inch, pleat it repeatedly until it can be placed in a test tube, and cover it with rectified

spirit. Place the test tube in a beaker containing water, and heat slowly. The spirit will boil before the water reaches boiling point, and in a short time the resin will be dissolved. As soon as the solution is cool, pour it into a test tube half full of distilled water, and the resin will appear as a ring, whitish in colour, at the junction of the two liquids. If the test tube is shaken up the opalescent appearance of the liquid indicates the presence of resin.

Starch.—A very weak solution of iodine in potassium iodide is dropped on the paper with a glass rod, or a strip of the paper is dipped into the solution. If a very small quantity of starch is present in the paper a blue reaction will take place, and the larger the amount, the darker the coloration. Therefore in order to form an opinion as to the quantity of starch used, a very pale solution must be used, or the colour may be too dark to enable one to make comparisons. An aqueous extract of the paper may be treated with the iodine solution, and if a comparative test is to be made, it is necessary to work on each paper with identical quantities of water for boiling, and iodine solution for testing. A faint colour must not be taken as evidence of added starch, as in rag pulp it is very difficult to remove starch from the raw materials.

Colouring Matters.—The tests for colours should be for the purpose of discovering whether they are reasonably fast to light and when wetted. The first can be tested by exposing the paper to a steady light —not sunlight—for a period according to the time of year. A photographic printing frame with a black disc on plain glass is a convenient method of testing, and if, after forty-eight hours in summer, and a proportionately longer period at other times, the difference between the exposed and protected areas is marked,

the paper must not be used where a permanent colour is required. Some tints will bleach completely with the treatment, and should be avoided as stock lines. To test water-fastness a piece of paper is left in warm water, or placed in cold water and heated slowly. If the colour is soluble it will very soon tint the water.

Coloured papers for pasting to book covers or boxes should be tested by pasting down to the boards intended for use. Some boards have a curious effect on certain tinted papers, owing to the presence of chemicals in the finished boards, and acidity or alkalinity may render change of covering paper necessary.

Absorbent Papers.—Blotting paper may be tested by the mounting test. To carry this out, cut strips from each direction of the paper—length and width—6 inches long by 1 inch in width. Make a pencil mark half an inch from the end, and immerse the strip as far as the pencil mark in water or ink. The fluid immediately commences to mount the strip, and the speed at which this takes place is an indication of the relative initial absorbency of papers tested by this method. In practice, blotting paper must absorb immediately, as the pressure usually applied will, if the paper is not sufficiently absorbent, spread the ink. For this reason the rising of the fluid should be marked and checked in the first ten to sixty seconds, and when several tests in each direction have been made, the figures tabulated and the mean rate calculated. It is convenient to measure in millimetres rather than in fractions of an inch. Ink makes the better testing fluid, as the way in which the blotting paper carries up the colouring matter can be seen at once, and a paper which is superior in this respect will usually be the

better paper. The zone test is an elaboration of the ink test. A small quantity (1 c.c. or ·5 c.c.) is allowed to fall a drop at a time upon the blotting paper, and when the blot is dry, the area of the outer non-absorbent zone, its proportion to the inner absorbent zone, and its regularity will serve as an index to the behaviour of the paper in use. Other factors in the choice of blottings are the resistance to wear, absence of fluff, and the resistance to surface dirt. A very rough blotting paper may not be entirely satisfactory in those respects, but, on the other hand, a very smooth paper may be produced at the expense of absorbency.

Copying papers are tested in the copying press with a document written with copyable ink, and the efficiency of the paper judged either by comparison with a standard sample, or merely by the clearness of the resulting copy.

Duplicating papers may be tested by drawing a fine pen charged with writing ink across the surface, and immediately rubbing the ink to see if it smears. Half-sized duplicating papers have the same method applied, but should be allowed five to ten seconds after writing. These methods are superseded by the use of the duplicating machine, if available.

Mineral Matter—Loading.—A weighed quantity of paper—say 1 gm.—is torn into small fragments, placed in a porcelain crucible, previously weighed, and subjected to the intense heat of a Bunsen burner until the paper is consumed and the residue reduced to a white ash, or in any case until all carbonaceous matter is burnt off. See that any black deposit on the crucible is burnt away. Cool the crucible, weigh it with its contents, deduct the weight of the crucible, and the weight, multiplied by 100, will give the percentage of mineral matter present in the paper.

Weight of crucible - -	6·25 gm.
Weight of paper - - -	1·00 ,,
Weight of crucible and ash -	6·365 ,,
Deduct weight of crucible	6·25 ,,
Weight of ash - -	·115 × 100 = 11·5 per cent.

The ash, if not required for subsequent examination, can be thrown away, the crucible wiped out and weighed again to check the net weight of ash. It is usual to calculate the whole of the ash as added mineral water, although all fibrous materials have ash of some weight, *e.g.*, cotton ·12 per cent., esparto $3\frac{1}{2}$ to 5 per cent. A delicate balance with weights from 50 gm. to 1 mgm. is advised for exact results.

Fibre Composition.—It is necessary to exclude mechanical wood from most papers, and its detection is rendered easy by the use of certain solutions. A solution is made up of 1 gm. of phloroglucine in 50 c.c. of rectified spirit with 25 c.c. of concentrated hydrochloric acid added. If a drop of this solution is placed on paper in which mechanical wood is present an intensely red coloration will follow. The amount of mechanical wood may be estimated by the depth of colour, but this is very difficult, as may be proved by comparing the results obtained on papers containing 40 and 70 per cent. of mechanical wood respectively. Some aniline colours are altered in colour by the acid of the solution, although the colour is not the same as that given by mechanical wood, and it appears and fades in a different manner. A solution of 2 per cent. of aniline sulphate (1 gm. in 50 c.c. of water) will give a yellow coloration in the presence of mechanical wood. As wood fibres, jute, and some other fibres which have not been thoroughly cleaned, give colour reactions as though mechanical wood were

present, the microscope should be used for confirmation.

Papers containing straw or esparto fibre are coloured pink, pale or deep according to the quantity of these fibres present, when heated in a weak solution of aniline sulphate. Strips of paper treated at the same time will afford comparative tests. Bamboo paper gives a pink reaction in the heated aniline sulphate solution, but some grasses, such as delta grass, are not affected.

Microscopical Examination.—Colour reactions reveal the presence of mechanical wood, straw, and esparto in papers, but the reagents used do not reveal the presence of chemical wood or rag fibres, nor do they distinguish between cotton and linen fibres. In order to obtain more exact conclusions the microscope is employed. Although a powerful microscope is a valuable possession, a moderate instrument is preferable; a microscope equal to the "London," with a combination of eye-pieces and objectives to give magnifications of 59 to 270 diameters, will be found excellent for the examination of fibres. A supply of slips, 3 inches by 1 inch, and half an ounce of cover glasses $\frac{5}{8}$ inch diameter will be required.

The fibres in most cases are securely fastened with the sizing materials, and to remove these the paper is boiled in a weak solution of caustic soda. After boiling, the paper is washed, and, with teasing needles, little pieces of paper picked out and placed on a glass slip. Or the paper is placed in a test tube with a little water, the thumb placed over the mouth of the tube, and by shaking violently the paper is soon reduced to pulp. A very small portion of pulp is placed on the slide, and superfluous moisture carefully removed with filter paper. A stain makes the markings

on the fibres more easily seen, and if a suitable stain is employed, some differentiation in colouring the various fibres takes place.

A good standard solution is iodine in potassium iodide, with an accessory acid solution :—

Iodine Solution.		Accessory Solution.	
Iodine - -	1·15 gm.	Glycerine - -	10 c.c.
Potassium iodide	2·0 ,,	Water - - -	5 ,,
Water - -	20 c.c.	Sulphuric - -	15 ,,

A drop of the iodine solution is placed on the fibre on the slide. After a minute or so it is blotted off, and a drop of the accessory solution is added. The fibres are separated with teasing needles (needles mounted in wooden handles) until well distributed on the slide. A cover glass is cleaned by rubbing with a piece of wash leather, and dropped on the slide. The excess of solution is carefully absorbed with the filter paper, and the slide is ready for examination. A description of each of the principal fibres is given, with the normal dimensions of the unbeaten fibres and the coloration given by the solutions specified. For general examination the lower powers of the microscope will be found most useful, the higher magnifications being employed for studying the markings and other characteristics of the fibres. The dimensions given of cotton, linen, and hemp fibres will not be met with in papers made from those materials, as in beating the lengths are shortened, and frequently the fibres are split longitudinally. Tissues, copyings, and Bible papers show the greatest reduction of the fibres.

Cotton.—Fibre 30 to 40 mm. × ·02 mm. Stained violet-red to brown. The fibres are long flattened tubes with large channel and numerous twists, blunt ends, and some fibres have cross markings. For a blotting the fibres are cut into short lengths, and the

Magnified 50 diameters

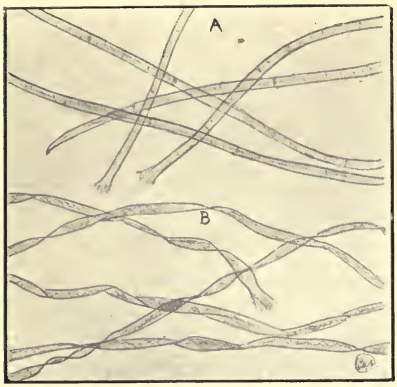
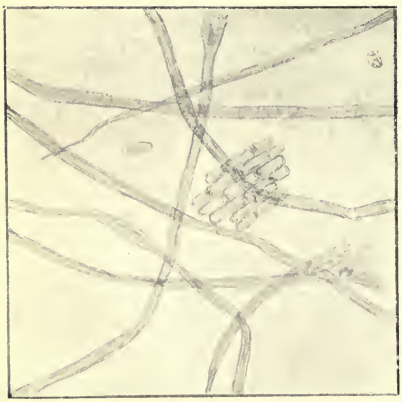


FIG. 17.—Rag Fibres Unbeaten.
A, Linen. B, Cotton.

FIG. 18.—Rag Fibres Beaten.

FIG. 19.—Hemp.



characteristics can be easily observed. The fibres are reduced in diameter as well as in length by prolonged beating for strong papers, the ends are frayed, and it is not easy to identify the cotton in a finely-beaten rag mixture (Figs. 17 and 18).

Linen.—Fibre 30 to 40 mm. × ·025 mm. Stained violet-red to brown. Linen is the fibre from the stem of the flax. The fibres have thicker walls than cotton, from which it is easily distinguished in its unbeaten state, being a smoother, rounder fibre, with marks like joints at intervals, small cross markings, and pointed ends. When beaten finely it is not possible to distinguish linen from cotton (Figs. 17 and 18).

Hemp.—Fibre 20 mm. × ·02 mm. Stained, unbleached fibre, yellow to brown ; bleached, brown-red to wine-red. In general appearance the fibre is similar to linen, with slightly thinner walls, more markings, and at the places where joint markings occur are also little hairs. The ends of the fibres are rounded or flattened. The fibre in paper is usually beaten so finely as not to be recognised (Fig. 19).

Manilla Hemp.—Fibre 7 mm. × ·02 mm. Stained yellow to blue, according to amount of bleaching and cleaning of the raw material. The fibres are like hemp fibres, but the canal is much larger, and accompanying the fibres are many oblong transparent cells, sometimes occurring like blocks of bricks (Fig. 20).

Jute.—Fibre 2·5 mm. × ·022 mm. Stained, unbleached, yellow ; bleached, brown. Jute fibres resemble linen and hemp, but the central canal is irregular in width, widening in places and narrowing again. The ends of the fibres are pointed and somewhat flattened (Fig. 21).

Straw.—Fibre 1·5 mm. × ·015 mm. Stained greyish to blue. Similar to esparto, but the fibres are more flexible, and become kinked when made into

paper. Serrated cells and transparent oval cells are present (Fig. 22).

Esparto.—Fibre 1·5 mm. × ·012 mm. Stained greyish-blue to colourless. The fibres are very fine and short with pointed ends. Characteristics of esparto are the comma-shaped hairs and the serrated cells (Fig. 23).

Bamboo.—Fibre 4 mm. × ·015 mm. Stained yellow to pale brownish-green. Resembling esparto, with cylindrical fibres with pointed ends, and usually a large number of transparent oval cells are found in paper made from bamboo (Fig. 24).

Chemical Wood.—The fibres vary considerably in length and thickness. Stained blue to colourless. Consisting of flat ribbon-like fibres, broad flat cells pitted and perforated, others similar to sections of a plant stalk, they are on the whole unlike any other fibres. A few fibres resemble linen fibres, but comparison will reveal differences. The differentiation between pine, spruce, poplar, birch is unnecessary for ordinary paper testing (Fig. 25).

Mechanical Wood.—Stained yellow. This pulp is unmistakable, owing to the broken pieces of various sizes and shapes, fragments of fibres torn away from the original wood, held together by cells, and showing pits and pores. Most newspapers are made of a mixture of chemical and mechanical wood, and microscopic examination of these mixtures furnishes an easy way of becoming familiar with the appearance of the different wood pulps (Fig. 26).

To arrive at a correct result, as regards the proportion of fibres in a mixture, is not at all easy. By taking a series of fields on one slide, counting and tabulating the contents under the headings of the different fibres, and averaging the fields, a fair approximation can be obtained. For comparison of two or more papers this will usually suffice, but consider-

PAPERMAKING FIBRES

Magnified 50 diameters

FIG. 22.—Straw.

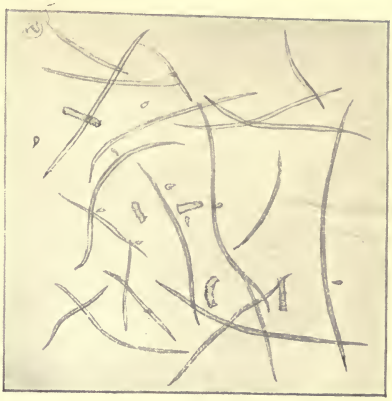


FIG. 23.—Esparto.

FIG. 24.—Bamboo.

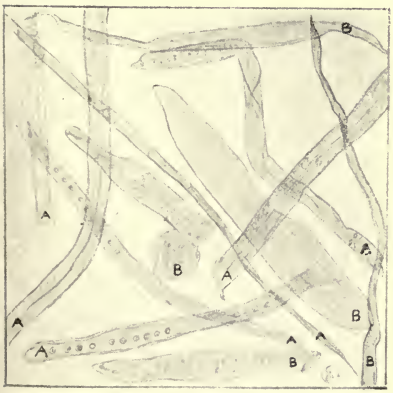


FIG. 25.—Chemical Wood.
A, Pine. B, Poplar.

FIG. 26.—Mechanical Wood.

able experience is required before one is able to formulate the furnish of a paper consisting of two or more kinds of fibre, as the different fibres have varying dimensions and weights.

Printing Qualities.—The test for comparison with a standard paper is carried out by printing on the papers under examination at the same time, under the same conditions, and judging the brilliance, solidity of colour, absorption of ink, and noting how the colours dry. The test for the efficiency of sizing will have shown whether the paper is likely to be too porous or too hard, but the actual test for printing is advisable when taking a large quantity of a special making into stock.

The trouble of registering colour work has been dealt with at length elsewhere. If a paper has newly arrived from the mill, it is scarcely reasonable to condemn it on a trial for register before a little time has elapsed for maturing. It is well to examine the bulk to discover if all the supply is cut with the same machine direction.

Various Faults.—Paper which has not been properly retreed—that is, the extraction of faulty sheets has not been done closely—will be found unsuitable for the highest class of work. The faults in the sheets may comprise spots, specks, creases, superficial markings and torn paper. The spots and specks may be caused by various foreign substances—sand, dirt, knots of fibre, pieces of rubber, sealing-wax, little lumps of mineral matter or froth. The foreign matter varies with different papers, and will be more apparent in super-calendered papers than in those which are not highly rolled, as the rolling brings faults into greater prominence. Creases formed before or during calendering render sheets unfit for use. Superficial markings may occur at the drying cylinders or from marks on the other rolls, resulting in rust marks, streaks, and

sometimes in bleaching coloured papers in lines. Torn paper shows hurried sorting, as it is not difficult to see such a fault when turning over the sheets. In various coated papers sheets with uneven coating or surface markings should not be included as "good" paper. A paper which is even in texture cannot be considered matched by a supply which is "wild" or cloudy in the look-through. Although wildness is sometimes accompanied by strength in paper, this is not always so, and it is desirable that printing papers should not be wild.

To analyse papers in order to discover chemical residues and to identify them requires some very delicate tests, and unless one has had an extensive chemical training, mistaken conclusions may result.

The various apparatus and chemicals necessary for paper testing as detailed in this chapter (other than machines, chemical balance and microscope) are detailed below.

1 glass measure, 50 c.c. capacity.
2 beakers, 225 c.c.
6 beakers, 60 c.c.
1 dozen test tubes, 5 in. × $\frac{5}{8}$ in.
1 test-tube stand to take 6 tubes.
6 porcelain crucibles without covers, No. 1.
1 tripod stand, 7 in. × 5 in.
1 piece gauze asbestos covered.
1 pipeclay triangle.
1 Bunsen burner) or one spirit
3 ft. rubber tubing) lamp, 70 c.c.
2 dozen glass slips, 3 in. × 1 in.
$\frac{1}{2}$ oz. cover glasses, No. 3, $\frac{5}{8}$ in. diameter.
2 teasing needles.
1 oz. tannic acid.
1 oz. aniline sulphate.
1 oz. caustic soda.
5 oz. rectified spirit.
25 c.c. iodine in potass. iodide sol.
25 c.c. sulphuric acid and glycerine sol.
25 c.c. phloroglucine solution.

Messrs Townson & Mercer Ltd., of 34 Camomile Street, London, E.C., undertake to supply the whole of the articles for 17s. 6d. if the Bunsen burner is desired, and for 16s. if a spirit lamp is to be used.

CHAPTER XVII

ALPHABETICAL LIST OF PAPERS

Account Book Papers.—Strong, even, well-made papers, hard tub-sized, with good writing surface, usually azure laid. The finish of both sides of the paper should be as nearly as possible equal, and opacity is essential. Hand-made and the best machine-made papers are all-rag, tub-sized, air-dried. Cheap varieties of account book papers can be obtained at 2½d. per lb., but these are engine-sized, and the strength is not sufficient to bear the handling to which account books generally are subjected.

Angle Papers.—Envelope papers, made in the usual way, and, after slitting, cut at an angle in order to economise in cutting the envelope blanks. The angle may be varied to suit customers' requirements.

Anti-Acid Manillas.—*See* Cable and Insulating Papers.

Backing Papers.—For stereotyping purposes. Brown papers which paste down easily and strengthen the flong.

Bag Papers.—Brown papers of medium substance for bags, usually royal in size.

Banks.—Thin tough papers, glazed or unglazed, for use where strong papers of little weight are required. Banks run from hand-made, tub-sized, air-dried, to machine-made, engine-sized, machine-finish, and the prices from 2s. 6d. to 3d. per lb. The usual sizes and weights are:—foolscap, 7 lb.; large post, 11 lb.; medium, 13 lb.

Bank-note Papers.—Hand-made papers for which new linen cuttings are used; the notes having to withstand considerable handling, the paper is specially strong and tough. Watermarks of special design are employed; the sheets are made twice the size of a bank-note, each note having three deckled edges.

Bible Papers.—Thin printing papers of good quality, opaque and strong. Used for Bibles and other books where a large number of pages is required to occupy a small bulk.

Bill Papers.—Hand- or machine-made, all-rag papers, tub-sized, air-dried. Being used for documents such as promissory notes, bills of exchange, etc., the paper must be very durable.

Biscuit Caps.—Thin white M.G. papers, employed for making bags for confectionery and similar trades, in various sizes. The bags are frequently made up at the mill.

Blotting Papers are made from the tenderest of old cotton rags, and are free from loading and sizing. Made in white, pink, buff, green, blue, and silurian, the usual size is demy, and the weight 38 lb. per ream of 480 sheets, at prices from 4d. to 8d. per lb. Other stock substances are demy 27, 48, 60, 80, and 100 lb. Blottings for interleaving diaries and similar works are sometimes made of a mixture of rag and soda wood pulps, or even entirely of wood pulp, in much lighter weights, and in various sizes equivalent to demy 14 lb., at prices from 2½d. per lb., according to quality. Enamelled blottings are made by pasting enamelled papers to blottings of the usual substance.

Bond Papers are similar in character to banks, but are heavier in weight. The term is often applied to superior looking engine-sized writings of medium substance, but strength is essential in all papers included in this class.

Bowl Papers, made from the waste from flax spinning mills, unsized, bleached or unbleached, are used for covering the rolls in calendering machines, where there are alternate rolls of compressed paper and chilled iron. The paper is made in sheets, square and circular, in the substance equivalent to 10 lb. demy.

Box Boards, in various qualities, from the common grey board to the tough glazed board, made from different wastes, well rolled. Used by boxmakers, cut and creased by machinery, folded and fastened by glue or metal fastenings. Boxes for all trades are thus made,

some being quite plain, others covered with coloured or fancy papers.

Bright Enamel Papers.—Enamelled papers, coated on one side only, finished with a high polish produced by calendering and brushing. Used for labels for various purposes, the design printed in several colours and bronze.

Bristol Boards.—Fine boards for black and white drawings. Various boards are called "Bristol," but the name rightly applies to those boards made of fine rag paper throughout, hot pressing being the method employed for obtaining the high surface. They are manufactured with the utmost care, free from all defects. Stock sizes, foolscap, demy, medium, royal, and imperial, and as papers of these sizes are pasted, and the finished boards trimmed all round, the boards are slightly smaller than the sizes of the papers.

Browns.—Brown wrapping papers are made of various materials and in many qualities and substances. Rope browns, air-dried, cylinder-dried are three kinds, "rope" being properly made from old ropes, but some papers sold under the name have wood pulps in their composition. Browns are made on the Fourdrinier machine, either dried on cylinders as ordinary papers, or cut up and hung to become air-dried. Air-dried browns are much more flexible and more durable than cylinder-dried papers. Browns are usually sold by the cwt., prices ranging from 8s. 6d. to 22s. 6d. per cwt. Usual sizes are shown on page 142. *See also* Wrappings.

Butter Papers.—These are greaseproof papers used for wrapping butter and similar articles. Vegetable parchment papers are used, imitation parchments, and papers treated with a solution of albumen and salt. Butter papers are glazed or unglazed.

Cable Papers.—Also known as insulating papers, which better describes their purpose. These papers are made from various materials, such as manilla, jute, and sometimes all wood; some are unsized, but others are hard-sized. Strength is essential, as they are cut to narrow widths, from one-sixth of an inch upwards, wound round the individual wires which go to make up cables. The

covered wires are dried and the whole coated with some waterproofing non-conductive substance to ensure complete insulation. *See* Anti-acid Manillas.

Caps.—Thin brown wrappings, used in a variety of trades, fall under this general description.

Carbolic Paper.—Strong packing paper impregnated with carbolic acid, used for packing goods liable to attack by insects or fungi. Carbolic acid being a powerful germicide, and poisonous to insects, acts as protection.

Carbon Paper.—This is a class of paper increasing in use. It consists of a paper with a coating of colour, ground in an oily or waxy medium, applied to one or both sides of the sheet. The pigment, for the black, mauve and blue carbons, is largely composed of lampblack, but other colouring materials are used. The paper is unrolled from the web, the colour applied to the surface, and brushes rub the coating into the paper. Passing over heated and cooled cylinders the paper receives its finish, and is reeled and allowed to mature. Afterwards the paper is cut to special or standard sizes (foolscap folio and large post quarto). By the use of a very thin paper and very thin carbon papers, as many as twelve copies of a typewritten document may be obtained at one time. To make this possible the finest carbons are coated on the thinnest tissue paper procurable. Carbon papers for special purposes include two-sided, greaseless, copyable and hektograph.

Cards.—Pasteboards, ivory boards and pulp boards are cut into cards and put up in packets of 52 and 1,040. Retree cards have the wrappers inside out. Sizes of cards are given on page 140.

Carpet Felt Papers.—Thick, loosely-felted papers, having very little strength. Made of waste papers, grey in colour, used for placing under carpets to prevent marking by floorboards, to give a better feel to the floor covering, and, when impregnated with certain ingredients, to prevent moth infesting the carpet. Made in widths of 54 and 60 inches and sold in rolls of 12 and 25 yards.

Carriage Panels.—A special variety of compressed millboards, afterwards thoroughly waterproofed and used for roofing railway and other carriages.

Cartridges.—Strong papers, the best qualities are tub-sized, originally made for cartridge manufacture, but now used for cover papers and as cheap drawings.

Casings. — Comparatively thin brown papers, used for lining cases, crates, etc.

Chart Papers.—Largely used by lithographers for map and chart printing. Machine-made, the best qualities are all-rag, tub-sized, with smooth surface. Must be strong, pliable, tough, resistant to wear, and at the same time a good printing surface is essential. The manufacture is arranged so as to avoid subsequent stretch.

Cheque Papers.—Good quality of paper, specially made for strength, usually all-rag. Special watermarks may be employed, or protection from fraud is obtained by special printing. Other cheque papers contain chemical compounds which render alteration or erasure easy of detection. The means adopted for erasure cause chemical combinations which alter the colour of the ink, or develop chemical change which discolours the paper.

Chromo Papers.—Fine coated papers for colour lithography, having a thick coating on a good body paper, finished dull or with a good surface. Usual sizes, medium, royal, double crown, imperial. The weights listed are usually those of the uncoated paper.

Cigarette Papers.—Tissues of finest quality, wove or laid, thin, strong, free from loading and taste, and must burn easily. Ropes form the basis of the paper, fine beating being essential. Some papers have chemical additions to the pulp in order to ensure even combustion.

Cloth-lined Paper.—Cotton cloth, equivalent to scrim or common muslins, according to quality, having paper facing. Cloth-centred paper has thin paper pasted on each side, while cloth-backed papers are of better quality, with a fair cloth on the back. Useful where much handling is required. Cloth-lined cards (sometimes described as linen-lined) are thicker substances than the papers. Surface enamelled cloth-lined cards are first made as cloth-backed cards and then enamelled with the coloured coating and plate glazed.

Coils.—Used for various purposes, such as telegraph, time recording machines, cash registers, music rolls for piano players, wiping the die in relief stamping, and for printing small forms on the reel. Papers are slit from the full reel, and re-wound on centres suitable for the machine or other spindles.

Collar Papers.—Papers for making paper collars and similar articles; made of wood pulp with a woven cotton or linen fabric rolled down to the paper, the surface filled with mineral and the whole highly rolled.

Copying Papers.—Thin glazed or unglazed papers of the same character and composition as tissues, but sometimes having a small amount of mineral matter added to ensure perfect copying. These papers are used for taking press copies of correspondence, the original being written (or typewritten) with copyable ink. The copying paper is damped, the superfluous moisture removed with a sheet of drying royal (*q.v.*), an oiled sheet placed at the back of the copying page and the whole placed in the copying press and given a good squeeze. One or more perfect copies of the correspondence can be obtained by this method. As copying books are made with 500 or 1,000 leaves, the reams are made up of 500 sheets. Rotary copying machines employ copying paper in rolls, sometimes perforated at regular intervals, a damping roller preparing the paper: the copy is taken by rotary pressure. Everdamp copying paper eliminates the damping roller from this class of machine.

Cork Paper.—For packing bottles, coarse wrapping paper is covered with adhesive, and on this powdered cork is sprinkled making an elastic packing material. For cigarette tips very thin sheets of cork are pasted to tissues and cut to widths suitable for the well-known cork tips.

Corrugated Paper. — The corrugation is effected by machine, the corrugated paper being glued or pasted to a flat web of similar paper. Commonly the thinnest strawboards are used, but for better classes white papers are employed. Obtainable in sheets or rolls, corrugated paper serves as protective packing for many classes of goods.

Cover Papers.—The term is applied to a large class of fancy papers, made in many shades, substances and sizes, suitable for the covers of pamphlets, booklets, price lists, for box covering, and the neutral shades for photographic albums and mounts. The qualities vary with the prices, which range from 2d. to 8d. per lb., the sizes following those most in demand, viz., medium (for demy), royal, etc.

Crayon Papers.—Drawing papers specially prepared for crayon work, with a rough surface, or finished smooth on one side. Hand-made or machine-made white or tinted papers are obtainable.

Crepe Papers.—Tissues in tints and deep colours, crinkled by passing through rollers bearing the pattern. The paper is much reduced in length, often to less than half the original length. Made up in rolls of 20 inches wide, $2\frac{1}{2}$ yards long. Used for many fancy purposes, candle and lamp shades, artificial flowers, etc.

Cutlery Papers.—Thin brown papers, glazed on one or both sides, manufactured with special care to avoid acidity, so that they are sometimes finished with some alkalinity in order that cutlery and similar articles wrapped in the paper shall not be liable to attack from residues in the paper.

Drapers' Caps.—Very thin brown papers, glazed on one side (M.G.), made of wood pulp, used for wrapping small articles in many trades besides that of drapers; usual size, double crown.

Drawing Papers are made of the best and strongest rag fibres, free from impurities of all kinds. The highest classes of drawing papers are hand-made from unbleached fibre, tub-sized, with special treatment to avoid deterioration of the sizing, air-dried, and finished with various surfaces to suit different purposes. Machine-made drawing papers are made of similar materials with similar treatment, but papers of very fair quality, made entirely of chemical wood and engine-sized, are on the market. Cartridge papers are frequently used as substitutes for ordinary machine-made drawing papers. The usual sizes are royal, imperial, double elephant, and antiquarian.

Drying Royal.—Strong, unsized papers, royal in size, used in copying books to absorb the excess of moisture after the copying paper has been wetted. Blotting paper is not sufficiently strong to stand the handling to which the drying royal is subjected. Hand-made papers of this class are all-rag, but other fibres are used for some of those made on the machine. Weight, 44 lb. or 88 lb. per ream of 480 sheets.

Duplex Papers may be made of two layers of differently coloured papers brought together in the wet state and rolled together, or may be coated with different colours, after the paper is made, as duplex art papers.

Duplicating Papers.—Unsized or half-sized papers used for taking copies on cyclostyle, mimeograph and similar duplicating machines. Best qualities are composed largely of esparto, but the common varieties contain mechanical wood. Usual sizes: double foolscap 24 lb., large post 18 lb. per ream of 480 sheets.

Embossed Papers.—Papers of various qualities and colours are run through rollers engraved with patterns, by which means the papers are permanently embossed. Hard cover papers retain the patterns better than softer papers, but many kinds, repp, linen, crash, crocodile and other leather patterns are made upon soft papers. Embossed papers find favour as cover papers and box covering papers.

Enamelled Papers are body papers with a mineral coating on one side, white or coloured, the surface being highly polished. Used for labels, box coverings, and outside wrappers of various kinds, printed in one or more colours.

Engine-sized Papers.—The majority of papers are sized with resin, which is added to the pulp in the beating engine, hence the term "engine-sized" (E.S.). The attempts to size with animal size in the engine are not completely successful, as a large part of the gelatine, being in solution, goes away with the water. Most machine-made papers which are tub-sized are to some extent engine-sized.

Envelope Papers.—All kinds of paper may be used for envelope making, but papers highly glazed on one side

are usually meant. The highly-glazed surface is more suited for writing, while the rougher side takes the gum for the flap better than a burnished surface. Envelope papers are usually cut at an angle to prevent waste when cutting out blanks for envelopes. Demonstration of the waste involved by the use of square paper can be made by opening an ordinary envelope, and marking it out on an ordinary sheet of paper.

Feather-weight Paper.—A term applied to bulky book papers much in favour for current fiction. The fibre is esparto, beaten quickly, no loading, but little sizing, very little pressure while passing through the machine. The fibre being loose occupies a large space, and the paper is very light for its bulk, hence the term. Usual sizes and weights: double crown 30 to 60 lb., double demy 40 to 70 lb., and quad crown 55 to 120 lb. per ream of 516 sheets.

Filter Papers are used in chemical laboratories to separate substances in suspension from liquids. It is essential that the papers be entirely free from chemicals, and allow liquids to pass freely while retaining suspended matter. All-rag fibre is used, but grey filter papers may contain a proportion of wool fibre. Filter papers are made as blotting papers, and subjected to special treatment to remove all matter that is likely to confuse chemical analyses. Usual size, 24 by 24 inches.

Foil Papers.—Metals reduced to fine powder are dusted upon the paper which has received a coating of adhesive, and when all is dry the surface is highly burnished. Embossed foil papers are passed through special rolls. Used for covering boxes and picture mounts.

Fruit Paper.—Thin papers, similar to tissues in texture, but much lower in quality, used for wrapping fruits—apples, oranges, etc.—before packing. It is found that this isolation justifies the trouble and expense, an increased percentage of sound fruit reaching the market. Some wrappers are printed with the merchant's name and address.

Glazed Boards.—Millboards which are given a very high surface by repeated rolling.

Grass-bleached Tissues.—This term is applied to special tissues to describe papers quite free from chemicals. The ideal method of bleaching linen is by exposing on grass, and though these tissues are not treated in that manner, the ideal papers which will not tarnish silver or other bright metal goods are so described. Used for wrapping silver goods, and for protecting metal decorations and buttons on uniforms.

Greaseproof Papers.—Used for packing butter, lard, and other provisions; may be prepared as such in the pulp by prolonged beating, "wet" pulp being the result of long beating. The resulting paper is close, transparent, and, with ordinary sizing, is greaseproof. Other papers are rendered greaseproof by immersion in a bath of albumen and salt, this giving the paper an impervious coating. Vegetable parchment papers are used for similar purposes.

Grocery Papers.—The well-known blue sugar paper and purple sugar bags are examples of this class of paper. They are made of low-grade pulps, with which are mixed waste papers, a moderate amount of loading, and aniline colours. The squares are cut at the mill and bags too are often produced at the paper mill.

Hosiery Papers.—These are special heavy white wrapping papers, prepared to stand a good amount of handling, used as wrappers for packets of hosiery stock, and for similar purposes.

Imitation Art Paper.—To meet the demand for a cheaper paper than art paper, with some of the characteristics of the latter, such as opacity, absorbency, and a surface suitable for printing half-tones, imitation art papers have been introduced. They contain a large proportion of loading, and receive a good surface, the water finish being usually adopted. Stocked in double crown, double demy, double royal, quad crown, and quad demy.

Impression Papers.—Another term for duplicating papers. *See* Duplicating Papers.

Index Boards.—Pulp boards made of strong stuff, even, hard-sized, well-rolled, giving a good writing surface. It is important for card index systems to employ a card which is made in one thickness only; pasteboards bend and split

at the corners if frequently handled. The uncut boards should be perfectly flat in order that ruling, printing, and cutting may be executed with accuracy. Guillotine cutting is not so satisfactory as cutting singly with a hand cutter or rotary cutting on a card cutting machine. The usual sizes of index boards are 20½ by 25½ inches and 30½ by 25½ inches, cutting to 5 by 3 inches, 6 by 4 inches and 8 by 5 inches.

India Proof Paper.—Thin paper made from the inner fibres of bamboo stems. Extremely soft and absorbent, it is therefore eminently suitable for taking full-bodied impressions in plate printing.

Insulating Papers.—For insulating wires for electric cables. *See* Anti-acid Manillas *and* Cable Papers.

Ivory Boards.—Hard, white, transparent boards, made from well-beaten stuff, the substance being obtained by bringing two or more webs of moist paper together, the junction being effected by rolling, no adhesive being employed. Ivories are obtainable in three or four substances, white or cream, and are used for high-class work, such as visiting, business, and menu cards. Stocked in royal boards, and also in various cut sizes.

Japanese Copying.—Specially thin and strong papers made in Japan from long fibres, used for copying books. Japanese papers are hand-made, the fibres pulped by hand, the sheets made on moulds of bamboo or hair. The length of fibre, precluding machine making, makes a paper of exceptional wearing qualities, the fibres pulling apart, and not tearing.

Japanese Vellum.—Thick papers made of Japanese fibres, very tough and durable, almost as difficult to tear as vellum. Finished with a good surface, suitable for certificates and various jobs where very tough and durable material is required. Stock sizes from crown to imperial; substance about 19, 28, 38 lb. demy per ream of 500 sheets; price about 2s. 3d. per lb.

Kraft Papers.—"Kraft" means strength, and this is the characteristic of these papers. Unbleached wood pulp is the material used, and by prolonged boiling with soda under comparatively low pressure, the fibres receive less drastic chemical treatment than is usual in the

preparation of wood pulp. Reduction to fibrous state is accomplished by the edge runner, drawing the fibres out, thus retaining the length and strength. Kraft papers are smooth, light brown in colour, strong and flexible, and are used for wrappings where these qualities are required.

Leather Boards.—Millboards made of strong materials to which a proportion of leather cuttings may be added. Used in boot and portmanteau manufacture.

Leatherette.—Papers used for box covering and for covers of cheap note-books. Common papers made to colour of the leather of which they are imitations, either as coloured body papers, or with coloured surface, and then embossed with leather grain.

Ledger Papers.—Strong, well-made writing papers, used for ledgers, therefore manufactured to withstand considerable handling. The best qualities are all-rag, tub-sized, air-dried, plate-glazed, quite opaque, with equal surface both sides. Usual sizes and substances: demy 24 lb., medium 34 lb., royal 44 lb., imperial 72 lb. per ream of 480 sheets.

Lined Brief.—Foolscap paper ruled with thirty-six lines across the width of the paper, and a vertical marginal line. Hand-made and high-class machine-made papers of this kind have the lines as watermark.

Linen-faced Papers receive their patterns in one of three ways: (1) by passing between embossed and engraved rollers, as described under embossed papers; (2) by interleaving with zinc plates upon which are glued sheets of linen and passing through the plate-rolling machine; (3) sheets of linen used between sheets of paper to be impressed, metal plates top and bottom, and pressure applied at the plate-rolling machine. Many common papers are so treated, and are at present the favourites among fancy note-papers, silurian note being quite eclipsed. High-class writings and cover papers are also linen-faced.

Lithographic Papers.—Papers for lithographers' general use, with good super-calendered surface, frequently soft-sized, the manufacture so arranged as to reduce the amount of stretch to a minimum. The best qualities

are made of rag, the next quality of esparto. With the advent of the off-set litho. press, all papers have become possible as lithographic papers, but the description applies only as above.

Loan Papers.—Superior cream wove papers, made of the strongest materials, tub-sized and finished with a good writing surface. The materials and treatment are similar to those employed for bank papers, but the substances are heavier. Usual sizes, medium, double foolscap, royal, imperial, equivalent weights 20 to 40 lb. medium, 480 sheets.

London Boards.—Originally boards formed by pasting sheets of best hand-made drawing paper. Thick pasteboards are sometimes supplied as London boards.

Long Elephants do not concern the ordinary printer. They are used by paper stainers, that is, wall paper printers. They form the ground papers for wall papers, are frequently of the same materials as printing papers, but put up in rolls of 22½ inches in width, with a length of 12 yards.

Magazine Paper.—Soft printing paper with a good supercalendered surface in order to give equal printing surfaces for half-tone illustrations each side of the sheet. Imitation art papers also are used for illustrated magazines.

Manifold (Typewriting) Banks.—The thinnest substances of typewriting papers are so described in lighter weights than ordinarily used as banks. The descriptions under Banks and Typewriting Papers are applicable to Manifold Banks.

Manifold Papers.—Papers used for taking copies at the time of making the original by writing or typewriting by means of carbon papers. In order to obtain a better impression of the original, the manifold paper, which is a tissue, is impregnated with oil. To enable the paper to take ruling and printing the paper is allowed to mature for some time to allow the oil to become distributed evenly throughout the paper.

Manilla Papers.—Strong, tough, flexible papers made from manilla hemp. Manilla does not bleach easily, the so-called white manilla papers being always low in

colour. These papers are used for manilla labels (parcel tags), cartons, folders in index systems, correspondence covers, index cards, and for work where strength and durability are essential. The term "manilla" is now applied to a class of paper rather than to the papers made entirely or principally of manilla fibre. Many such papers are composed of unbleached chemical wood pulp, a long-fibred tough paper resulting, which is suitable for most of the purposes for which manilla papers are generally employed. For envelopes, however, the genuine article is not easily replaced. Low grade manillas may contain mechanical wood. Usual size and weights: double crown, 80, 100, 120 lb. per ream of 480 sheets.

Map Papers are thin and tough, folding without cracking, usually slightly sized with animal sizing. Used for printing maps which are to be folded into small compass.

Marbled Papers are used for covers of various books, as wholly covering the book, or as sides in half- and quarter-binding, but the principal use is for end papers in account books. High-class marbled papers are made a sheet at a time in the following manner: a trough of gum is prepared, the colours for the pattern are sprinkled and dropped upon the surface, patterns are made by combing or some other means of regularising the design. The body paper is let down carefully to the gum, the colour adheres to the paper, and the sheets are hung to dry. Intricate machines are employed to make marbled papers, depositing the colours for transference to the paper. There are many patterns of marbling, the favourites being the Spanish, shell, and nonpareil designs, carried out in reds, blues, and greens. Fancy marbled papers are sold, but binders are conservative in their tastes. Cheap marbled papers are produced by lithography.

Metallic Paper is a coated paper for special uses, such as note-books for indelible writing, in which case writing with a metal stylus or indelible pencil is easily made, but cannot be erased; for indicator diagrams for various instruments where a light touch only can be given, but

the diagram is faithfully recorded. A good quality paper is coated with a mixture of glue and zinc oxide, usually applied by hand and finished in the same way as art papers. Cheaper metallic papers are coated with barium sulphate.

Middles.—The materials for middles (of pasteboards) vary from waste paper to all-esparto fibre. Grey middles contain a large proportion of waste, mechanical wood and added mineral matter, while white middles are usually free from mechanical wood and of very fair strength. Made on the Fourdrinier machine, and left with machine finish, in order that the subsequent pasting of facing papers may be more thoroughly performed. In addition to their use for pasteboards, middles are used for tramway and bus tickets, frequently being tinted in the pulp.

Millboards are made from various waste fibres and waste papers. Hand-made and the best machine-made boards are made from hemp and flax fibres, the commoner machine-made from waste papers with or without long fibred material. The raw materials are reduced to pulp (the stronger materials boiled and beaten), made into boards in hand moulds or on special board machines, pressed, dried, heavily rolled, trimmed to size. Used for binding, boxmaking, portmanteaux, carriage panels, etc. (*see* page 143 for sizes and substances).

Mould-made Papers come between hand- and machine-made papers, having most of the characteristics of hand-mades. The moulding is mechanical, but the other operations are carried out as for hand-made papers. Four deckled edges will be present.

Music Papers, used for printing sheet music, are thick printing papers with a moderate amount of sizing, and with machine finish, making an easy printing surface for music type, plates, or lithographic surfaces. Usual size: demy, $20\frac{1}{2}$ inches by $14\frac{3}{4}$ inches, 24 to 28 lb. per ream of 480 sheets.

News.—Common printing papers, containing 60 to 80 per cent. of mechanical wood, a small amount of loading, and very little sizing. Suitable for news and other work of an ephemeral nature. Supplied in reels or sheets.

Non-curling Gummed Paper. — Specially prepared gummed paper, the body paper being made as nearly free from stretch as possible, and the coating of gum, when dry, is broken into fine particles by drawing the finished paper over a steel bar. This prevents the film of gum from acting as a single surface, and only when the particles again cohere is the non-curling property destroyed.

Oiled Paper.—*See* Manifold Paper and Stencil Paper.

Onion Skin.—A term applied to thin, hard, highly glazed translucent papers, because of their resemblance to the thin outer skin of the onion.

O. W. Papers are specially prepared for water colour drawings, the rags being reduced to pulp without chemical treatment, without bleaching. The papers are tested for chemical purity. Usual sizes of drawing papers.

Pamphlet Papers.—Tinted papers of various substances, used for covers of pamphlets, and for a large variety of jobbing work where a paper of fair weight is required.

Parcel Tape Paper is supplied in various widths and qualities, from ordinary gummed paper to kraft brown with gummed back; used for fastening small parcels instead of string or wax. Supplied in coils for use with a special damping machine.

Parchment Papers.—Properly, parchmented papers, *i.e.*, the cellulose of which the paper is composed is altered in character to resemble parchment. A web of unsized paper is passed through a bath of strong sulphuric acid, which attacks and dissolves the cellulose, changing its fibrous form. Before the change is complete the paper is washed, the acid is neutralised, and the paper dried. The paper shrinks considerably, but is greaseproof and much stronger than before treatment. Vegetable parchment and pergamyn are alternative names for the same material. Used as an impervious packing paper for provisions, for tea packing, jam covers, etc.

Pasteboards.—Cardboards formed by pasting fine papers to middles of inferior quality. Distinct from triplex, ivory, and pulp boards.

Pastings.—Papers for pasting down; facings for paste-

boards; covering paper used by boxmakers; white or coloured.

Plate Papers.—Thick, soft printing papers, made of good material, soft-sized. The thicker kinds are made by bringing two or more webs together in the wet state and pressing them together, one side only being calendered. Used for taking impressions from engraved copper and steel plates, also for fine lithography. Usual sizes and weights are crown, demy, royal, and double crown, equivalent to 40 to 60 lb. demy.

Porcelain Paper.—Thick transparent paper of the nature of celluloid, made of well-beaten pulp. Used for Christmas cards and similar work.

Portmanteau Boards.—Tough boards used for the shapes or shells of portmanteaux and trunks, over which the leather or canvas cover is fixed. Manufactured as millboards, flax and hemp fibres being employed.

Pottery Tissues.—Tissue papers specially prepared for printing transfers for pottery decoration. The printing is from copperplate, engraved rolls, or lithographic surface, and the pattern is transferred to the china or earthenware before glazing.

Press Boards.—Thin, hard glazed boards, made of the best materials (*see* Millboards). Heavily rolled and friction glazed. Used for interleaving work which is to be hot or cold pressed.

Pressings.—Thick coloured papers, made on the single cylinder machine, therefore with M.G. surface. Used for the covers of exercise books, for box covering, etc.

Printings.—A large class of papers, which are usually made with a fair surface, machine finish. Printings are moderately sized, so as to absorb ink readily, and only a small quantity of loading is added. The materials used include all the fibres which will bleach well; hand-made printings are tub-sized, machine-made are all engine-sized. Rag, rag and esparto, chemical wood and esparto, chemical wood, chemical and mechanical wood papers are the varieties obtainable, white or toned. Super-calendered, imitation art, and art papers can be included under this heading, but they are usually treated separately. Sizes, weights, and prices on pp. 136-37.

Profile Papers are specially ruled papers for the use of engineers and surveyors; ruled, or printed from engraved roll. The usual pattern has quarter-inch squares, divided into five horizontal sections.

Programme Papers.—Soft papers, white or tinted, used for concert programmes, in order that there shall be no rustle when the pages are turned. The light weight (44 lb.) of drying royal is sometimes used as a programme paper.

Pulp Boards are boards of one thickness only, made on the Fourdrinier machine, well sized, well rolled, in various substances and qualities, and in a variety of useful tints. Used for all purposes for which cards are employed.

Railway Buffs.—Cheap buff papers used for forms and envelopes for railway business. Forms are printed on glazed buffs, super-calendered papers; envelopes are made from M.G. buffs.

Rocket Paper.—Thick coarse paper used for making cases for rockets and other fireworks. White, coloured, or fancy papers are pasted on the outside of the firework cases, and the touch paper fastened on last.

Royal Hands.—A term used for wrapping papers made to royal size (24 by 19 inches).

Safety Cheque Papers are specially prepared by printing, as a groundwork, a small design in ink which is fugitive if treated with chemicals, or if erasure is attempted. Other safety papers are made by adding sensitive chemicals to the pulp, or by impregnating the finished paper. These additions act as detectives, as any alteration or attempt to remove the original writing results in coloured patches which betray the work.

Sampling Papers.—Coloured papers used for the display of textile and other samples, usually deep blue or deep yellow. Made in medium, 25 lb. per ream of 480 sheets, and also supplied in rolls.

Sealings.—Thin tough M.G. papers used as parcel papers. Being glazed on one side, sealing wax adheres readily to the rough side. Made in various substances and colours.

Sectional Papers are papers with squares of definite measurement, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{10}$, $\frac{1}{12}$, $\frac{1}{16}$ inch, or millimetre

ruling. The larger squares are ruled, the smaller are printed from engraved rolls or from electrotypes of engraved plates. Printed on drawing paper, also on thin paper for subsequent reproduction by contact with sensitized papers.

Sensitized Paper.—Various papers for photographic printing, the paper receiving treatment after making. The emulsions are made and applied to the surface of the papers, or the paper is passed through a solution of sensitive salts. The developing after printing is done in another solution or in water, according to the preparation of the paper.

Shops.—White papers for packing, either glazed or unglazed; white grocery papers are shops. Substances equivalent to demy, 40 to 48 lb.; sizes: demy, royal, 28 by 20 inches and in rolls.

Silurian.—Grey paper mottled with blue fibres. The pulps are coloured separately with fast dyes, and a small proportion of the darker fibres added to the grey pulp.

Skips.—Thin packing papers for lining skips or crates in which various goods are packed.

Small Hands.—Thin M.G. wrapping papers, made of the commonest pulps.

Squared Papers.—Ruled or printed squares of various sizes on drawing, cartridge, and tracing papers. *See* Sectional Paper.

Stencil Paper (Oiled).—Thick strong paper used for cutting stencils for decorators. Manilla or other papers of good strength and substance are soaked in linseed oil, and sometimes varnished on one side.

Stencil Papers (Waxed) are used in connection with cyclostyle, mimeograph and similar machines. Thin, strong, unsized papers are coated with wax, and a stencil is actually made by removing the wax in various ways. For stencils made by handwriting the wax is removed by writing with a stylus on a file plate or a metal plate covered with bolting silk, or a cyclostyle pen, having a wheel at its tip, is used, making a series of perforations through the waxed paper. With the typewriter the wax is removed by a blow of the letter upon a tissue which is placed in front of the stencil paper. Wherever wax

is perforated or removed ink can be forced through the stencil, and the prints, although not always showing the broken lines of stencil work, are actually produced by stencil process. On account of the strength of long fibred papers, Japanese tissues are usually employed as the basis of stencil papers.

Stereotyping Papers.—Tissues, grey blottings, and brown papers, as used in making stereo flong, are included in this category. It is possible to obtain flong papers made on the paper machine, the three papers being made separately and brought together before the couch rolls are reached.

Strawboards.—The cheapest boards obtainable for binding and mounting purposes. Made from straw, boiled with lime and reduced to pulp, manufactured into boards of various substances. Usual sizes, 30 by 25 inches, 32 by 22 inches, the boards being made up into bundles weighing 56 lb., the weight of individual boards governing the number in a bundle, *e.g.*, 8 oz. board, 112 to bundle, 2½ lb. 22 in bundle, etc.

Sulphite Browns.—Brown wrapping papers made from unbleached sulphite wood pulp producing very strong papers.

Super-calendered Papers.—Term applied to printing papers which have received a high surface by passing through the super-calender rolls; but most writings, art, manilla, and coloured papers receive their finish in the same manner.

Tea Cartridges.—Generally made from chemical wood, but in some cases a mixture of rag and chemical wood is employed. Engine-sized, supplied in sheets or reels, substance equivalent to 14 to 34 lb. demy.

Ticket Boards.—Pasteboards with good white or coloured facing papers, sometimes coated, white or coloured; used by ticket writers for window tickets.

Tips.—Binders' tips are very thin millboards. Trunk makers' tips are thick, tough brown papers.

Tissues.—Fine thin papers, made of strong materials such as rag and hemp fibres, beaten very finely. Other tissues are made of chemical wood and a proportion of straw pulp. Papers are unsized, used for wrapping and

protective purposes. Usual size and weight: double crown 7 lb. per ream of 500 sheets.

Tobacco Papers.—Papers used for packing small quantities of the cheaper tobaccos; with good printing surface. Substance and sizes, 28 to 30 lb. demy.

Toilet Papers.—Very thin M.G. papers put up in packets of cut pieces, or in rolls with or without perforation.

Tracing Papers.—Thin papers specially treated with a coating consisting of a mixture of certain gums and turpentine. Other papers used for tracing are glazed imitation parchments. Used for tracing maps, plans, drawings, etc.

Transfer Papers.—Specially coated papers for transferring designs to lithographic printing surfaces. Opaque or transparent papers are used, according to the use of the paper, whether it is merely as a transfer paper or also as a tracing paper. The coating mixture is such as will readily strip from the paper when put down on stone and the back is damped, all the ink of the transfer being left on the stone.

Triplex Boards are made on a cylinder machine, three webs being brought together in the wet state, but rolled, dried, and finished as a single web.

Tube Papers.—Soft unsized papers, made with a good percentage of rag, for making tubes or spools on which the yarn for spinning machines is wound.

Typewriting Papers.—Strong bank papers of good appearance, unglazed, used for correspondence and other typewritten matter. The extra superfine qualities are all-rag, tub-sized; some of the lower grades, chemical wood, engine-sized.

Vegetable Parchment.—Another name for parchment or parchmented paper. *See* Parchment Paper.

Vellum Papers.—(1) Name applied to writing papers with a good writing surface, not so smooth as super-calendered papers, but nearer to the surface of a well-finished vellum. Usually vellum woves, although laid papers with vellum finish are supplied. (2) Thick, strong, fine papers, used for engravings. *See* Japanese Vellum .

Waterproof Papers for packing purposes are made by coating strong wrappings with tar or bitumen, and rolling

scrim on to the surface to prevent the coating coming in contact with the contents of the package. A coating between two sheets of thin wrapping paper is another method of waterproofing. Used for protecting goods from the influence of moisture. Roofing paper is a variety of waterproof paper prepared by coating strong papers with tar.

Waxed Paper.—Thin paper passed through a bath of melted paraffin wax which makes it perfectly impervious to moisture. Used for packing goods which are liable to deterioration if exposed to the atmosphere.

Whatman Boards are made by pasting sheets of "Whatman" drawing paper together until the desired thickness of board is attained. Boards only faced with "Whatman" paper are also supplied under this name.

Wheatstone Paper.—Blue tinted paper cut to narrow width for use in the tape machine, the telegraphic messages being recorded on the paper strip.

Willesden Paper.—Strong paper rendered impervious to moisture by immersion in a solution made copper in ammonia. The surface of the paper is thus partially dissolved, and the paper is washed, rolled, and dried. If a thick sheet is desired, thinner sheets are brought together while wet and consolidated by rolling.

Wiping-off Papers.—Papers used for relief stamping machines, usual substance demy 20 to 30 lb.; in widths 2 inches, 2½ inches, 3 inches, 3½ inches, 4 inches, 5 inches, 6 inches, 7 inches, 7½ inches, 9 inches, 10½ inches.

Wrapping Papers are described under the heads of Bag, Biscuit Caps, Browns, Caps, Carbolic, Casings, Cork, Corrugated, Cutlery, Drapers, Fruit, Grocery, Hosiery, Kraft, Parchment, Rocket, Royal Hands, Sealings, Shops, Skips, Small Hands, Sulphite Browns, Tea Cartridges, Tobacco Papers. Sizes, weights, and prices on page 142.

Writings.—Hard-sized papers of all kinds are suitable for writing, but an even paper of good surface is essential. *See under* Account Book, Bank-note, Banks, Bill, Cheque, Ledger, Lined Brief, Loan, Safety Cheque, Silurian, Typewriting, Vellum Papers. Sizes, weights, and prices on pp. 138-39.

TABLES OF SIZES, WEIGHTS, AND PRICES

Sizes of Note and Letter Papers

Arranged Alphabetically

Fancy Names.	Size in Inches.	Cut Paper Sizes.	Size in Inches.
Albert	$3\frac{7}{8} \times 6$	Copy 4to	$7\frac{3}{4} \times 9\frac{5}{8}$
Czarina	$4\frac{1}{2} \times 6$	„ 8vo	$4\frac{5}{8} \times 7\frac{1}{4}$
Duchess	$4\frac{1}{4} \times 6$	Demy 4to	$7\frac{3}{8} \times 9\frac{3}{8}$
Duke	$4\frac{3}{4} \times 6\frac{3}{4}$	„ 8vo	$4\frac{3}{4} \times 7\frac{1}{4}$
Emperor	$5\frac{1}{2} \times 7\frac{1}{4}$	Foolscap folio	8×13
Empire	$4\frac{1}{4} \times 6\frac{1}{4}$	„ 4to	$6\frac{1}{2} \times 8$
Princeps	$4\frac{1}{4} \times 5\frac{5}{8}$	Large post „	8×10
Princess	$4\frac{1}{8} \times 5\frac{5}{8}$	„ 8vo	5×8
Prince of Wales	$3 \times 4\frac{1}{2}$	Medium 4to	$8\frac{3}{8} \times 10\frac{3}{4}$
Queen	$3\frac{1}{2} \times 5\frac{3}{8}$	„ 8vo	$5\frac{3}{8} \times 8\frac{3}{8}$
Regina	$4\frac{3}{4} \times 6\frac{5}{8}$	Post 4to	$7\frac{3}{8} \times 9$
Viscount	$5 \times 6\frac{1}{2}$	„ 8vo	$4\frac{1}{2} \times 7$

Arranged in Order of Size

Prince of Wales	$3 \times 4\frac{1}{2}$	Demy 8vo	$4\frac{3}{4} \times 7\frac{1}{4}$
Queen	$3\frac{1}{2} \times 5\frac{3}{8}$	Viscount	$5 \times 6\frac{1}{2}$
Albert	$3\frac{7}{8} \times 6$	Emperor	$5\frac{1}{2} \times 7\frac{1}{4}$
Princess	$4\frac{1}{8} \times 5\frac{5}{8}$	Large post 8vo	5×8
Princeps	$4\frac{1}{4} \times 5\frac{5}{8}$	Medium 8vo	$5\frac{3}{8} \times 8\frac{3}{8}$
Duchess	$4\frac{1}{4} \times 6$	Foolscap 4to	$6\frac{1}{2} \times 8$
Empire	$4\frac{1}{4} \times 6\frac{1}{4}$	Post 4to	$7\frac{3}{8} \times 9$
Czarina	$4\frac{1}{2} \times 6$	Demy 4to	$7\frac{3}{8} \times 9\frac{3}{8}$
Post 8vo	$4\frac{1}{2} \times 7$	Copy 4to	$7\frac{3}{4} \times 9\frac{5}{8}$
Regina	$4\frac{3}{4} \times 6\frac{5}{8}$	Large post 4to	8×10
Duke	$4\frac{3}{4} \times 6\frac{3}{4}$	Medium 4to	$8\frac{3}{8} \times 10\frac{3}{4}$
Copy 8vo	$4\frac{5}{8} \times 7\frac{1}{4}$	Foolscap folio	8×13

Sizes of Printing Papers, Etc.[1] With the Extremes of the Usual Stock Weights

Name of Paper.	Size in Inches.	Area in Square Inches.	Extremes of Stock Weights.
			Lb. per ream.
Pott	15 × 12½	187½	5-13
Foolscap	17 × 13½	229½	6-18
Post	19¼ × 15½	298⅜	15-25
Music demy	20¾ × 14⅜	298⅜	24-28
Crown	20 × 15	300	6-20
Copy	20 × 16½	330	10-20
Large post	21 × 16½	346½	10-40
Double pott	25 × 15	375	10-25
Demy	22½ × 17½	393¾	10-60
Medium	23 × 18	414	18-30
Double foolscap	27 × 17	459	10-35
Royal	25 × 20	500	16-70
Super-royal	27½ × 20½	563¾	20-40
Double crown	30 × 20	600	11-80
,, post	31½ × 19¼	606⅜	30-50
Elephant	28 × 23	644	24-60
Imperial	30 × 22	660	30-60
Double large post	33 × 21	693	20-60
Quad pott	30 × 25	750	20-50
Double demy	35 × 22½	787½	22-120
,, medium	36 × 23	828	30-60
Quad foolscap	34 × 27	918	20-70
Double royal	40 × 25	1,000	30-70
,, globe	38 × 28	1,064	60-100
,, elephant	40 × 27	1,080	40-100
Quad crown	40 × 30	1,200	20-120
Double imperial	44 × 30	1,320	60 120
Quad demy	45 × 35	1,575	40-240
,, royal	50 × 40	2,000	60-120
,, globe	56 × 38	2,128	120-140

[1] Including coloured papers, and papers detailed on next page.

Extremes of Weights and Prices.[1] Printings, Etc.

Description of Paper.	Equivalent Weights in Demy, 480 sheets.	Prices per lb.	Remarks as to Number of Sheets, etc.
	Lb.		
Antique book paper	18-40	1⅞d. to 6½d.	Wove or laid: 516
Art - - -	24-50	2⅝d. ,, 4d.	One- or two-sided: 480 or 516
Bible papers (*see* Oxford India paper)	...	...	...
Chart - - -	14-48	4¼d. to 8d.	480
Chromo - -	13-50	4d. ,, 6½d.	480: Weights given are those of uncoated papers, also sold, without weight specified, as "thick" and "thin"
Collotype - -	35-60	4½d. ,, 7d.	...
Cover - - -	18-56	2¼d. ,, 6d.	516
Etching - -	...	...	...
Greaseproof (*or* imitation vegetable parchment)	11-20	1⅞d. to 3½d.	Double crown: 480
Imitation art - -	22-40	2d. ,, 2¾d.	516
Litho. - - - -	20-60	2½d. ,, 4d.	480 to 516
M.G. poster - -	16-20	2d. ,, 2¾d.	...
News printing -	11-22	1½d. ,, 1⅞d.	500
Oxford India paper	9-11	7d. to 1s. 2d.	480, 504
,, ,, ,, (imitation)	10-12	3d. to 6d.	...
Plan - - -	20-24	3¼d. ,, 3¾d.	480, 516
Plate - - -	20-100	4d. ,, 7½d.	516
Printing—			
Hand-made -	20-40	9¾d. ,, 1s.6d.	480
Mould-made -	30-40	6½d. ,, 8d.	480
Machine-made -	13-40	1½d. ,, 6d.	480, 516
Super-calendered -	15-40	1½d. ,, 3¼d.	480, 516
Tissues - - -	5-6	3½d. ,, 10d.	500: Usually double crown
Vegetable parchment	11-27	4d. ,, 4¾d.	480: Usually double crown

[1] The prices given in this section are for small quantities from stock. Special sizes may be liable to an extra charge for cutting. Special makings and large quantities are usually subject to a reduction of ⅛d. per lb.

Sizes of Writing Papers, Etc.[1] With the Extremes of the Usual Stock Weights

Name of Paper.	Size in Inches.	Area in Square Inches.	Extremes of Stock Weights.
			Lb. per ream.
Pott	15 × 12½	187½	7-12
Foolscap	16½ × 13¼	218⅝	7-22
Pinched post	18½ × 14¾	272⅞	10-28
Post	19 × 15¼	289¾	11-30
Demy	20 × 15½	310	20-25
Sheet-and-a-half foolscap	24½ × 13¼	324⅞	24
Copy	20 × 16½	330	15-19
Large post	21 × 16½	346½	11-28
Double pott	25 × 15	375	14-40
Medium	22 × 17½	385	13-34
Double foolscap	26½ × 16½	437¼	14-40
Royal	24 × 19	456	28-44
Super-royal	27 × 19¼	519¾	52-54
Double post	30½ × 19	579½	20-60
„ demy	31 × 20	620	40-50
Elephant	28 × 23	644	40-60
Imperial	30 × 22	660	70-72
Double large post	33 × 21	693	20-60
Atlas	34 × 26	884	85-100
Double royal	38 × 24	912	54-88
„ elephant	40 × 27	1,080	130-140
„ imperial	44 × 30	1,320	140

[1] Including coloured paper and papers detailed in next page.

Extremes of Weights and Prices, Writings, Etc.

Description of Paper.	Equivalent Weight in Demy, 480 sheets.	Price per lb.
Hand-made—	Lb.	
Bank	12	1s. 8d. to 2s. 10d.
Ledger	32-44	10d. ,, 1s. 9d.
Loan	12-25	1s. ,, 2s.
Writing	20-26	10d. ,, 1s. 9d.
Machine-made—		
Banks—tub-sized	5-14	5d. ,, 1s. 8d.
,, engine-sized	5-14	2½d. ,, 10d.
Blottings	28-140	3d. ,, 8d.
,, interleaving	10-19	2½d. ,, 6d.
Bonds—tub-sized	12-25	5d. ,, 1s. 3d.
,, engine-sized	12-25	3d. ,, 9d.
Copying	3-18	4d. ,, 1s. 5d.
Duplicating	14-18	2¼d. ,, 3¼d.
Ledger—tub-sized	32-44	4d. ,, 10½d.
,, engine-sized	32-44	2½d. ,, 5d.
Typewriting	5-14	3d. ,, 1s. 8d.
Writings—tub-sized	12-42	4d. ,, 1s. 1d.
,, engine-sized	12-42	2⅛d. ,, 3¾d.
Drawings		
Hand-made	25-75	1s. to 2s.
Machine-made—tub-sized	25-40	4d. ,, 10d.
,, engine-sized	25-40	2¾d. ,, 7d.
Cartridges		
Tub-sized	24-60	3½d. to 10½d.
Engine-sized	24-60	2¼d. ,, 3¾d.

Sizes of Cards

Showing how to Cut Out of Royal Board

Name.	Size in Inches.	Number out of Royal Board, 25 in. × 20 in.	Method of cutting out.	
			25 in. way.	20 in. way.
Half small	$2\frac{3}{8} \times 1\frac{13}{16}$	104	13	8
Third large	$3 \times 1\frac{1}{2}$	96	8	12
Extra third	$3 \times 1\frac{3}{4}$	88	8	11
Town	3×2	72	8	9
Half large	$3 \times 2\frac{1}{4}$	64	8	8
Reduced small	$3\frac{1}{2} \times 2\frac{1}{8}$	55	11	5
Small	$3\frac{5}{8} \times 2\frac{3}{8}$	50	10	5
Carte-de-visite	$4\frac{1}{8} \times 2\frac{1}{2}$	36	9	4
Large	$4\frac{1}{2} \times 3$	32	8	4
Double small	$4\frac{3}{4} \times 3\frac{5}{8}$	25	5	5
Correspondence and square post-card	$4\frac{1}{2} \times 3\frac{1}{2}$	25	5	5
Post-card (official size)	$5\frac{1}{2} \times 3\frac{1}{2}$	20	4	5
Large court 8vo	$4\frac{7}{8} \times 4$	24	6	4
Intimation	$6 \times 3\frac{5}{8}$	20	4	5
Double large	$6 \times 4\frac{1}{2}$	16	4	4
Cabinet	$6\frac{1}{2} \times 4\frac{1}{4}$	15	5	3
Quad small	$7\frac{1}{4} \times 4\frac{3}{4}$	12	3	4
Quad large	9×6	8	4	2

Index Cards

Showing Method of Cutting Out of Index Boards, $25\frac{1}{2}$ *in.* × $20\frac{1}{2}$ *in. and* $30\frac{1}{2}$ *in.* × $25\frac{1}{2}$ *in.*

Size of Index Card in Inches.	Number out of Board, $25\frac{1}{2}$ in. × $20\frac{1}{2}$ in.	Method of cutting out.		Number out of Board, $30\frac{1}{2}$ in. × $25\frac{1}{2}$ in.	Method of cutting out.	
		$25\frac{1}{2}$ in. way.	$20\frac{1}{2}$ in. way.		$30\frac{1}{2}$ in. way.	$25\frac{1}{2}$ in. way.
5 × 3	32	8	4	50	10	5
6 × 4	20	4	5	30	5	6
8 × 5	12	3	4	18	6	3

Extreme Prices of Boards

Royal, 20 in. × 25 in., except where other sizes are stated

Description of Boards.	Substances.	Prices per Gross.
Antique and programme	...	5s. to 23s.
Art, coated both sides	4 to 5 sheet	7s. 6d. ,, 22s.
Art, coated one side	5 ,, 10 ,,	11s. ,, 26s.
Bristol (royal, 22½ in. × 18 in.)	2 ,, 6 ,,	3s. ,, 10s.
Chromo, coated one side	3 ,, 12 ,,	9s. ,, 30s.
Cloth-lined and cloth-centred	...	17s. 6d. ,, 26s.
Ivory - - -	Various thicknesses	8s. 6d. ,, 30s.
Pasteboards - -	4 to 12 sheet	6s. 6d. ,, 30s.
Post-card, white -	...	5s. 6d. ,, 10s.
,, art -	...	7s. 3d. ,, 13s.
,, ,, 28½ in. × 22½ in.	...	9s. 3d. ,, 17s.
Pulp - - -	2 to 7 sheet	4s. 9d. ,, 15s.
Tinted and duplex	4 sheet	6s. 6d. ,, 10s.
Ticket, white one side	6 to 14 sheet	8s. ,, 16s. 6d.
Ticket, white both sides	,, ,,	9s. ,, 17s. 6d.
Ticket, tinted one side	,, ,,	9s. 6d. ,, 19s.
Window ticket -	12 ,, 16 ,,	18s. 6d. ,, 30s.
Index boards, 20½ in. × 25½ in.	20 to 52 lb. per gross	6s. 6d. ,, 30s. 6d.
Index boards, 25½ in. × 30½ in.	32 ,, 52 ,, ,,	10s. 6d. ,, 30s. 6d.

Browns and Wrappings

Name of Paper.	Size in Inches.	Area in Square Inches.	Weights Equivalent to Demy 10 lb., 480 sheets.
Small hand	20 × 15	300	$7\frac{1}{2}$
Lumberhand	$22\frac{1}{2} \times 17\frac{1}{2}$	$363\frac{3}{4}$	10
Kent cap	21 × 18	378	$9\frac{1}{2}$
Small cap	25 × 17	425	11
Bag cap	24 × $19\frac{1}{2}$	468	12
Havon cap	26 × 21	546	14
Double small hand	29 × 20	580	15
,, crown	30 × 20	600	15
Imperial	29 × $22\frac{1}{2}$	$652\frac{1}{2}$	17
Elephant	32 × 24	768	19
Double small cap	34 × 25	850	22
,, bag cap	39 × 24	944	24
Quad small hand	40 × 30	1,200	31
Double imperial	45 × 29	1,305	33
,, elephant	46 × 31	1,426	37
Casing	46 × 36	1,656	42

Extremes of Weights and Prices

Name of Paper.	Equivalent Weights in Demy, 480 sheets.	Prices per Cwt.	Usual Sizes.
Browns	18-48	7s. 6d. to 21s.	Various
Drapers' caps	6-10	11s. 6d. ,, 26s.	Double crown
Krafts	11-42	12s. to 19s.	...
M.G. caps	7-18	15s. ,, 21s.	Double crown and quad crown
Sealings, M.G., unglazed, and coloured	12-24	16s. ,, 25s.	Various
Rope browns	18-54	11s. ,, 21s.	Various

MILLBOARDS

Thicknesses and Sizes

Description.	Thickness.	6	7	8	8x	8xx	10
	No. of Dozens in Bundles.	6	6	6	5	4	3
	Size.	Approximate Weight of Bundles in Lbs.					
Pott - - - - P	17¼ × 14¼	28	38	48	54	58	56
Foolscap - - - FC	18½ × 14½	31	42	52	59	64	61
Crown - - - C	20 × 16¼	37	52	63	72	77	75
Small half royal SHR	20¼ × 13	30	41	52	58	62	60
Large ,, ,, LHR	21 × 14	33	45	58	64	70	67
Short - - - S	21 × 17	40	55	69	78	84	82
	No. of Dozens in Bundles.	6	6	5	4	3	2
Small half imperial - SHI	22¼ × 15	38	52	54	63	60	51
Half imperial - - HI	23½ × 16½	44	60	63	70	69	59
Middle or small demy M	22½ × 18½	48	64	68	74	74	62
Large middle or large demy LM	23¾ × 18½	50	68	72	78	78	67
Large or medium - L	24 × 19	52	70	74	80	81	70
Small whole royal - SR	25½ × 19½	57	80	81	88	88	76
	No. of Dozens in Bundles.	6	6	4	3	2	2
Large whole royal - LR	26¾ × 20¾	63	87	75	73	66	84
Extra royal - - ER	28½ × 21½	69	95	80	81	72	93
	No. of Dozens in Bundles.	6	4	3	2	2	2
Whole imperial - - I	32 × 22½	82	74	72	63	85	110

Only those sizes in general use are given.

Equivalent Weights of Papers of Various Sizes based on the Weight of Demy, $22\frac{1}{2}$ in. × $17\frac{1}{2}$ in.

Area in Square Inches.	Size of Paper.	Size in Inches.	½	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	22	24
187½	Pott	15 × 12½	.24	.48	.95	1.43	1.90	2.38	2.86	3.33	3.80	4.28	4.76	5.71	6.66	7.61	8.57	9.51	10.47	11.42
218⅝	*Foolscap, writing*	16½ × 13¼	.28	.56	1.11	1.66	2.22	2.78	3.33	3.88	4.44	5.00	5.55	6.66	7.77	8.88	9.99	11.10	12.21	13.32
229½	Foolscap, printing	17 × 13½	.29	.58	1.17	1.75	2.33	2.91	3.50	4.08	4.66	5.25	5.83	6.99	8.15	9.32	10.49	11.65	12.82	13.98
272⅞	Pinched post	18½ × 14¾	.35	.69	1.39	2.08	2.77	3.47	4.16	4.85	5.54	6.24	6.93	8.31	9.70	11.08	12.47	13.86	15.24	16.63
289⅜	*Post, writing*	19 × 15¼	.37	.74	1.47	2.21	2.94	3.68	4.42	5.15	5.89	6.62	7.36	8.83	10.30	11.77	13.24	14.71	16.18	17.66
298¾	Post, printing	19¼ × 15½	.38	.76	1.52	2.27	3.03	3.79	4.55	5.31	6.06	6.82	7.58	9.09	10.60	12.12	13.63	15.15	16.66	18.18
300	Crown	20 × 15	.38	.76	1.52	2.28	3.05	3.81	4.57	5.33	6.10	6.86	7.62	9.14	10.67	12.19	13.71	15.24	16.76	18.28
310	*Demy, writing*	20 × 15½	.39	.78	1.55	2.33	3.11	3.89	4.66	5.44	6.22	6.99	7.77	9.32	10.88	12.43	13.99	15.54	17.10	18.65
324⅝	Foolscap, sheet-and-a-half	24½ × 13¼	.41	.82	1.65	2.47	3.30	4.12	4.95	5.77	6.60	7.42	8.24	9.89	11.54	13.19	14.83	16.48	18.13	19.78
330	Copy	20 × 16½	.42	.84	1.68	2.51	3.35	4.19	5.03	5.87	6.70	7.54	8.38	10.05	11.73	13.40	15.08	16.76	18.43	20.11
346½	Large post	21 × 16½	.44	.88	1.76	1.64	3.52	4.40	5.28	6.16	7.04	7.92	8.80	10.56	12.32	14.08	15.84	17.60	19.36	21.12
375	Double pott	25 × 15	.48	.95	1.90	2.86	3.81	4.76	5.71	6.66	7.62	8.57	9.52	11.42	13.33	15.23	17.14	19.04	20.95	22.85
385	*Medium, writing*	22 × 17½	.49	.98	1.96	2.93	3.91	4.89	5.87	6.85	7.82	8.80	9.78	11.73	13.68	15.64	17.59	19.55	21.51	23.46
393¾	Demy, printing	22½ × 17½	.50	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	12.00	14.00	16.00	18.00	20.00	22.00	24.00
414	Medium, printing	23 × 18	.53	1.05	2.10	3.15	4.20	5.26	6.31	7.36	8.41	9.46	10.51	12.61	14.71	16.82	18.92	21.02	23.13	25.23
437¼	*Double foolscap, writing*	26½ × 16½	.56	1.11	2.22	3.31	4.44	5.55	6.66	7.77	8.88	9.99	11.10	13.32	15.54	17.76	19.98	22.20	24.43	26.65
456	*Royal, writing*	24 × 19	.58	1.16	2.32	3.47	4.63	5.79	6.95	8.11	9.26	10.42	11.58	13.89	16.21	18.52	20.84	23.16	25.47	27.79
459	Double foolscap, printing	27 × 17	.58	1.17	2.33	3.50	4.66	5.83	6.99	8.16	9.33	10.49	11.66	13.98	16.31	18.65	20.98	23.31	25.64	27.97
500	Royal, printing	25 × 20	.63	1.27	2.54	3.81	5.08	6.35	7.62	8.89	10.16	11.43	12.70	15.23	17.77	20.31	22.85	25.39	27.93	30.47
519¾	*Super-royal, writing*	27 × 19¼	.66	1.32	2.64	3.96	5.28	6.60	7.92	9.24	10.56	11.88	13.20	15.84	18.48	21.12	23.76	26.40	29.04	31.68

Equivalent Weights of Papers of Various Sizes based on the Weight of Demy, 22½ in. × 17½ in.

Area in Square Inches.	Size of Paper.	Size in Inches.	½	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	22	24
563¾	Super-royal, printing	27½ × 20½	.72	1.43	2.86	4.30	5.32	7.16	8.59	10.02	11.46	12.89	14.32	17.18	20.05	22.91	25.78	28.64	31.50	34.37
579½	*Double post, wtg.*	30½ × 19	.74	1.47	2.94	4.42	5.89	7.36	8.83	10.30	11.77	13.25	14.72	17.66	20.60	23.54	26.49	29.43	32.37	35.32
600	Double crown	30 × 20	.76	1.52	3.05	4.57	6.10	7.62	9.14	10.69	12.19	13.72	15.24	18.28	21.33	24.38	27.42	30.47	33.52	36.57
606⅜	Double post, printing	31½ × 19¼	.77	1.54	3.08	4.62	6.16	7.70	9.24	10.78	12.32	13.86	15.40	18.48	21.56	24.64	27.72	30.80	33.88	36.96
620	*Double demy, writing*	31 × 20	.79	1.57	3.15	4.72	6.30	7.87	9.44	11.02	12.59	14.17	15.74	18.89	22.04	25.18	28.34	31.48	34.64	37.78
644	Elephant	28 × 23	.82	1.64	3.27	4.91	6.54	8.18	9.81	11.45	13.08	14.72	16.36	19.62	22.89	26.16	29.43	32.71	35.98	39.25
660	Imperial	30 × 22	.84	1.68	3.35	5.03	6.70	8.38	10.06	11.73	13.41	15.08	16.76	20.11	23.46	26.81	30.17	33.52	36.87	40.22
693	Double large post	33 × 21	.88	1.76	3.52	5.28	7.04	8.80	10.56	12.32	14.08	15.84	17.60	21.12	24.64	28.16	31.68	35.20	38.72	42.24
750	Quad pott	30 × 25	.95	1.90	3.81	5.71	7.62	9.52	11.42	13.33	15.23	17.14	19.04	22.85	26.66	30.46	34.28	38.09	41.90	45.70
787½	Double demy	35 × 22½	1.00	2.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00	24.00	28.00	32.00	36.00	40.00	44.00	48.00
828	,, medium, printing	36 × 23	1.05	2.10	4.20	6.31	8.41	10.51	12.62	14.72	16.82	18.93	21.03	25.23	29.43	33.64	37.85	42.05	46.26	50.46
884	Atlas	34 × 26	1.12	2.25	4.49	6.74	8.98	11.23	13.47	15.72	17.96	20.21	22.45	26.94	31.43	35.92	40.41	44.90	49.39	53.88
912	*Double royal, writing*	38 × 24	1.16	2.32	4.63	6.95	9.26	11.58	13.89	16.21	18.52	20.84	23.16	27.79	32.42	37.04	41.68	46.32	50.94	55.58
1,000	Double royal, printing	40 × 25	1.27	2.54	5.08	7.62	10.16	12.70	15.24	17.78	20.32	22.86	25.40	30.47	35.55	40.63	45.71	50.79	55.87	60.95
1,064	Double globe	38 × 28	1.35	2.70	5.40	8.11	10.81	13.51	16.21	18.91	21.62	24.32	27.02	32.42	37.83	43.23	48.64	54.04	59.44	64.84
1,080	,, elephant	40 × 27	1.37	2.74	5.49	8.23	10.97	13.71	16.46	19.20	21.94	24.69	27.43	32.91	38.39	43.88	49.37	54.85	60.34	65.82
1,200	Quad crown	40 × 30	1.52	3.05	6.10	9.14	12.19	15.24	18.28	21.33	24.38	27.42	30.47	36.57	42.66	48.76	54.84	60.95	67.04	73.14
1,320	Double imperial	44 × 30	1.68	3.35	6.70	10.06	13.41	16.76	20.11	23.46	26.82	30.17	33.52	40.22	46.93	53.63	60.34	67.04	73.75	80.45
1,575	Quad demy	45 × 35	2.00	4.00	8.00	12.00	16.00	20.00	24.00	28.00	32.00	36.00	40.00	48.00	56.00	64.00	72.00	80.00	88.00	96.00
2,000	,, royal	50 × 40	2.54	5.08	10.16	15 24	20.32	25.40	30.48	35.56	40.64	45.72	50.80	61.94	71.10	81.26	91.42	101.60	111.74	121.90
2,128	,, globe	56 × 38	2.70	5.40	10.81	16.21	21.62	27.02	32.42	37.83	43.23	48.64	54.04	64.84	75.66	86.46	97.28	108.08	111.88	129.68

To obtain equivalent weights of heavier papers, take the column which is a multiple of the weight, and multiply, *e.g.*, 72 lb. demy, equivalent in atlas required; 24 lb. demy = 53.88; 72 = 53.88 × 3 = 161.64 = 162 lb. Or take the unit column from table, multiply and add, *e.g.*, demy 65 lb., equivalent weight required in super-royal printing; 6 lb. demy = 8.59 super-royal. ∴ 60 lb. = 85.9; 5 lb. = 7.16 = 93.06 = 93 lb. super-royal. The table may, of course, be used to obtain all equivalents, such as imperial, 40 lb.; required weight of demy = 24 lb. demy. The nearest whole number should be taken, except when ordering regular stock weights.

PROBLEMS IN COST, WEIGHT, AND QUANTITIES OF PAPER

To find the Cost of Paper.—The methods of calculation of cost will depend upon the number of sheets to the ream. If packed in 480's, and the quantity is stated in reams, quires, and sheets, the cost is obtained very easily. Paper at £1 per ream is 1s. per quire, ½d. per sheet. Take 110 reams, 17 quires, 12 sheets, at 7s. 6d. per ream. At £1 per ream this equals £110. 17s. 6d., and at 7s. 6d. this comes to $\frac{3}{8}$ of that sum = £41. 6s. 7d.; or reckoned at $110\frac{7}{8}$ reams at 7s. 6d., the same figures are obtained. When reams containing a larger number of sheets are concerned, the calculation is made on the number of reams plus the fraction of the ream.

Prices and Weights of Boards.—To obtain the price per 480 when the price per gross is given, multiply the figure by $\frac{10}{3}$. Per 500 is taken as $3\frac{1}{2}$ times the price per gross. When the price is given per 480, the price per gross is $\frac{3}{10}$ of that amount. If the price is given as per 500, the gross will cost $\frac{2}{7}$ of that amount. Weights are calculated on the same basis.

To Calculate the Weight of a Paper from the Size and Weight of another Paper.—A table of equivalent weights papers of regular sizes based on demy of certain weights is given on pages 144-45. To find the weight of other sizes, multiply the weight of the ream in pounds by the area of the new size in inches, and divide by the area of the size, the weight of which is known.

Example. — The weight of large post is required equivalent to double foolscap 30 lb.

$$\frac{30 \times 21 \times 16\frac{1}{2}}{17 \times 27} = 22\frac{11}{17} = 23 \text{ lb. large post.}$$

If the table of equivalent weights be examined, it will be seen that the area of large post is $346\frac{1}{2}$ square inches, and

that of double foolscap 459 square inches. For approximate purposes these may be taken as 350 and 460, and this shows large post to be practically three-quarters of the area of double foolscap. Other instances may be cited: demy $393\frac{3}{4}$ square inches, if taken as 400, renders royal as one-fourth extra, and double crown one-half above the demy weights. These figures are useful for quick calculation, but the first method is more exact and should be generally adopted.

To find the Number of Sheets which a Reel of Paper will Produce.—Weigh the reel and deduct the weight of the core or centre. Cut a piece the full size of the sheet, but if a trim is allowed, the sheet cut should be untrimmed size. Weigh the sheet on the sheet scale, read the weight in 500's, and divide the weight given into the net weight of the reel, and multiply the result by 500, this giving the number of sheets which will be produced.

Example.—Reel is 50 inches wide, weighs 740 lb.; the centre is 10 lb. in weight; to be cut to sheet 25 by 20 inches Sheet 25 by 20 inches = 25 lb. per 500.

$$740 - 10 = 730 \text{ lb.} \div 25 = \frac{730}{25} \times 500 = 14{,}600 \text{ sheets.}$$

Alternatively a square may be cut by the demy template, weighed on the demy scale, the weight of the sheet equivalent to the demy weight calculated or obtained from table, and the number of sheets obtained as in above example.

Example.—Reel is 48 inches wide, weighs 640 lb. with 4 lb. centre; to be cut to 24 by 36 inches; demy = 21 lb. per 500 sheets.

$$640 - 4 = \frac{636 \times 500 \times 17\frac{1}{2} \times 22\frac{1}{2}}{24 \times 36 \times 21} = 6{,}901 \text{ sheets.}$$

To find the Number of Copies of a Book that may be Obtained from a Given Quantity of Paper.—A publisher sends in twenty-seven perfect reams of quad crown for a crown octavo work of 216 pages. How many copies will be produced? A sheet of crown octavo = 16 pages, therefore quad crown = 64 pages.

$$27 \times 500 \div \frac{216}{64} = \frac{27 \times 500 \times 64}{216} = 4{,}000 \text{ copies.}$$

To find the Quantity of Paper required for an Edition of a Book of a Given Size.—An edition of a book of 400 pages demy octavo, 6,500 pages, is required. What quantity of double demy should be issued in perfect reams? A sheet of double demy will contain 32 pages; a ream will produce 500 copies.

$$\text{Therefore, } \frac{6{,}500 \times 400}{32 \times 500} = 162\tfrac{1}{2} \text{ reams.}$$

Or, $400 \div 32 = 12\tfrac{1}{2}$ sheets per copy; $6{,}500 = 13$ reams;
$13 \times 12\tfrac{1}{2} = 162\tfrac{1}{2}$ reams.

To Calculate the Weight of a Ream Containing a Larger or Smaller Number of Sheets.—Multiply the weight by the factor given below, or else add or subtract the fraction representing the difference in the number of sheets.

TABLE OF FACTORS

TABLE OF FACTORS.					TABLE OF FRACTIONS.[1]			
To convert to	480	500	504	516	480	500	504	516
480	...	1.042	1.05	1.075	...	$+\frac{1}{24}$	$+\frac{1}{210}$	$+\frac{3}{410}$
500	.96	...	1.01	1.032	$-\frac{1}{25}$	...	$+\frac{1}{125}$	$+\frac{4}{125}$
504	.95	.992	...	1.022	$-\frac{1}{21}$	$-\frac{1}{126}$	...	$+\frac{1}{42}$
516	.93	.969	.977	...	$-\frac{3}{43}$	$-\frac{4}{129}$	$-\frac{1}{43}$	...

[1] Add or subtract the fraction of the weight of the ream as shown.

PAPER TRADE CUSTOMS

THE following are the recognised customs of the trade relative to papermaking, provided that no agreement to the contrary has been made at the time of the order between the vendor and the purchaser.

SALE

Paper is sold either at a price per ream, based upon its nominal weight, or at the actual weight by the pound, packed in reams or in reels. Wrapping paper is sold at scale weight.

MACHINE-MADE PAPERS

1. A ream of paper, unless otherwise specified, contains 480 sheets.

2. A "perfect" ream for printing papers contains 516 sheets.

3. A ream of envelope paper contains 504 sheets.

4. A ream of news contains 500 sheets.

5. An "insides" ream contains 480 sheets all "insides," *i.e.*, 20 good or inside quires of 24 sheets.

6. A "mill" ream contains 480 sheets, and consists of 18 "good" or "inside" quires of 24 sheets each, and 2 "outsides" quires of 24 sheets each.

7. Reams are classed as "good," "retree," and "outsides." The price of "retree" is 10 per cent., and of "outsides" 20 per cent. lower than that of "good."

HAND-MADE PAPERS

8. A "mill" ream, "good" or "retree," contains 472 sheets, and consists of 18 "insides" quires of 24 sheets each, and two "outsides" quires of 20 sheets each.

9. An "insides" ream, "good" or "retree," contains 480 sheets, and consists of 20 "insides" quires of 24 sheets each.

In all cases the "outsides" quires are placed one at the top and one at the bottom of the ream.

VARIATIONS IN WEIGHT[1]

1. In printings, writings, etc., the average variation in substance of any ream must not exceed 4 per cent., either above or below the ordered substance.

In greys, caps, manillas, browns, coloured printings, etc.,

[1] Not applicable to hand-made paper.

the average variation in substance of any ream must not exceed 5 per cent. either above or below the ordered substance.

2. In news, printings, writings, etc., the average variation in substance of any reel must not exceed 5 per cent. above or below the ordered substance.

In the case of paper on reels, claims for short length can only be made when the shortage exceeds 5 per cent., and then only for the amount of any excess over and above such 5 per cent., unless special arrangements to the contrary are made.

In greys, caps, manillas, browns, coloured printings, etc., the average variation in substance of any reel must not exceed 6 per cent. above or below the ordered substance.

3. But for all papers of substance under 6 lb. demy ($17\frac{1}{2}$ by $22\frac{1}{2}$ inches), and above 50 lb. demy, the actual weight may vary 8 per cent. either over or under.

4. Payment for paper in reels, according to the printed or manufactured results, cannot be claimed by the purchaser.

VARIATIONS IN MEASUREMENTS[1]

1. The variation in measurement of paper in reams must not exceed $\frac{1}{2}$ per cent., either above or below the ordered measurement, but in no case shall the margin of variation exceed $\frac{1}{4}$ inch or be less than $\frac{1}{8}$ inch.

2. The width of paper in reels must not vary more than $\frac{1}{2}$ per cent.

SPECIAL MAKINGS

1. For makings of special weight, size, tint, watermark, etc., not having a regular sale in the market, the buyer is to take at full price any excess not exceeding 10 per cent. above the quantity ordered, including a reasonable proportion of "retree."

2. Where a maximum quantity is stipulated for when ordering, the order is considered duly executed if it amounts to not less than 90 per cent. of the stipulated quantity.

MATERIALS

1. Unless otherwise expressly stipulated in the order, the maker is free as to what material he shall use.

WRAPPING UP

The weight of necessary wrappers and string for reams and reels is to be included in the chargeable weight of the paper.

[1] Not applicable to hand-made paper.

MODE OF PAYMENT

The customary terms of payment are:—A monthly account to run from the 20th of one month to the 19th of the next, payable during the succeeding month; thus goods invoiced from the 20th January to the 19th February shall be payable during March.

RETURNED EMPTIES

Carriage on returned empty frames, centres, boards, boxes, packing-cases, etc., is payable by the customer returning the same, unless special arrangements to the contrary are made.

EXCESS CARRIAGE

The excess carriage charged by the railway companies on smalls shall be paid by the purchaser.

MARKING REAMS

The actual weight ordered shall be marked on each ream at the mill.

LIMIT OF TIME

The limit of time for a mill to hold stock to order of the purchaser shall be six months from the date when the paper is advised as ready for delivery, such date not being earlier than that specified on the order, after which it shall be invoiced, and shall therefrom become the property of the purchaser, and remain at his sole risk and expense, and shall be paid for within thirty days of invoice.

DANDIES AND MOULDS

In all cases the purchaser shall pay for the dandy or moulds forthwith, but the maker shall allow an extra 2½ per cent. off the invoice for each delivery of paper made from such dandy until the cost of same is extinguished, after which it shall become the property of the maker. If after an interval of three years no further order has been received, the maker shall be at liberty to take out the watermark and make use of the frame as his property after giving thirty days' notice, provided nevertheless that the purchaser shall have the right of retaining the dandy or moulds by refunding one-half of the extra discount of 2½ per cent. allowed in respect of the cost.

CITY AND GUILDS OF LONDON INSTITUTE EXAMINATIONS

TYPOGRAPHY AND LITHOGRAPHY

Extracts from Syllabus as regards Paper

TYPOGRAPHY

Press and Machine.—Grade I

Sizes, and subdivisions of papers and cards; number of sheets in quires and reams; easy questions on the various grades of paper.

Composing.—Grade II

Hand- and machine-made; qualities and weights, equivalent weights; sizes and subdivisions of printings, writings, and account book papers; sizes and subdivisions of cards.

Press and Machine.—Grade II

Various sizes, weights, and subdivisions; differences between machine- and hand-made; coated and super-calendered; effect of heat and damp upon; avoidance of waste from dirt and careless handling.

Final

Papers and Boards.—The manufacture of paper. The paper-making machine; fibre-yielding material; warehouse tests for the various celluloses; soft-, half-, tub-, and engine-sizing; china clay, its uses and how to determine proportion.

Various classes of paper (hand-made, mould-made, and machine-made). Printings, coated papers, writings, banks and loans, plate, drawings, account books, cover papers, blottings, vegetable parchments, imitation parchments, manillas, "safety" cheque papers, wrapping papers, gummed papers.

Judging Papers.—How to judge the quality of various classes of papers and their suitability for the purposes to which they

are to be put. Bulk, handling, and "look-through," strength, tear (straight and across), length of fibre. British and foreign makes and how to detect. The right and wrong sides.

Defects in Paper.—Cockling, and creasing, stretching, lifting, fluffing, the mill edge, spots, air-bubbles, foreign substances, electricity in paper.

Technical terms used by papermakers and merchants.—Insides, outsides, retree, job, mill job, overmake, etc.

Sizes and Weights of Paper.—Standard sizes of the various classes. Standard weights. Equivalent weights of standard and odd sizes, and of reams consisting of 480, 504, or 516 sheets. Reams to the reel.

Watermarks and mill numbers.

Stocking of Paper.—What classes to select for stocking. Racks, for stock. The care of stock, samples, oddments, and useful offcuts. Tying up and marking reams. The effect of light, temperature, chemical fumes, damp and dust on the various classes of paper. Stock-keeping systems and books.

Boards.—Bristol, paste, pulp, wood-pulp, art and tinted, millboards and strawboards. Standard sizes; subdivisions and standard thicknesses. Boards to the cwt.

Market prices and terms for stock papers and makings.

LITHOGRAPHY

Grade I

Machine-made uncoated printing papers: their nature and qualities; dimensions of the more common printing papers, tinted and white, wove and laid, sized and unsized.

Grade II

Hand- and machine-made; tinted; enamels (single and duplex coated); plain and glazed cards, their nature, qualities, and sizes. Paper creasing and its remedies.

Final

Tests for printing properties; papers suitable for particular classes of work.

BOOKS AND PERIODICALS

"C.B.S. Standard Units and Standard Paper Tests," Cross, Bevan, Beadle, and Sindall. E. & F. N. Spon, Ltd. 2s. 6d. net.

"Chapters on Paper Making," Vols. I.-V., Beadle. Crosby Lockwood & Son. 5s. net each volume.

"Dyeing of Paper Pulp," Erfurt. Scott, Greenwood, & Son. 15s. net.

"Manufacture of Paper," Sindall. Constable & Co., Ltd. 6s. net.

"Outlines of Stationery Testing," Bromley. C. Griffin & Co., Ltd. 2s. 6d. net.

"Paper Makers' Pocket Book," Beveridge. J. Gibson. 12s. 6d.

"Paper Making," Clapperton. Crosby Lockwood & Son. 5s. net.

"Paper Making," Watt. Crosby Lockwood & Son. 7s. 6d.

"Paper Mill Chemist," Stevens. Scott, Greenwood, & Son. 7s. 6d. net.

"Paper Technology," Sindall. C. Griffin & Co., Ltd. 12s. 6d. net.

"Text-Book of Paper Making," Cross, Bevan, and Briggs. E. & F. N. Spon, Ltd. 12s. 6d. net.

"Treatise on Paper Making," Hofmann. Sampson Low, Marston, & Co., Ltd. 6 parts, 5s. net each.

"Treatment of Paper for Special Purposes," Andés. Scott, Greenwood, & Son. 6s. net.

"What a Stationer ought to know about Paper," Maddox. J. Whitaker & Sons, Ltd. 1s. net.

"Wood Pulp," Cross, Bevan, and Sindall. Constable & Co., Ltd. 6s. net.

British Empire Paper, Stationery and Printing Trades Journal. Monthly, 6d.

Paper Maker and British Paper Trades Journal. Monthly, 1s.

Paper Makers' Monthly Journal. Monthly, 6d.

Paper Trades Review. Weekly, 6d.

Paper Making. Monthly, 6d.

INDEX

NOTE.—*The Alphabetical List of Papers, pages* 113-34, *is not included in the Index.*

No.	Description.	Size in Inches.	Weight.	Sheets to Ream.	Price per Lb.	Approximate Furnish.	Watermarks, I
			Lb.		s. d.		
	Section 1.—Supplied by Messrs J. Spicer & Sons, Ltd.						
1	Hand-made, cr. ld.	19 × 15½	30	480	1 2	All rag - - - - -	Eltham Cou
2	Mould-made, cr. ld.	18½ × 14¾	30	480	0 10	,, - - - - -	...
3	Cream wove, tub-sized	18 × 23	28	480	1 0	,, - - - - -	Majesta Su Strong, 50
4	Blue laid, tub-sized	18 × 23	34	480	0 7½	Rag, 90 °/₀; chem. wood, 10 °/₀	Indiana Mil
5	Cream laid, e.s. -	18 × 23	25	480	0 3	Esp , 90 °/₀; chem. wood, 10°/₀	The Effra.
6	Blue wove, e.s. -	18 × 23	21	480	0 4	,, 80 °/₀; ,, 20 °/₀	...
	Section 1A.—Supplied by Messrs Grosvenor, Chater, & Co., Ltd.						
7	Typewriting manifold bank - -	21 × 16½	7	480	1 0	Rag, 80 °/₀; chem. wood, 20 °/₀	British Oak Bond.
8	Cream wove bank -	21 × 16½	11	500	0 5½	,, 60 °/₀; ,, 40 °/₀	68 Quality.
9	Loan - - -	18 × 23	20	500	0 10	,, 85 °/₀; ,, 15 °/₀	No. 537.
10	Drawing, hand-made	30 × 22	72	472	1 4½	All rag - - - - -	Whatman H. (mill ream)
11	Drawing, machine-made	30 × 22	70	480	0 2¾	Chemical wood - - -	No. 818.
12	Cartridge - -	30 × 22	70	480	0 3¾	Rag, 30 °/₀; chem. wood, 70°/₀	No. 642.
13	Duplicating - -	21 × 16½	21	480	0 2½	Esp., 80 °/₀; chem. wood, 20°/₀	193 Mill.
	Section 2.—Supplied by Messrs Spalding & Hodge, Ltd.						
14	Hand-made printing	17½ × 22½	36	516	1 0	All rag - - - - -	Aldwych, H.
15	Machine finish printing	17½ × 22½	20	504	0 2⅜	Esp., 30°/₀; chem. wood, 70°/₀	" 147."
16	Sup.-cal. printing -	17½ × 22½	30	480	0 2¼	Chemical wood - - -	Lyceum.
17	News printing -	17½ × 22½	20	500	0 1⅜	Chem. wood, 25 °/₀; mech. wood, 75 °/₀	...
18	Litho. - - -	17½ × 22½	24	516	0 2½	Esp., 95 °/₀; chem. wood, 5°/₀	Esp. No. 2 lit
19	Plate paper - -	17½ × 22½	40	516	0 6	Esparto - - - -	Fine Plate.
20	Bible ,, - -	17½ × 22½	11	500	0 2⅜	Chemical wood - - -	Aldwych Bib
21	Antique laid book	17½ × 22½	25	516	0 2⅜	Esp., 60°/₀; chem. wood, 40°/₀	Univ. Ant. la
22	,, wove ,,	17½ × 22½	30	516	0 2⅜	,, 60°/₀; ,, 40°/₀	Univ. Ant. w
	Section 2A.—Supplied by Messrs J. Dickinson & Co., Ltd.						
23	Chromo, one-sided	17½ × 22½	—	480	—	Esparto - - - -	12s. 6d. per r
24	Art, two-sided -	17½ × 22½	40	516	0 3½	Chem. wood, 40 °/₀; esp., 60°/₀	...
25	Imitation art -	17½ × 22½	36	516	0 2⅜	,, 20 °/₀; ,, 80°/₀	...
26	Featherweight, wove	17½ × 22½	20	516	0 2½	,, 10 °/₀; ,, 90°/₀	...
27	,, laid	17½ × 22½	20	516	0 2½	,, 10 °/₀; ,, 90°/₀	...
28	M. G. poster - -	17½ × 22½	20	516	0 2⅛	Chemical wood - - -	...
	Section 3.—Supplied by Messrs Lepard & Smiths, Ltd.						
29	White tissue - -	20 × 30	7	480	0 5	Chem. wood, 70 °/₀; straw, 30 °/₀	" 555."
30	Cream wove, copying	18 × 23	6	504	0 10	Rag (trace of chem. wood) -	" T.Y."
31	White blotting -	17½ × 22½	38	480	0 4¾	All rag - - - - -	Crown.
	Section 3A.—Supplied by Messrs Spalding & Hodge, Ltd.						
32	Drying royal - -	20 × 25	44	480	0 4½	Rag, 80 °/₀; chem. wood, 20°/₀	...
	Section 3B.—Supplied by Messrs J. Spicer & Sons, Ltd.						
33	Vegetable parchment	20 × 30	32	480	0 4½	All rag - - - - -	...
34	Imitation parchment	20 × 30	18	480	0 3	Chemical wood - - -	...

No. 1.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Cream laid, hand-made	19 × 15¼	30	480	**All rag.**

Eltham Court. Messrs J. Spicer & Sons, Ltd.

Section 3[illegible]

Drying royal - -	20

Section 3B.—

Vegetable parchment	20
Imitation parchment	20

No. 2.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Cream laid, mould-made	$18\frac{1}{2} \times 14\frac{3}{4}$	30	480	All rag.

Messrs J. SPICER & SONS, LTD.

No. 3.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Cream wove, tub-sized	18 × 23	28	480	**All rag.**

Majesta Super Strong, 5050. Messrs J. Spicer & Sons, Ltd.

No. 4.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Blue laid, tub-sized	18 × 23	34	480	Rag, 90 °/₀; chemical wood, 10 °/₀.

Indiana Mill. Messrs J. SPICER & SONS, LTD.

No. 5.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Cream laid, engine-sized	18 × 23	25	480	Esparto, 90 %; chemical wood, 10 %.

The Effra. Messrs J. Spicer & Sons, Ltd.

No. 8.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Cream wove bank	21 × 16½	11	500	Rag, 60 %; chemical wood, 40 %.

68 Quality. Messrs Grosvenor, Chater, & Co., Ltd.

No. 9.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Loan	18 × 23	20	500	Rag, 85 %; chemical wood, 15 %.

No. 537. Messrs Grosvenor, Chater, & Co., Ltd.

No. 10.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Drawing, hand-made	**30 × 22**	**72**	**472**	**All rag.**

Whatman H.P. Messrs GROSVENOR, CHATER, & Co., LTD.

No. 11.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Drawing, machine-made	**30 × 22**	**70**	**480**	**Chemical wood.**

No. 818. Messrs GROSVENOR, CHATER, & Co., LTD.

No. 12.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Cartridge.	30 × 22	70	480	**Rag, 30 %; chemical wood, 70 %.**

No. 642. Messrs GROSVENOR, CHATER, & Co., LTD.

No. 13.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Duplicating.	21 × 16½	21	480	**Esparto, 80 °/₀; chemical wood, 20 °/₀.**

193 Mill. Messrs Grosvenor, Chater, & Co., Ltd.

No. 14.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Printing, hand-made	17½ × 22½	36	516	**All rag.**

Aldwych, hand-made. Messrs Spalding & Hodge, Ltd.

No. 15.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Printing, machine finish	$17\frac{1}{2} \times 22\frac{1}{2}$	20	504	Esparto, 30 %; chemical wood, 70 %.

"147," Printing. Messrs Spalding & Hodge, Ltd.

No. 16.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Printing, super-calendered	**17½ × 22½**	**30**	**480**	**Chemical wood.**

Lyceum, S.C. printing.

Messrs SPALDING & HODGE, LTD.

No. 17.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
News printing	$17\frac{1}{2} \times 22\frac{1}{2}$	20	500	Chemical wood, 25 %; mechanical wood, 75 %.

Messrs Spalding & Hodge, Ltd.

No. 18.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Litho	$17\frac{1}{2} \times 22\frac{1}{2}$	24	516	**Esparto, 95 °/₀; chemical wood, 5 °/₀.**

Esparto, No. 2 litho. Messrs SPALDING & HODGE, LTD.

No. 19.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Plate paper	$17\frac{1}{2} \times 22\frac{1}{2}$	40	516	Esparto.

Fine Plate. Messrs Spalding & Hodge, Ltd.

No. 20.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Bible paper	$17\frac{1}{2} \times 22\frac{1}{2}$	11	500	**Chemical wood.**

Aldwych Bible.

Messrs SPALDING & HODGE, LTD.

No. 20.

Description.	Size in Inches.	Weight.	Sheets in Ream.	Manufacturer's Name.
Bible paper	17½ × 22½	11	500	Chemical wood.

Always Pride. Henry Spicer & Sons, Ltd.

No. 21.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Antique laid book	$17\frac{1}{2} \times 22\frac{1}{2}$	25	516	Esparto, 60 %; chemical wood, 40 %.

Universal Antique, laid. Messrs Spalding & Hodge, Ltd.

No. 22.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Antique wove book	$17\frac{1}{2} \times 22\frac{1}{2}$	30	516	**Esparto, 60 °/₀; chemical wood, 40 °/₀.**

Universal Antique, wove. Messrs Spalding & Hodge, Ltd.

No. 23.

12s. 6d. per ream.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Chromo, one-sided	$17\frac{1}{2} \times 22\frac{1}{2}$	...	**480**	**Esparto**

Messrs J. DICKINSON & Co., LTD.

No. 24.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Art, two-sided	$17\frac{1}{2} \times 22\frac{1}{2}$	**40**	**516**	**Esparto, 60 °/₀; chemical wood, 40 °/₀.**

Messrs J. DICKINSON & CO., LTD.

No. 25.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Imitation Art	$17\frac{1}{2} \times 22\frac{1}{2}$	36	516	**Esparto, 80 %; chemical wood, 20 %.**

Messrs J. Dickinson & Co., Ltd.

No. 26.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Featherweight, wove	$17\frac{1}{2} \times 22\frac{1}{2}$	20	516	**Esparto, 90 %; chemical wood, 10 %.**

Messrs J. DICKINSON & Co., LTD.

No. 27.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Featherweight, laid	$17\frac{1}{2} \times 22\frac{1}{2}$	20	516	Esparto, 90 %; chemical wood, 10 %.

Messrs J. DICKINSON & Co., LTD.

No. 28.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
M. G. Poster.	$17\frac{1}{2} \times 22\frac{1}{2}$	20	516	**Chemical wood.**

Messrs J. DICKINSON & Co., LTD.

No. 29.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
White tissue	20 × 30	7	480	Chemical wood, 70 °/₀; straw, 30 °/₀.

"555."

Messrs LEPARD & SMITHS, LTD.

No. 29.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
White tissue	20 × 30	7	480	Chemical wood, 70 °/₀; straw, 30 °/₀.

"555."

Messrs Lepard & Smiths, Ltd.

No. 30.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Cream wove, copying	18 × 23	6	504	Rag (trace of chemical wood).

"T.Y."

Messrs Lepard & Smiths, Ltd.

No. 30.

Description.	Size in inches.	Weight. lb.	Sheets in ream.	Approximate Furnish.
Cream wove, copying	18 × 23	6	504	Rag (trace of chemical wood).

"TIV."

Messrs. Lepard & Smiths, Ltd.

No. 31.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
White blotting	$17\frac{1}{2} \times 22\frac{1}{2}$	38	480	All rag.

Crown Blotting. Messrs Lepard & Smiths, Ltd.

No. 32.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Drying royal	20 × 25	44	480	Rag, 80 °/₀; chemical wood, 20 °/₀.

Messrs SPALDING & HODGE, LTD.

No. 33.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Vegetable parchment	20 × 30	32	480	**All rag.**

Messrs J. SPICER & SONS, LTD.

No. 33.

Description.	Size in inches.	Weight lb.	Sheets in ream.	Approximate Furnish.
Vegetable parchment	20 × 30	32	480	All reg.

Messrs J. Spicer & Sons, Ltd.

No. 34.

Description.	Size in inches.	Weight, lb.	Sheets in ream.	Approximate Furnish.
Imitation parchment	20 × 30	18	480	Chemical wood.

Messrs J. Spicer & Sons, Ltd.

No. 34

Description.	Size in inches.	Weight lb.	Sheets in ream	Approximate Furnish.
Imitation parchment	20 × 30	18	480	Chemical wood.

Messrs J. Spicer & Sons, Ltd.

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CONTENTS:—THE
PAPERS—THE "AGEING" A
—CONTROLLING THE MAR
RAGS—FROTH ON THE PA
WATER IN THE MANUFACTU
THE SHRINKAGE OF PAPER

Volume V. co
With Photomicr
pages ...

CONTENTS:—EARLY
OF BEATING—DIFFICULTIES
DIFFERENT FIBRES—"REFI
DIFFERENT KINDS OF BEATE
AND "REFINING" OF DIFFE
AND "AGITATION" IN A HO
HOLLANDERS WHEN BEATING
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