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THE WET AND DRY QUESTION

REVISED AND ENLARGED EDITION

THE *WARREN* STANDARD

NINETEEN HUNDRED AND TWENTY-FOUR

No. 1

THE WARREN STANDARD

In which will be published from time to time discussions of various paper and printing problems

Number 1 S. D. WARREN COMPANY, BOSTON 1924

THE WET AND DRY QUESTION

BOTH EXCESSIVE AND INSUFFICIENT HUMIDITIES ARE THE CAUSES OF MANY PRESSROOM AND BINDERY TROUBLES

NOAH became famous because of a Wet season. Volstead became famous because he tried to eliminate a certain kind of moisture. And likewise the printer has a Wet and Dry Question, the complete solution of which might entitle someone to a place in the hall of fame.

Humidity, with its many variations, is the cause of many printing difficulties. How to control it is something which vitally concerns printers and paper manufacturers, for once it is controlled in a pressroom or bindery many paper troubles are eliminated and production costs lowered.

What is Humidity? Humidity is not temperature. While it is closely related and is decidedly affected and to a great extent (see page 23) determined by temperature, humidity is moisture—not heat or cold. And for this reason, in studying the humidity conditions in a plant or attempting to control humidity conditions, it is well to bear in mind that regulation of temperature alone will not in itself correct or overcome troubles of humidity.

There must be a certain amount of moisture in the air to give satisfactory paper working conditions and while it is highly desirable and essential to maintain even temperature in pressrooms and binderies, the real problem is to inject and maintain the right amount of moisture in the air for the temperature which is being maintained. It is this proper combination of temperature and moisture (or relative humidity) which insures good performance of paper in pressrooms and binderies.

Humidity is the amount of vapor of water in the air. When it is expressed in the number of grains of moisture per cubic foot of air, it is called the absolute humidity. When expressed in the form of a percentage, as the ratio of the actual quantity of moisture in the air to the quantity that would saturate it under its actual conditions as to pressure and temperature, it is called the relative humidity. Complete saturation of the air at any given temperature is represented in hygrometrical reports by 100, and partial

(*Continued on page 10*)

THE FARMER WAITS FOR FAVORABLE WEATHER

Farming operations, unlike printing operations, are governed by weather conditions. The farmer makes hay in dry weather. He refuses to pick fruit during wet weather, and the heavy moist sod must dry out before he does his spring plowing.

(Gripper Edge)

[4]

THIS is reproduction of a sheet from an actual press run, showing the effects of stretch. Grain parallels short side. Paper was run for the first impression direct from the case on a warm, muggy August day. After a lapse of 13 minutes, a second impression showed results reproduced here with register out, due to stretch of the sheet, 1/16 of an inch on length of sheet and a slightly less amount on width. This edge of the sheet represents the side guide. Edge shown at bottom of these pages was gripper side of sheet. Note register on page at gripper and side guide corner of sheet is perfect, and that it is increasingly out of register as you go toward both back and end of sheet

(Side Guide Edge)

THIS edge of the sheet is of the end farthest from the side guide and shows the full amount of stretch which has taken place. Examination of the type impressions shows how much and how rapidly the sheet stretched in the 13 minutes between the first and second impressions. Note also that the sheet expanded in both directions. At the gripper edge, on the left, the register sidewise is perfect, but as you follow to the edge opposite the gripper, it is increasingly out. The same condition holds true working from the side guide (page 4) edge of the sheet to the edge shown here. Note actual size reproductions of the four corner pages of this sheet on pages 6 and 7

(Side Guide)

ABOVE is an exact size reproduction of the corner on the side guide end and back side of the sheet reproduced on page 4. Note that the two impressions of the type line up at bottom because this end of sheet comes next the side guide, but the type is out of register sidewise full amount of stretch from the gripper edge to back side of sheet

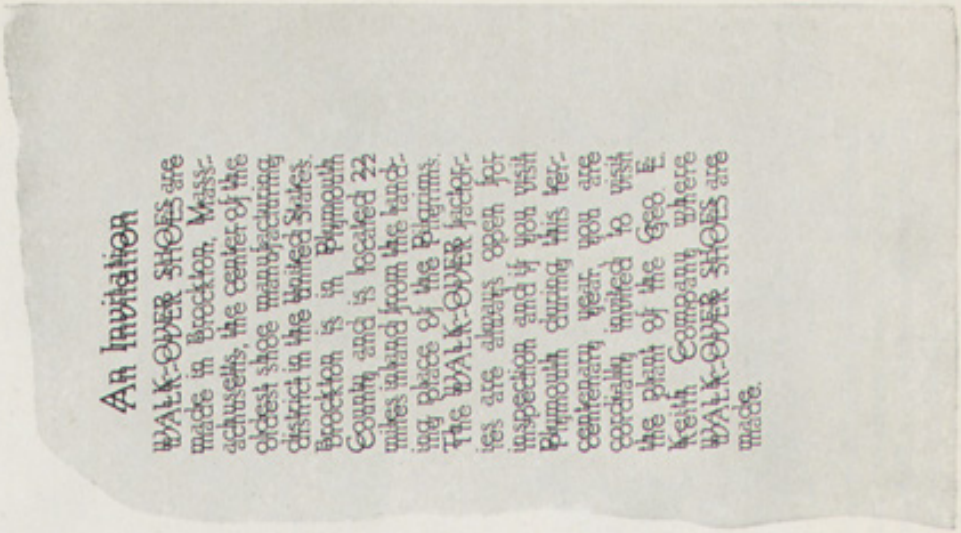
REPRODUCTIONS ON THIS AND OPPOSITE PAGE SHOW IN FULL SIZE FOUR CORNERS OF SHEET SHOWN ON PAGES 4 AND 5

BELOW is an exact size reproduction of the page on the side guide end and gripper side of the sheet reproduced on page 4. Note it is practically in register both ways because it comes close to both guide edges, proving the perfect mechanical operation of the press

(Side Guide)

(Gripper Edge)

(Gripper Edge)



ABOVE is an exact size reproduction of the corner of the sheet farthest from the side guide and from the gripper edge of the sheet reproduced on page 5. Note it is out of register both ways, this corner of the sheet getting full effect of the expansion or stretch which occurred

NOTICE AMOUNT OF STRETCH IN 13 MINUTES BETWEEN THE FIRST AND SECOND IMPRESSIONS

BELOW is an exact size reproduction of the corner of the sheet farthest from the side guide on the gripper edge of the sheet reproduced on page 5. Note it is practically in register sidewise because it comes next the grippers, but is out of register full amount of the stretch from side guide to this end of sheet

(Gripper Edge)

(Gripper Edge)

(*Gripper Edge*)

[8]

(*Side Guide Edge*)

THIS is reproduction of a sheet showing two impressions in perfect register all over the sheet. These results may only be expected where presses are operating perfectly and paper has been given opportunity to stretch or contract all it will under the relative humidity conditions which exist. This edge of the sheet represents the side guide edge and the edge at the right the gripper edge

(Gripper Edge)

THIS reproduction of a sheet on which two impressions were taken shows the two impressions to be in perfect register—even on this edge of the sheet which is the edge farthest away from the side guide. These impressions were taken from the same form with press set exactly the same and on the same paper as the sheet shown on pages 4 and 5. The only difference in handling the two sheets was the paper for these two impressions was allowed to set in the pressroom for a few hours to adjust itself to the prevailing condition of relative humidity

saturations by a less number. It is the relative humidity condition existing in pressrooms and binderies which most concerns printers, since tests have proved conclusively that better operating conditions prevail in pressrooms and binderies where a relative humidity ranging from 60 to 70 per cent is maintained.

NORMAL HUMIDITY

EACH PRINTER MUST DETERMINE FOR HIMSELF THE RELATIVE HUMIDITY BEST SUITED TO HIS LOCALITY

FREQUENTLY the question is raised as to what is normal humidity. No relative humidity can be considered as normal for the whole country. What might be considered a normal or average humidity for Boston would not be a true condition in Denver or San Francisco perhaps. And printers need not be particularly concerned about a normal humidity and its relation to good working conditions for paper. What is much more to be desired is a uniform relative humidity.

Every printing plant may readily determine with hygrometer readings, in conjunction with printing and folding tests, a degree of relative humidity which will give the best working conditions.

The problem then is to maintain as closely as possible this degree of relative humidity throughout all seasons of the year with particular attention to the winter months when pressrooms and binderies become abnormally dry because of artificial heat.

THE DEEP-SEA FISHERMAN ALSO HEARKENS TO THE WEATHER

When the gathering storm clouds predict a rough and boisterous sea, the deep-sea fisherman is quite apt to be found warming the top of a keg in some comfortable shanty. The customer must find something else to fry or go without.

PRESSROOM HUMIDITY TROUBLES

EVERY Spring you marvel at the budding and developing of the trees on your front lawn. Nature has taken care of warming the earth and providing moisture which is taken up by the roots to feed the tree. The tree expands and grows.

If you have ever watched the family wash you know how quickly a piece of cloth will absorb moisture. And you also know how much quicker the wash dries on a clear, dry day than on a damp, foggy day. So it is when either wood or rag fibers are made into paper—they still are receptive to and seek moisture. Chart 1 on page 12 shows the relative moisture content of 14 raw fibers for paper making at varying degrees of humidity. You will note a sharp increase in moisture content with the increase in humidity.

The amount of moisture in finished paper varies exactly as it does in the raw fibers and in direct relation to the amount of moisture it absorbs or throws off, it expands or contracts.

Mr. Sutermeister, Chief Chemist at Cumberland Mills, makes the following interesting statements on this subject:

"It has been proved time after time and by observers in many countries that paper takes up moisture in a damp atmosphere and gives it off in a dry one, and that these changes cause an expansion and contraction of the sheet. This is just as inevitable as that a board will shrink when it is dried and swell when it is wet. The similarity goes still further, for the board does not change much in length because the fibers run lengthwise, and the paper changes much less in the machine direction than across the sheet because many more fibers lie in the machine direction. This is due to the fact that individual fibers change in width far more than they do in length when they are wet or dried.

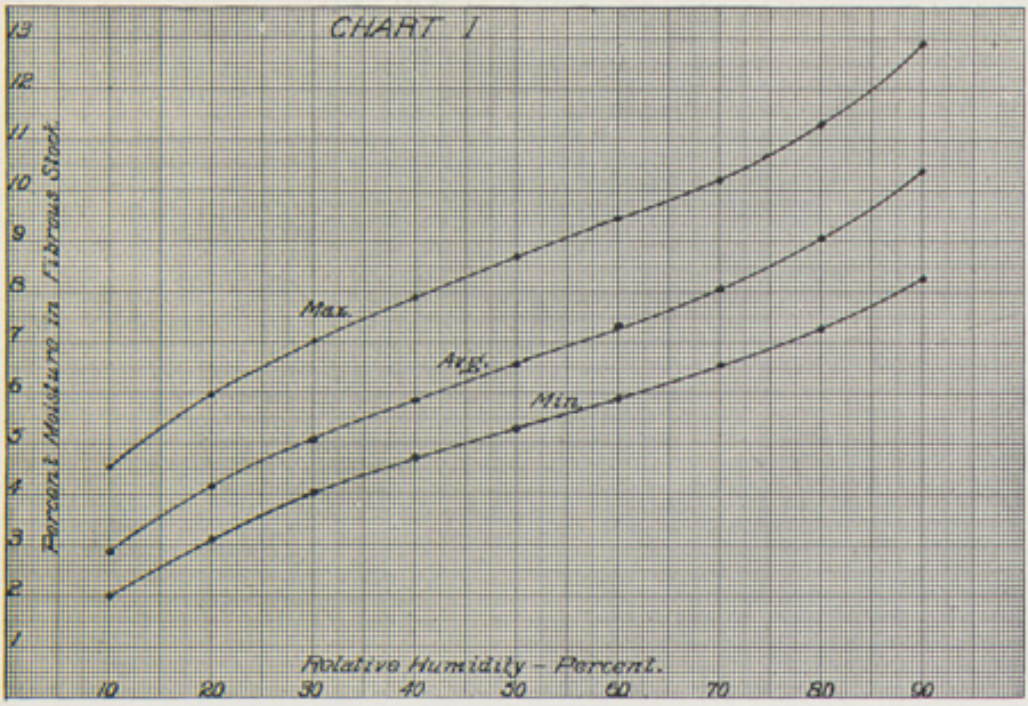
"It has been shown by tests made in both Germany and America that the moisture in paper, and consequently the size of the sheet, depends on the relative humidity of the surrounding air. While different papers, and the different fibers from which they are made, may have different percentages of moisture at any given humidity, yet if the humidity changes, the moisture content of the fibers or papers will all change in the same direction and in approximately the same ratio. Measurements of fourteen raw fibers for paper making gave varying percentages of moisture at humidities between 10% and 90%. The fibers tested included samples of cotton, linen and manila half sheets, bleached and unbleached sulphite and soda fibers, straw cellulose and both brown and white ground wood.

"These results are shown graphically in Chart 1, page 12, which illustrates plainly the uniform increase in moisture with increasing humidity for all paper stocks. Similar results were obtained by the Forest Products Laboratory, where twenty-six samples of paper were tested at humidities that ranged from 37% to 95%. One of the largest paper companies in the country, making printing papers, also tested a great variety of papers and demonstrated the same facts.

"From all of these investigations it appears to be proved without question that the moisture taken up by paper, and paper stocks, depends upon the humidity of the surrounding atmosphere. Since all fibers from which paper is made are susceptible to moisture in about the same proportions, it is obvious that papers of all kinds will show the same relative changes in moisture content if the humidity changes.

THE WEATHER, HOWEVER, NEVER SLACKENS THE ARDOR OF THE MAN WHO PRODS THE PRINTER

Any printer will tell you the name of this party. He is the man who makes it necessary for the printer to keep the job moving no matter whether it rains or snows or clears up. It is to the successful completion of his work that the book is partly dedicated.



THIS chart shows relative moisture content of fourteen raw fibers for paper making at varying humidities between 10% and 90%

"The following table shows moisture content of paper at varying percentages of humidity:

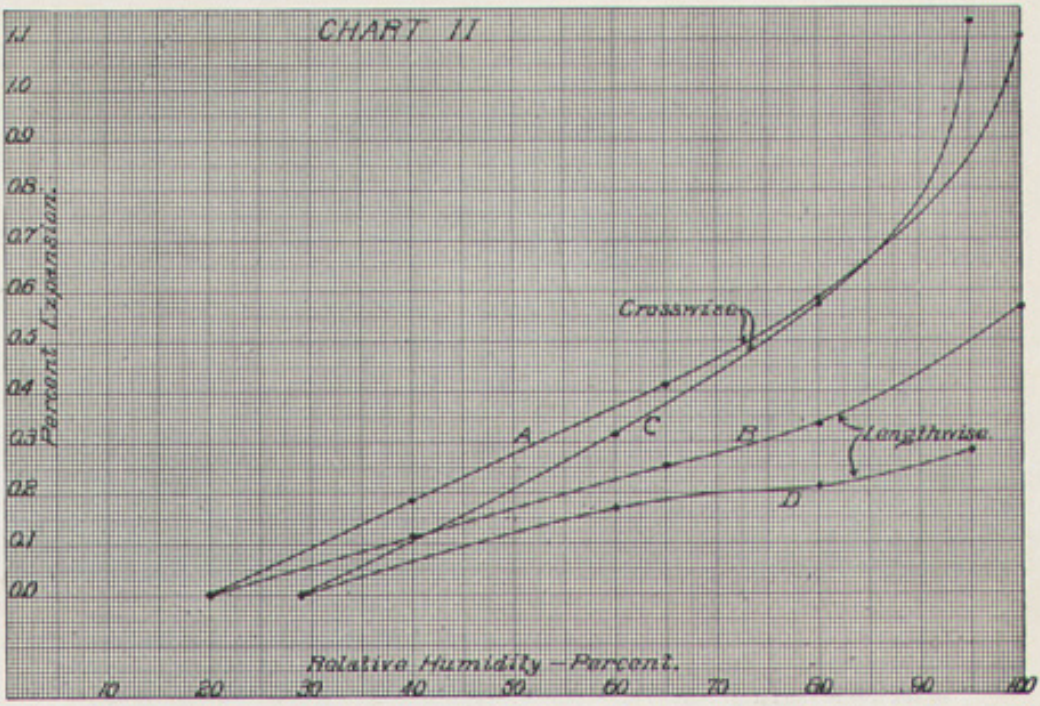
Humidity	10%	20%	30%	40%	50%
Max. Moist.	4.53	5.95	7.03	7.90	8.70
Min. "	2.00	3.10	4.02	4.70	5.28
Av. "	2.87	4.12	5.07	5.87	6.58

Humidity	60%	70%	80%	90%
Max. Moist.	9.45	10.20	11.30	12.90
Min. "	5.88	6.52	7.27	8.27
Av. "	7.31	8.09	9.05	10.38

"Chart 2, page 13, shows graphically the results of tests on eighteen papers; A and B show the crosswise and lengthwise expansion of three German coated papers, while C and D show the corresponding figures for fifteen samples of uncoated American papers. The percentages from which these curves are plotted are based on the dimensions of the sheet at 20% and 29% relative humidity respectively, and the results show the total expansion in the sheet when the humidity is increased from those points to any other point up to 95% or 100%. Comparison of these curves with those for moisture in Chart 1 shows that while not of exactly the same form both rise as the relative humidity increases. In other words, increasing humidity increases the moisture in the paper and also the size of the sheet, and if the humidity is decreased the corresponding reverse changes take place."

Paper as it leaves the paper mill has a certain moisture content. Paper leaves Cumberland Mills packed in a waterproof-lined case to protect it from excessive moisture. This paper changes very little until the case is opened and it is exposed to the humidity conditions of the pressroom or storage room.

Almost immediately it starts to adjust itself to the wet or dry condition of the room. It either absorbs moisture or gives it off, as the case may be, according to the amount of moisture in the air at the time. With this change of moisture content, it expands or contracts. Just how quickly this action takes place and to what extent the sheet actually varies in size is shown by the record of a test made by Mr. P. E.



LINES A and B show the crosswise and lengthwise expansion of three German coated papers. Lines C and D show the expansion of fifteen samples of uncoated American papers

Hinkley of the S. D. Warren Company. The stretch and shrinkage across the grain of a sheet of coated paper 28 x 32½ — 96 was measured over a period of several months. The results were as follows:

Date—1921	Change*	Humidity
Aug. 31 2.33 P.M.	(Call zero as opened)	
Aug. 31 2.41 P.M.	+1	72 Boston
Aug. 31 2.44 P.M.	+2	72 Boston
Aug. 31 2.52 P.M.	+3	72 Boston
Sept. 1 11.17 A.M.	+4	74 Boston
1922		
Jan. 25 10.40 A.M.	+1	32 Boston
June 7 11.30 A.M.	+4	66 Boston
June 21 3.45 P.M.	+5	97 Boston

*Stretch (or shrinkage) in thirty-seconds of an inch.

Note: On August 31 the sheet stretched 3/32 of an inch in nineteen minutes.

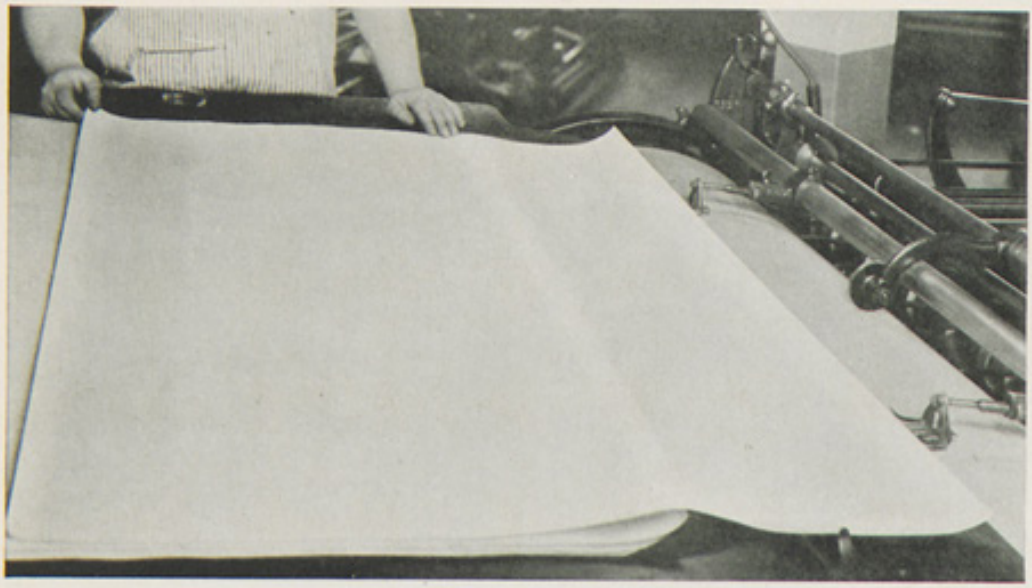
Note particularly that this sheet stretched 3/32 of an inch in 19 minutes. Then just imagine this sheet lifted from the case and run immediately on the first color of a register job and you have a definite picture of the troubles facing the pressman when he comes to register his second color. An actual instance of this character is shown by the printed sheet reproduced on pages 4 and 5.

WHY PAPER CURLS

Not all paper troubles in the pressroom, however, are due to moisture. Excessive dryness adds many other difficulties.

Probably those paper troubles caused by excessive dryness which most seriously interfere with good pressroom performance are curling and electricity.

Every paper manufacturer recognizes that there are certain circumstances and conditions that will always arise in the processes of making paper which will contribute to a tendency of curling unless well controlled. On the paper machine, for instance, if through any cause the removal of water is unequal at any point during which the paper is being dried by forced means, unequal contraction will result with a tendency to wrinkling or curling. Plain paper is calendered one side at a time.



CURLED PAPER HARD TO HANDLE

THIS picture shows how difficult it is to feed paper which is badly curled. Note the paper has already slid over the prong on the guide next the feeder and is above the level of the one in the foreground. This means the press must be tripped, resulting not only in lower production but uneven color and a tendency to offsetting

If in this part of the process one side becomes calendered considerably more than the other a tendency to curl is created.

These are conditions which are carefully guarded against by every good paper manufacturer and it is our belief that very little paper is delivered by high grade mills from runs showing any of these characteristics or tendencies.

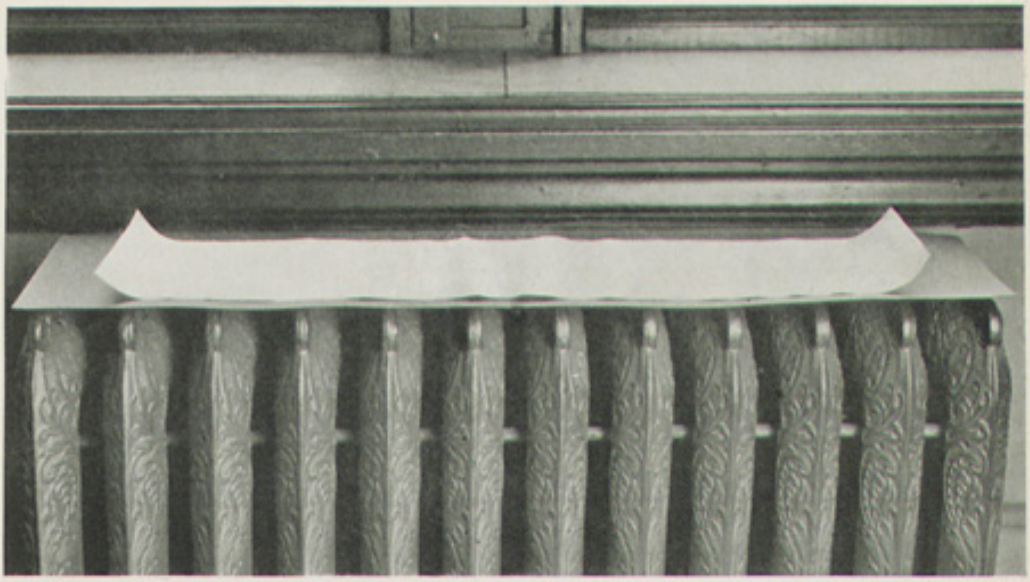
PRESSROOM CONDITIONS THAT CAUSE PAPER TO CURL

The reason for curling is, in most cases, directly traceable to local conditions of humidity or in other words, the moisture or lack of it in the room where paper is taken from the case. A too dry atmosphere draws the moisture from the paper, causing the fibers to contract and the paper to curl.

A frequent cause of trouble with curling paper is the fact that the paper has been stored in another section of the print shop or in a room away from the presses where there are different temperature and humidity conditions and frequently also a much lower temperature. Sometimes there is no heating system whatever and the result is when the paper is brought to the presses to run it comes in with very much the same amount of moisture as when it originally left the mill. It comes, thoroughly chilled, into a dryer and warmer atmosphere that at once begins to absorb moisture from the paper. This causes a contraction (largely on the exposed surface of the sheet) of the fibers, which contract to a greater degree across their diameter, thus producing the curl which is always so decidedly noticeable along two edges of the sheet.

An exaggerated case of this kind is shown by the demonstration pictured on page 15, where the sheet was placed on a warm radiator for quick drying out. It does show clearly, however, just what action takes place in any pressroom where there is a lack of moisture.

While it is true most of the trouble from curling is experienced during the winter months because of artificial heat, an extended period of hot dry summer days will cause quite as much curling trouble.



CURLING, THE EFFECT OF EXCESSIVE DRYNESS

THIS picture shows one of the effects of extracting moisture from paper. The sheet shown was a strip 8″ wide x 25″ long, grain across the 8″ way. It was perfectly flat when placed on the cardboard shown on top of the warm radiator. In two minutes the fibers in the paper had dried out and contracted enough, across their diameter, to curl the ends of the sheet as shown

Other things being equal, thin papers curl more rapidly and to a greater extent than thick ones, as there is less resistance in the thin paper to the surface action. On the other hand, the thin sheets more easily resume their normal position, while wrinkles or curls in a thick sheet often leave permanent marks.

On page 14 we show one of the chief annoyances of curling paper in the pressroom. Whether such paper is run on a hand fed press or on presses equipped with automatic feeds, with this amount of curl it will seriously interfere with production.

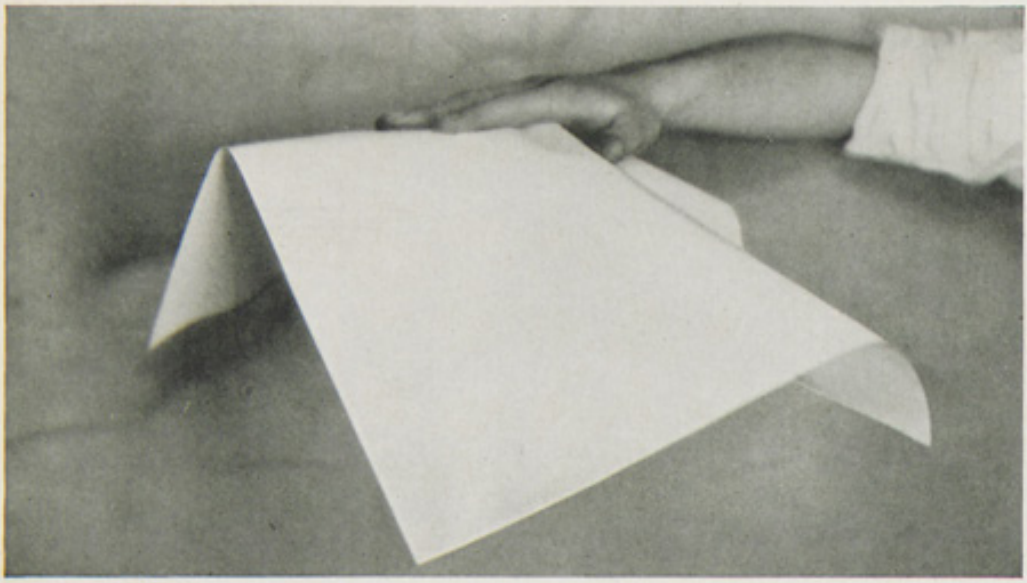
There is only one solution to this problem. It can be overcome by injecting moisture into the air and maintaining a reasonably even temperature. With more moisture in the air the paper will adjust itself to the new conditions, the fibers will expand and the paper will gradually flatten out into workable condition. See pages 24 to 33 for methods of controlling humidity conditions.

ELECTRICITY IN PAPER

Electricity troubles in the pressroom and bindery make their appearance annually as soon as cold weather sets in. Dry atmosphere and low temperature or radical changes in temperature cause paper to accumulate a considerable amount of electricity—which means no end of trouble when the paper is started through the presses.

THE WEATHER IS ALSO RESPONSIBLE FOR THIS GROUCH

During dry cold weather the air reverses its operations. Artificial heating dries out or isolates humidity till the air lacks its normal quota. Then it sucks moisture from everything. Doors shrink away from their catches and each gust of wind blows them open. Paper under such conditions shrinks just as the door shrinks.



ELECTRICITY HOLDING PAPER TO HAND

This picture indicates how much electricity accumulates in paper subjected to radical changes of temperature and humidity. Find a pile of paper in a cold storage room, run your bare arm in between the sheets and notice the snapping and crackling. Try to lift a sheet as shown above and see how snugly it grips the hand

Most electricity troubles arise from the fact that there is usually less humidity in the air on cold days and because artificially heated air will absorb more moisture than unheated air a greater degree of dryness is created. The paper, the tympan, the press and the air are all very dry, and electricity is generated much more quickly than in a moist atmosphere.

An idea of how much electricity a sheet of paper accumulates is shown by the picture on this page. If you have ever lifted a sheet of paper from a pile brought into a warm pressroom from a cold storage room, you know how strongly it will cling to your arm or hand. When on the press, it is hard to feed. It clings to the cylinder and fly rods and is almost impossible to deliver smoothly to the jogger. It clings to the jogger boards and slides across the pile of freshly printed sheets causing offset.

All of these things delay production and lower the quality of the work produced, pointing out the necessity for giving paper an opportunity to adjust itself to pressroom humidity conditions before attempting to run it. Electricity troubles can be almost entirely eliminated by maintaining a proper degree of relative humidity and a reasonably even temperature in storage room and pressroom. Opening pet cocks in steam radiators, wetting the floor or placing wet sponges on the feed board and jogger table will help overcome electricity trouble somewhat. Electric neutralizer and gas flame attachments are also a big help in reducing electricity and offsetting troubles.

Varying temperatures and humidities prevail in every city in every section of the country and every pressroom and bindery to a greater or less degree. As a result paper is constantly adjusting itself to the moisture conditions surrounding it and unless an effort is made to maintain a fairly even degree of relative humidity, printers and binders will experience all the variations of paper troubles which have been mentioned.

It is not difficult to eliminate the serious radical changes of humidity. A little consideration of local humidity conditions will amply repay the effort necessary to record those conditions and to help correct them.

TESTING THE VALUE OF MOISTURE IN FOLDING

This picture shows how readily the value of a proper amount of moisture in paper, to be folded, may be tested. When paper seems brittle and folds poorly, give it this test. Hold close to mouth and exhale. Moisture carried by breath will soften paper and give smooth fold

BINDERY PAPER TROUBLES

CAUSED PRINCIPALLY BY LACK OF HUMIDITY

The damaging effect of low humidity (or a lack of proper moisture) on paper is more apparent perhaps in the bindery than in the pressroom, for here the changes which take place in the physical qualities of paper, because of a lack of sufficient moisture, are quickly brought to light.

Flexibility in paper is largely a question of moisture. If paper has been in a dry, heated pressroom several days and been over the gas flame attachment, which extracts more moisture, it has little chance to fold evenly and smoothly.

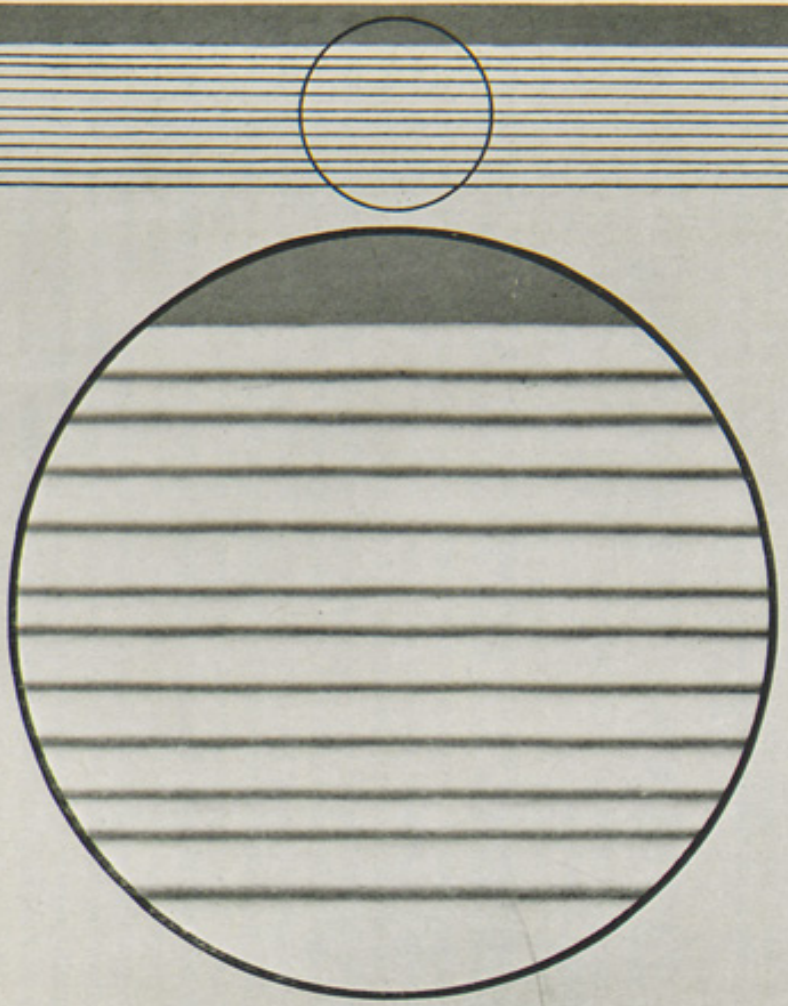
A practical test that can be made quickly to show how moisture helps in folding paper is pictured on this page. Take any sheet of paper. Fold it. Then hold it in front of the mouth and exhale on it for a minute or two. Fold it again through the section covered by the breath. You will find that the slight moisture carried by the breath has made the paper more flexible and easier to fold.

The definite relation of the amount of moisture in paper to its folding qualities is clearly shown in a test of ground wood-sulphite paper in which the number of folds increased 153% with a humidity increase from 41% to 77%. Above 77% relative humidity, the folding strength decreased, showing that the per cent of relative humidity giving the greatest folding strength had been passed.

The Bureau of Standards at Washington recently made some tests which show that every printer and binder who wants to make the most satisfactory deliveries to his customers should pay careful attention to the conditions under which paper is printed and folded.

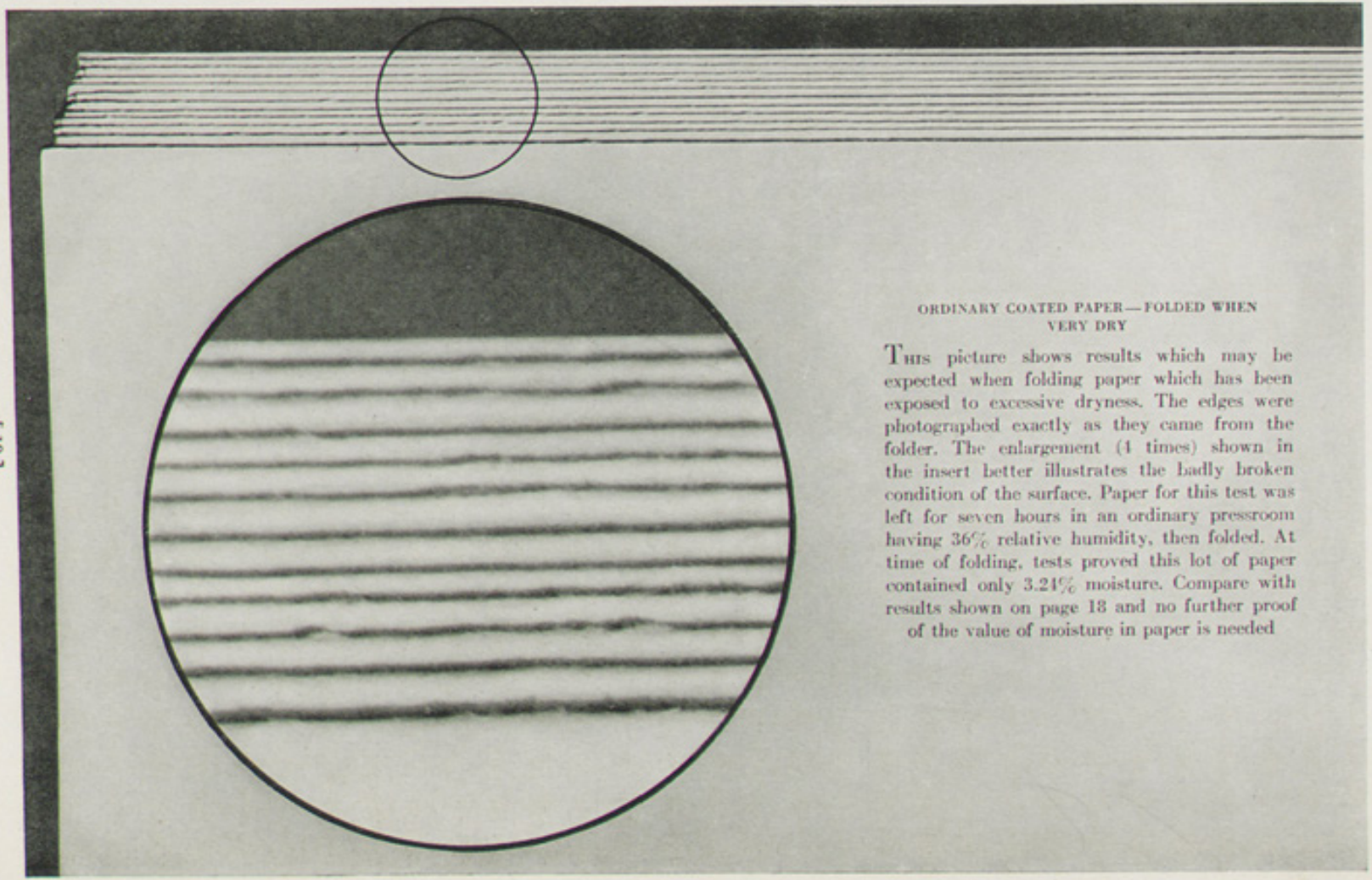
They first made tests of the folding endurance of twelve papers in an atmosphere with a relative humidity content of 65%. Various other tests were then made with a relative humidity content ranging

(*Continued on page 20*)



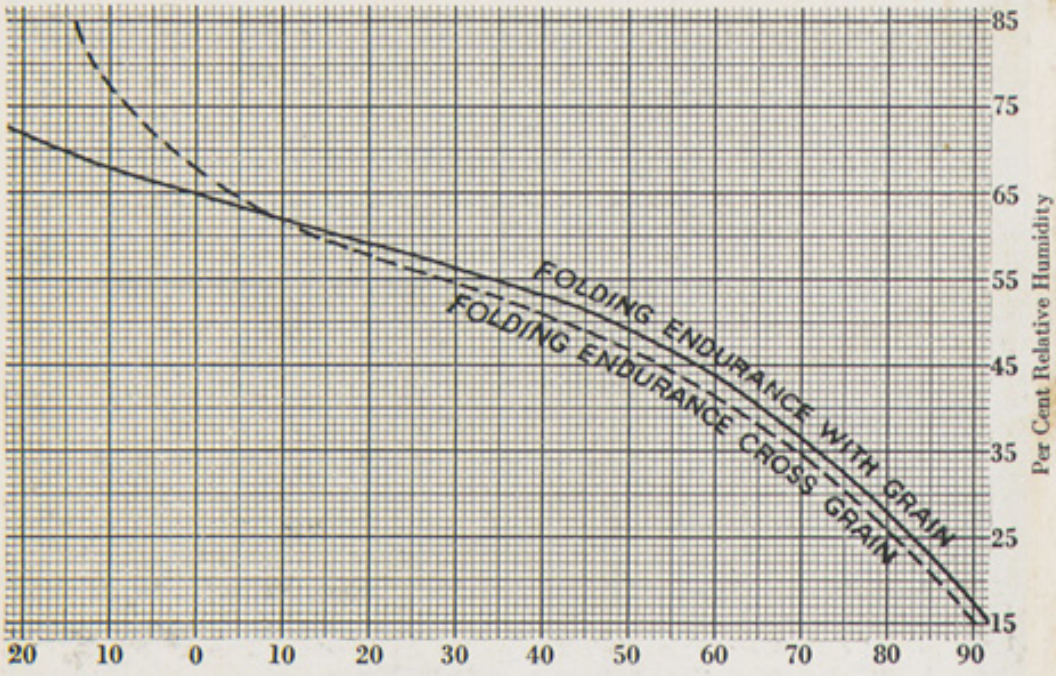
ORDINARY COATED PAPER — FOLDED WITH NORMAL AMOUNT OF MOISTURE

This picture shows results which may reasonably be expected from paper properly handled and folded in a room having a relative humidity of 60 to 70 degrees. The edges were photographed exactly as they came from the folder. The enlargement (4 times) shown in the insert better pictures the exact condition of the folded edge. Paper for this test, which was from the same making as that used in test pictured on page 19, was left in a room having 63% relative humidity for seven hours, then folded. At time of folding, tests proved the paper contained 5.08% moisture



ORDINARY COATED PAPER—FOLDED WHEN VERY DRY

THIS picture shows results which may be expected when folding paper which has been exposed to excessive dryness. The edges were photographed exactly as they came from the folder. The enlargement (4 times) shown in the insert better illustrates the badly broken condition of the surface. Paper for this test was left for seven hours in an ordinary pressroom having 36% relative humidity, then folded. At time of folding, tests proved this lot of paper contained only 3.24% moisture. Compare with results shown on page 13 and no further proof of the value of moisture in paper is needed



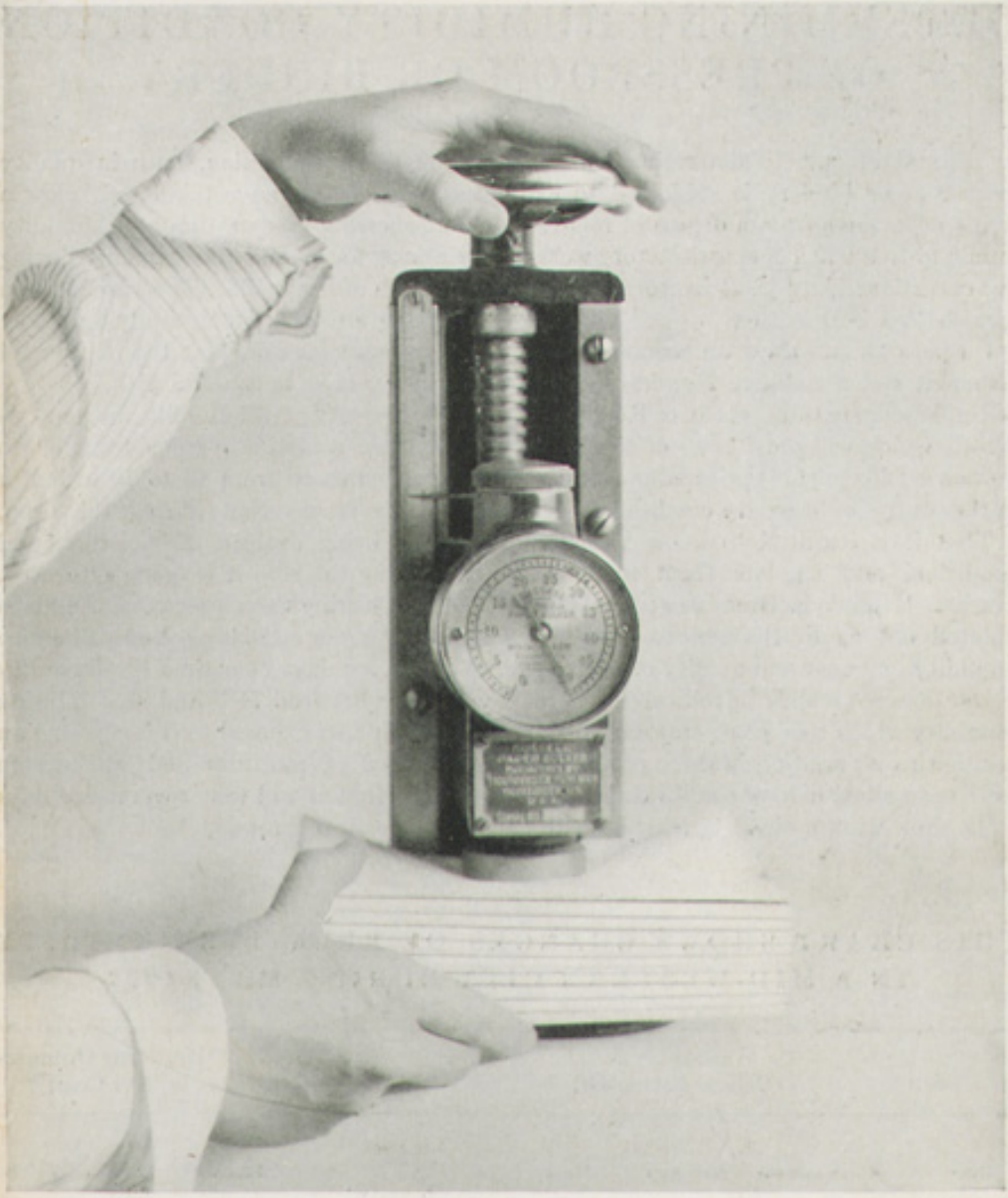
PER CENT variation of folding endurance from values at 65% relative humidity; zero represents endurance at 65% relative humidity. This chart was made from figures prepared by the Bureau of Standards at Washington and shows how paper loses in folding endurance with reduction of humidity. For example, at 35% relative humidity folding endurance has decreased 70% from that at 65% relative humidity

down to 35%. At this point the twelve papers had averaged a loss of 70% in folding endurance. The chart reproduced on this page graphically pictures the results of these tests and shows the steady decline in folding endurance which takes place with a decrease of moisture content.

On pages 18 and 19 are pictures of a folding test which show conclusively results which may be expected from paper folded under dry conditions and under favorable moisture conditions.

Paper for this test was from the same run, one lot of the sheets being placed in a rack in a pressroom where average winter conditions prevailed and having a relative humidity of 36%. Another lot of the sheets was placed in a damp room with a relative humidity of 63%. Each lot remained in these places for seven hours before being folded. At time of folding, laboratory tests showed the paper which had been in the pressroom contained 3.24% moisture and paper which had been in the damp room contained 5.08% moisture. Conditions similar to those under which this test was made prevail in nearly every bindery and "surface breaks," similar to those resulting from folding the dry sheets in this test, are the result on many jobs.

The only way in which a condition of this kind can be overcome is to inject a sufficient amount of moisture into the air in the bindery to maintain an average relative humidity of 60 to 70%, then allow the paper to stand long enough to absorb sufficient moisture to bring it back to its original condition. If divided into small lifts and racked, or better hung up, it will not take long to do this.



HUMIDITY VARIES BULK OF PAPER

THIS illustration shows one of the many tests each run of paper receives at the Cumberland Mills' Inspection Department. It is called the Bulk Test and records the bulk of paper under 50 lbs. pressure to the square inch. Humidity materially affects the bulking of paper, as well as the sheet size. In a recent test, a lot of paper left several hours in a pressroom, having a relative humidity of 28%, bulked 632 pages to 1 inch. These 632 pages were then left for 3 hours in a room having a relative humidity of 82%, after which they showed a bulk of 1 1/16", showing an increase in bulk of 1/16". This test is interesting because an increase in bulk with increasing humidity would indicate that fibers are absorbing moisture. And the absorption of moisture would result in an increase in both length and breadth of sheets

DETERMINING HUMIDITY CONDITION OF PRESSROOM OR BINDERY

It is not difficult to determine when a pressroom or bindery is subjected to extreme departures from a degree of relative humidity that will insure satisfactory working conditions. Any good hygrometer will furnish this information.

On page 23, we show an economical instrument and a Relative Humidity Table of the Taylor Instrument Co. of Rochester, N. Y., which will provide all of the information needed to guide printers and binders in the control of humidity conditions.

That it is essential to know humidity conditions and regulate them so far as possible is obvious from what has been pointed out as to the serious effects of humidity on paper and quality of printing.

One does not realize the radical changes of humidity which take place and their direct relation to a variation in daily production until some study of local conditions is made.

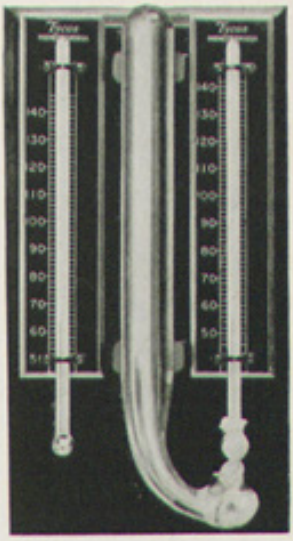
To show what a direct bearing humidity has on daily production, both in quality and quantity, we have tabulated below a report showing temperature and humidity variations for a mid-western city during the month of May, 1922. The variations in this table are well worth studying. They give an exact idea of what the paper man and printer have to contend with.

The percentage of humidity, as you can readily see, sometimes drops from 80 to 40 or is increased from 40 to 70 in half a day. This means that during the drop, paper is being drained of moisture, and that during the rise, it is being saturated. And that during these processes, the fibers are shrinking or stretching. You will notice also that for days at a time the humidity will range between 70% and 90%. During this time paper exposed to it is carrying an excess load of moisture and will stretch so much that it will take several dry days to restore it to normal.

THIS CHART SHOWS CHANGES OF RELATIVE HUMIDITY IN A MID-WESTERN CITY DURING MAY, 1922

Date	Temperature (Degrees Fahrenheit)				Relative Humidity (Per Cent)		
	Maximum	Minimum	Mean	Departure of Mean from Normal	7 A. M.	12 Noon	7 P. M.
M. 1	69	52	60	+ 7	82	53	49
T. 2	74	60	67	+13	68	62	55
W. 3	62	54	58	+ 4	91	94	85
T. 4	72	57	64	+10	82	46	42
F. 5	78	57	68	+13	60	34	41
S. 6	73	57	65	+10	74	53	36
S. 7	66	52	59	+ 4	68	45	57
M. 8	67	55	61	+ 5	60	46	58
T. 9	81	62	72	+16	59	54	61
W. 10	81	67	74	+18	81	67	50

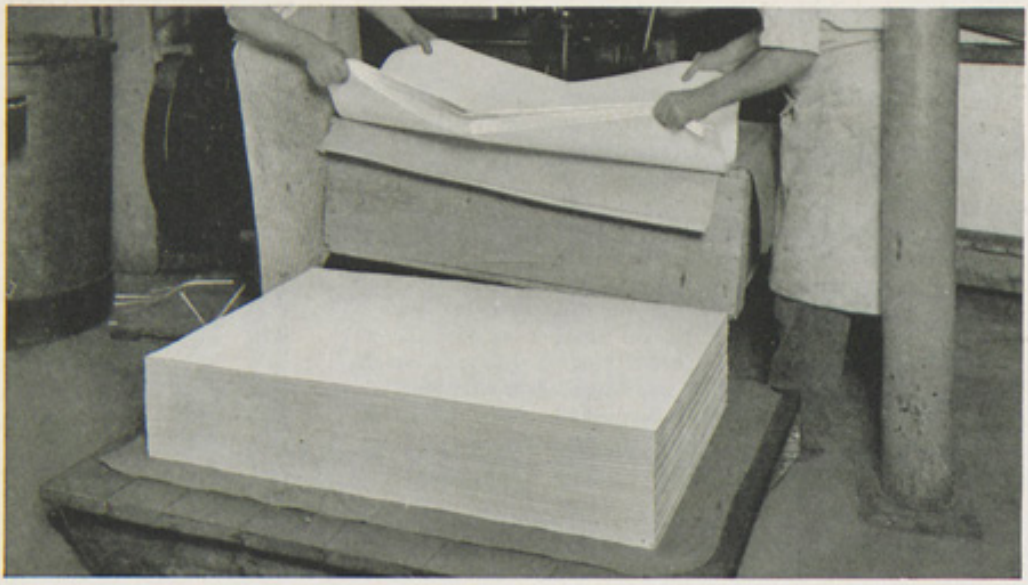
This illustration shows a hygrometer manufactured by the Taylor Instrument Companies of Rochester, N. Y. Humidity readings are obtained by subtracting the wet bulb reading from the dry bulb reading and then obtaining the relative humidity on the chart shown below. For instance, if the dry bulb reading is 70° and the wet bulb reading is 60°, the difference is 10°. Next find 70 in the column at the extreme left of the chart and then read across till you reach the column headed 10, you find a relative humidity figure of 56. In order to be sure that there is free circulation of air around the wet bulb, it is advisable to fan the bulb for a few minutes before reading. Readings should be taken twice a day. This particular hygrometer sells for $5.00 so that it is not a costly investment for the information it furnishes. A very understandable set of directions go with it



RELATIVE HUMIDITY TABLES—FAHRENHEIT

Temperature Readings in Degrees Fahrenheit. Relative Humidity Readings in Per Cent.
Barometric Pressure 29.0 in.

Readings of Dry-Bulb Thermometer	Difference in Degrees Fahrenheit between Wet and Dry-Bulb Thermometers																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
60	94	89	84	78	73	68	63	58	53	49	44	40	35	31	27	22	18	14	10	6	2
61	94	89	84	79	74	68	64	59	54	50	45	40	36	32	28	24	20	16	12	8	4
62	94	89	84	79	74	69	64	60	55	50	46	41	37	33	29	25	21	17	13	9	6
63	95	90	84	79	74	70	65	60	56	51	47	42	38	34	30	26	22	18	14	11	7
64	95	90	85	79	75	70	66	61	56	52	48	43	39	35	31	27	23	20	16	12	9
65	95	90	85	80	75	70	66	62	57	53	48	44	40	36	32	28	25	21	17	13	10
66	95	90	85	80	76	71	66	62	58	53	49	45	41	37	33	29	26	22	18	15	11
67	95	90	85	80	76	71	67	62	58	54	50	46	42	38	34	30	27	23	20	16	13
68	95	90	85	81	76	72	67	63	59	55	51	47	43	39	35	31	28	24	21	17	14
69	95	90	86	81	77	72	68	64	59	55	51	47	44	40	36	32	29	25	22	19	15
70	95	90	86	81	77	72	68	64	60	56	52	48	44	40	37	33	30	26	23	20	17
71	95	90	86	82	77	73	69	64	60	56	53	49	45	41	38	34	31	27	24	21	18
72	95	91	86	82	78	73	69	65	61	57	53	49	46	42	39	35	32	28	25	22	19
73	95	91	86	82	78	73	69	65	61	58	54	50	46	43	40	36	33	29	26	23	20
74	95	91	86	82	78	74	70	66	62	58	54	51	47	44	40	37	34	30	27	24	21
75	96	91	87	82	78	74	70	66	63	59	55	51	48	44	41	38	34	31	28	25	22
76	96	91	87	83	78	74	70	67	63	59	55	52	48	45	42	38	35	32	29	26	23
77	96	91	87	83	79	75	71	67	63	60	56	52	49	46	42	39	36	33	30	27	24
78	96	91	87	83	79	75	71	67	64	60	57	53	50	46	43	40	37	34	31	28	25
79	96	91	87	83	79	75	71	68	64	60	57	54	50	47	44	41	37	34	31	29	26
80	96	91	87	83	79	76	72	68	64	61	57	54	51	47	44	41	38	35	32	29	27



FRESH FROM THE CASE

PAPER that is packed in waterproof cases will not as a rule be greatly affected by changing weather conditions unless humidity is excessive for many days. This pile lies perfectly flat. Compare with opposite picture

CONTROLLING HUMIDITY

IN THE PRESSROOM OR BINDERY

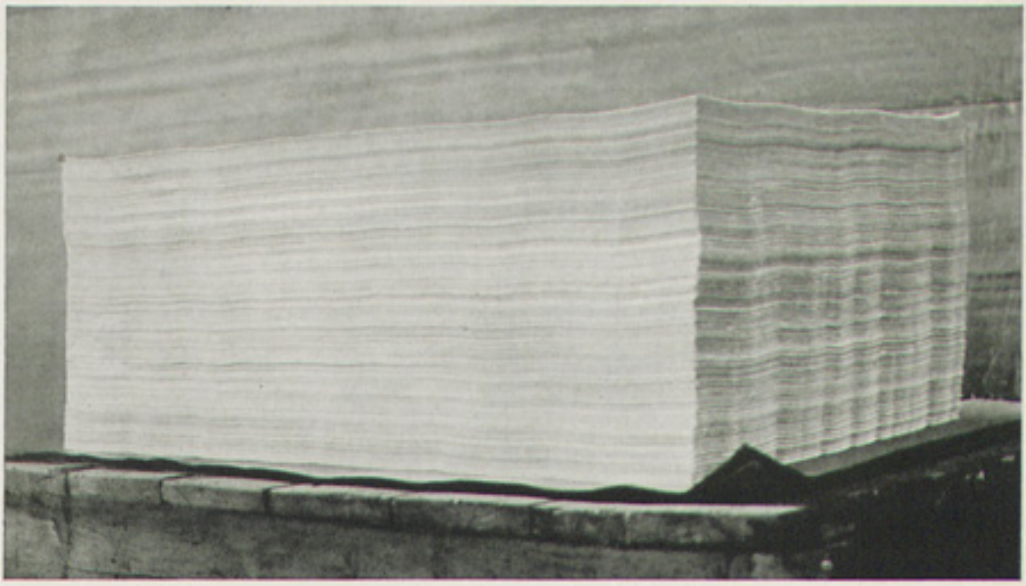
MANY experiments and attempts have been made to control humidity in pressrooms and binderies, but so far as we can determine, nothing has been devised or invented which will give even an approximately positive control without excessive cost. The most that can be hoped for at the present time is a regulation of humidity conditions to a point where extreme excesses and changes are eliminated. This can be accomplished.

To do this much simply means protection of paper against excessive moisture and on the other hand extreme dryness of the air.

In the protection of paper against the stretch and expansion, wavy edges, etc., caused by the absorption of excessive moisture, there are several simple methods which any printer may adopt, if his plant is not equipped with a mechanical humidity control device, any one of which will be of some assistance.

If the paper in a pile develops wavy edges (see picture page 25), the logical thing to do is to "rack" or hang the paper in very small lifts so that the air can reach it from all sides. If the wave develops after one or more colors have been printed, and the condition of excess humidity continues, it is a very difficult condition to handle.

If it is impossible to "rack" the paper and wait for a drop in humidity before completing the other colors, there is only one way in which this condition can be remedied, and this is not any too positive. This is to run the paper through a press which has a gas flame attachment (see picture page 26). The heat from the gas will dry out some of the moisture on the edges, and, if the paper is put into slip sheets as it is delivered (see picture page 27), it will not pick up moisture again very quickly. It is well always, on close register jobs run under conditions of excess humidity, to use slip sheets.



TWENTY-FOUR HOURS AFTERWARD

THIS is the same paper shown on the opposite page after it has been run through press and exposed to excessive humidity for twenty-four hours. Grain runs long way. Note the "waves" in end of pile

If paper run fresh from the cases has picked up moisture during the printing and continues to stretch so that a second form cannot be registered, it is because there is more humidity in the pressroom than there was in the paper as originally packed. The case is practically moisture proof and the moist air has not affected the paper. Each sheet of paper as it is exposed during the process of running picks up moisture with the result that before it stops stretching it is 1-16 to 1-4 inch longer and wider than when printed. The printing on the surface has stretched with the paper. (See reproduction of sheet on pages 4 and 5.) When the sheet goes through the press a second time there naturally is a pronounced discrepancy. The way to remedy this condition is to rack the paper and wait for normal humidity. The way to avoid it is to rack the paper in small lifts to let it stretch before running, or to run it through the press once without printing so that each sheet will be acclimated before printing.

The pictures on pages 30 and 31 show another form of protection against excessive moisture. This printer had to protect himself against extended periods of extremely humid weather and found these oilcloth containers more economical than slip sheeting.

There are more simple and yet effective ways of overcoming the difficulties caused by extreme dryness. Curling, electricity, offsetting and "cracking" or "breaking" during folding may be greatly helped by any one of a number of ways of injecting moisture into the room. Opening the pet cock of a steam radiator, sprinkling the floor, placing wet sponges on feed board and jogger table or placing pans of water around the room, will all help supply new moisture for the paper to absorb and less trouble will result from curling, electricity or offset.

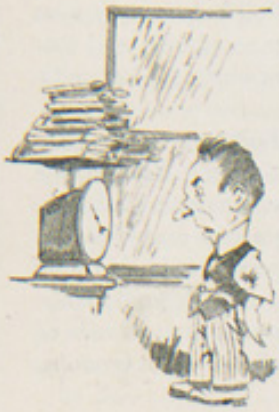
While all of these home made methods will help materially to overcome serious paper trouble in pressrooms and binderies, they do not insure anywhere near the uniform relative humidity which is desirable and almost a necessity if high grade color work is to be undertaken with assurance of a satisfactory amount of consistent economical production.

THE GAS FLAMES HELP TO DRY OUT MOISTURE

THIS shows press with gas flame attachment. The heat from this flame helps to dry the air coming in contact with the paper. This helps to prevent stretch

The manager of one plant doing high-class lithograph work states that, in printing a large size sheet, humidity must not change more than 2% if perfect register is to be obtained, but that with sheets half that size variations of 5% relative humidity may be allowed.

The following letter received from an executive of one of the finest printing plants in the United States, doing a business that runs into millions of dollars yearly, shows the difficulty of controlling humidity in the pressroom. This letter was written after the writer had made a fairly extensive canvass in search of methods to eliminate troubles caused by varying humidity:



"It is hardly necessary to say that I shall be very much interested in the article on 'The Controlling of Humidity in Pressrooms,' which you are preparing, and I shall appreciate very much your sending a copy of this to me.

"Very much to my regret, I cannot send to you any data or information that would be likely to be of any value to you. The problem is one which, so far as I know, no one has completely solved; and I am certain enough that we have not solved it. There is no doubt at all that a very large number of pressroom difficulties and delays would be prevented, and the efficiency of the pressroom would be greatly increased if some practicable method could be found to maintain uniformity of humidity and temperature, or if some genius should discover some method of making paper so that the paper would not expand and contract in response to changes in atmospheric conditions.

"We do succeed fairly well in controlling humidity and temperature in our offset pressroom. The methods which we have adopted, however, could not be practicable for our other

---

YOU'LL HAVE TO PROVE THIS

A printer whose veracity we have no reason to question told us that he once sent the advance mailing of 100,000 broadsides to the post office on a wet day and had them refused for one cent postage because of excess weight. The mailing weight had been guaranteed and the broadsides were folded in such a way that they could not be trimmed. After holding them and debating alternatives for a

ONE WAY TO KEEP OUT MOISTURE

SLIP SHEETING paper that is to be run many times through the press helps to keep moisture out and to prevent paper stretching

pressrooms, or at all events, could not be applied except at excessive cost."

A few large companies, among them those doing lithograph work, have installed devices to control the amount of humidity that enters the pressrooms. The amount of money required to install such devices, so far as we can determine, is far in excess of what most printers can afford to spend.

One of the very complete methods of helping paper adjust itself to pressroom humidity conditions which has come to our attention is that developed by the Stecher Lithographic Company of Rochester, pictures of which are shown on pages 28 and 29.

This machine is devised to expose each sheet of paper equally to air which contains approximately the same amount of humidity as the pressroom. Paper can be taken from the case and very quickly be put into just the condition that it would ultimately acquire if "racked" for days in the pressroom. Fibers in paper react very quickly to changed humidity conditions, 90% of any change usually taking place in the first ten minutes or less of exposure.

Our understanding of the Stecher machine is that it is not only used to season paper before printing, but also to bring back to size paper that has stretched or shrunk after one or more printings.

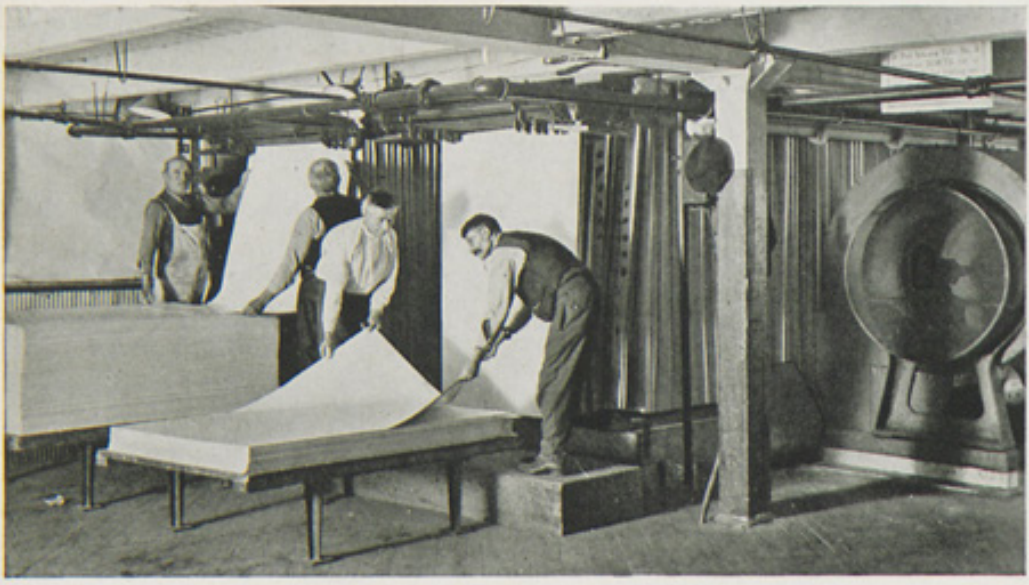
Mr. Moulton of the Stecher Lithographic Company of Rochester makes the following statement concerning the operation and sale of the Stecher Curing Machine.

"The Stecher Lithographic Company spent a good many thousands of dollars over a period of a number of years experimenting with various methods for the

(Continued on page 30)

ONE ON YOUR OWN SCALES

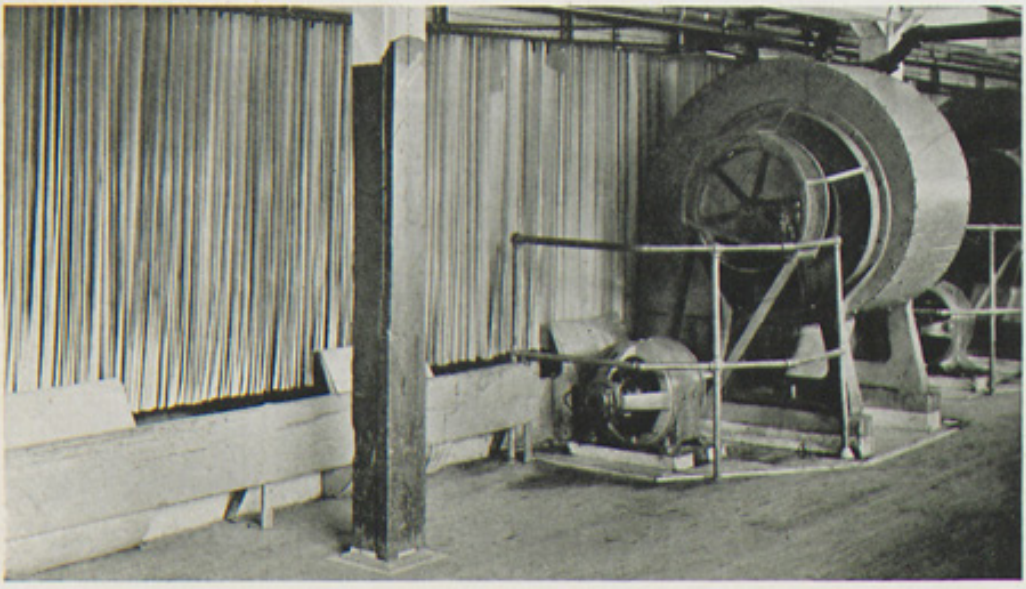
few days, it was decided to make another try at the post office. During the wait the weather had changed and had become extremely dry. To the surprise of the printer the post office accepted the shipment without question. The only solution in his mind seemed to be that enough moisture had dried out to let the job get by within the one cent rate.



HANGING PAPER IN THE STECHER CURING MACHINE

PAPER is being hung up in lifts of six to fifty sheets, depending on the thickness and weight of the paper, after which it travels through the Stecher Curing Machine. The picture below shows the paper as it travels through the machine and air is being blown between the sheets. The paper travels about fourteen inches per minute

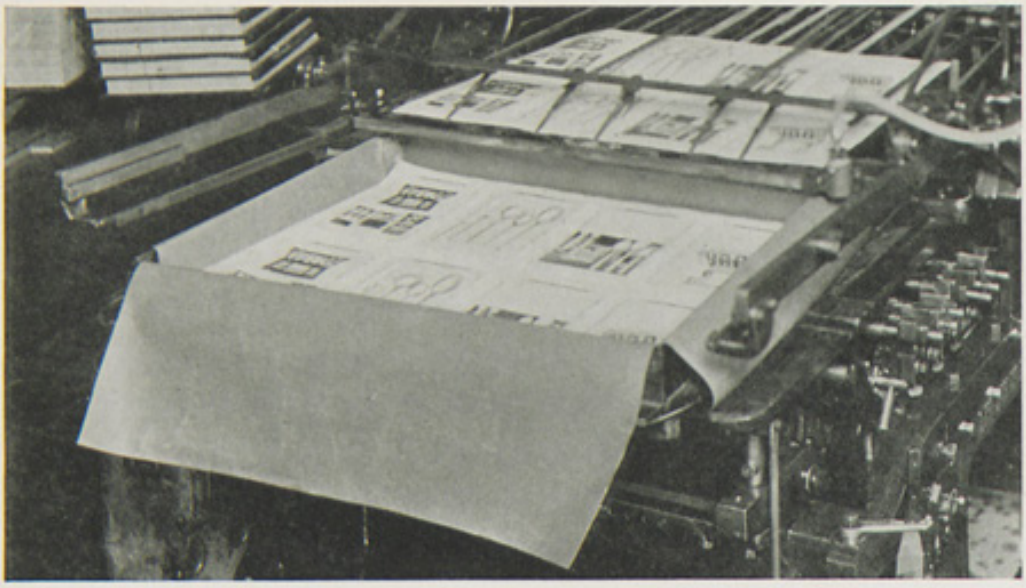
SHOWING HOW AIR IS BLOWN BETWEEN SHEETS



REVERSING SHEETS SO AIR WILL STRIKE ALL SURFACES ALIKE

After the paper has traveled 50 feet through the Stecher Machine, the lifts are reversed and hung from the other end, and then travel 50 feet more, so that the entire surface of the paper receives the same treatment. Picture below shows paper being taken down and put into piles. Notice that it lies perfectly flat

SHOWING PAPER LIES PERFECTLY FLAT AFTER TREATMENT



A STUNT SUGGESTED BY A COLOR PRINTER

A COLOR printer whose plant is so located that it is subjected to excessive moisture uses a sheet of oilcloth to protect the paper from the humidity. (See opposite picture.)

drying or seasoning of their stock, and finally developed and patented the Stecher Curing Machine. This machine is built in two sections, end to end, each section being a minimum of thirty-five feet in length; but they are generally built in fifty-foot sections.

"Photograph No. 1 (page 28) shows the paper as it is being hung up in the machine in lifts of from six to fifty sheets, depending upon the thickness and weight of the stock. After it is hung up, it moves at a speed of about fourteen inches per minute. Photograph No. 2 shows the paper hung in the Curing Machine going down through the room. After it has traveled fifty feet, the paper is reversed and hung the other end up, as shown in photograph No. 3 (page 29). It then travels the other fifty feet and is taken off the machine, as shown in photograph No. 4 and sent to the press. It takes about one and one-half hours for the stock to pass entirely through the Curing Machine.

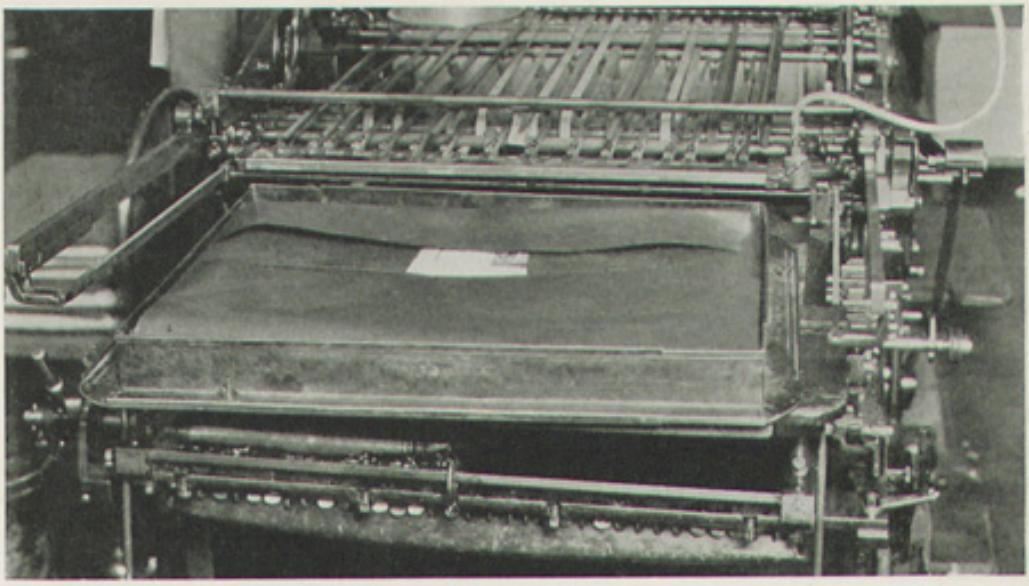
"As the paper is traveling down through these machines, air is being blown through these lifts from the bottom and from the sides from air ducts, as shown in the photographs. It is our endeavor to keep the air used for the Curing Machine as near the temperature and humidity of the pressroom as it is possible.

"Although the Stecher Lithographic Company are not in the machinery business, they have always shown a willingness to co-operate with other lithographers for the betterment of the trade and the improvement of manufacturing conditions; and have, therefore, consented to build these machines for other lithographers. There are two other lithographers that are now using these machines, others are considering installing them and Stechers are now building machines to go to England."

Considerable experimenting has been done within the past year or two by manufacturers of humidifying devices in their attempts to overcome conditions existing

HOT STICKY WEATHER ALWAYS ADDS SOMETHING TO THE PLEASURES OF A MARRIED MAN

If "wifey" could "wait till tomorrow" for the gold clasp that she wants to use to pin the bib on the baby, life would be more cheerful for this busy individual. The same thing that makes the wood in the bureau drawer swell makes paper also swell out of shape—namely, the moisture in the air.



THE OILCLOTH CONTAINER CLOSED UP

This shows how the sheet of oilcloth is wrapped about the lift of paper, protecting it completely. (See picture opposite.)

in pressrooms and binderies and produce a device which could be offered at a price which would enable the smaller printer to equip his plant. Much progress has been made along these lines. Some of the more satisfactory ones which have come to our attention are those made by the American Moistening Co. of Boston, the Parks-Cramer Co. of Fitchburg, Mass., and the Bahnson Co. of Winston-Salem, N. C. See illustrations shown on pages 33, 34 and 35.

MOISTURE IN PAPER AND ITS EFFECT ON INK

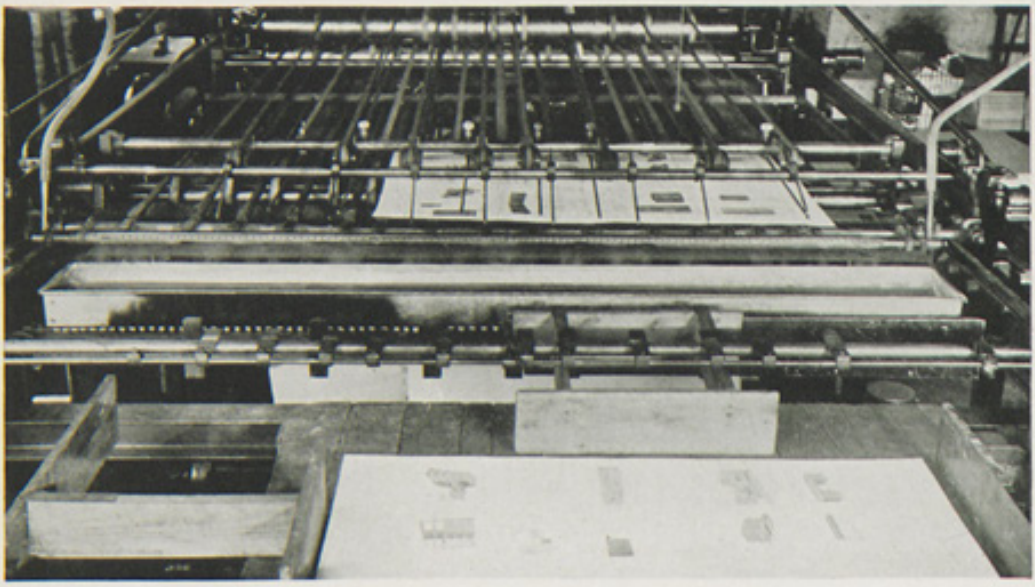
We are making no attempt here to completely cover the subject of ink and its relation to paper. We do want, however, to mention the relation moisture in paper has to the proper working of ink.

There are two ways in which ink dries; one is by absorption, the other is by oxidation. Ink dries on plain and dull surfaces and uncoated papers largely by absorption, while just the reverse is true in the case of highly coated papers where of necessity ink must dry largely by oxidation.

If inks mixed to dry largely by absorption are applied to a sheet of paper which already contains an excessive amount of moisture, it is obvious the paper cannot absorb or set the ink as quickly or as readily as it should. Such conditions will tend to increase offset and smooching.

Two tone inks require very careful consideration of moisture in paper. The stain in a two tone ink applied to a sheet of paper containing excessive moisture will "spread" or "crawl" from the edge of the halftone dot to a larger extent than on a paper with less moisture. If paper is too dry the stain in two tone ink may strike through the sheet, the dry paper absorbing the free stain very quickly, even to the extent of showing on the reverse side, and it may show absolutely no two tone effect.

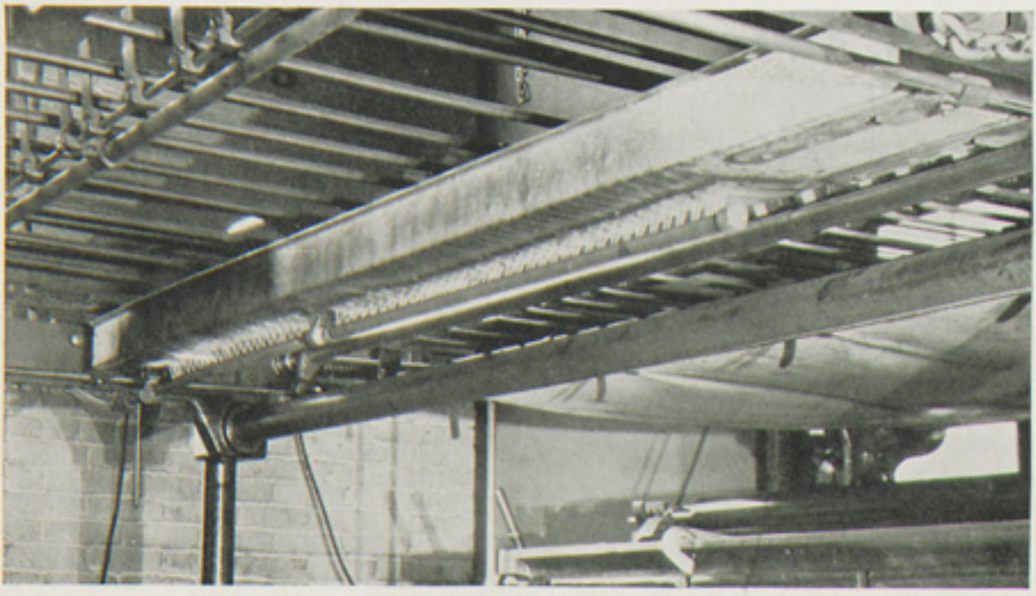
These are a few of the troubles likely to occur in applying ink to paper containing too much or too little moisture. They show, however, the necessity of knowing moisture conditions if quality printing is to be produced.



SHOWING VAPOR PAN FROM ABOVE THE PRESS LOOKING DOWN

Good results have been obtained in restoring humidity to paper by the installation of this vapor pan. A burner and valve at each end of the gas tube insure a uniform size flame from end to end. Repeated tests have shown that the paper either, coated or uncoated, is not harmed and folds better after passing through the vapor rising from the water heated in this pan

VIEW OF WATER PAN FROM UNDERNEATH AS INSTALLED AT THE DELIVERY END OF CYLINDER PRESS



A BRIEF EXPLANATION OF THE PRINCIPAL TYPES OF HUMIDIFIERS

Humidifiers may be broadly classified into two main groups:

(*a*) Those which inject free moisture into the air.

(*b*) Those which supply previously heated or cooled, moistened or dried air.

Group (*a*) consists of unit water pressure fan type and compressed air atomizer humidifiers.

The unit water pressure humidifier (Type A, pages 34, 35), 100-150 lbs. per square inch, is efficient and economical.

The atomizer type (Type B, pages 34, 35) operates on compressed air with no pressure on the water, a feature which prevents overflow without the use of any type of automatic valve.

In the centrifugal type (Type C, pages 33, 34, 35) the water, fed under very slight pressure, is thrown from the periphery of a fast revolving disc against a corrugated copper sheet which breaks up the drops of water so finely that the surrounding air is capable of absorbing them before they can be deposited on adjacent walls or machinery.

It is impossible to de-humidify, withdraw the moisture, to any appreciable extent with any of the devices in group (*a*).

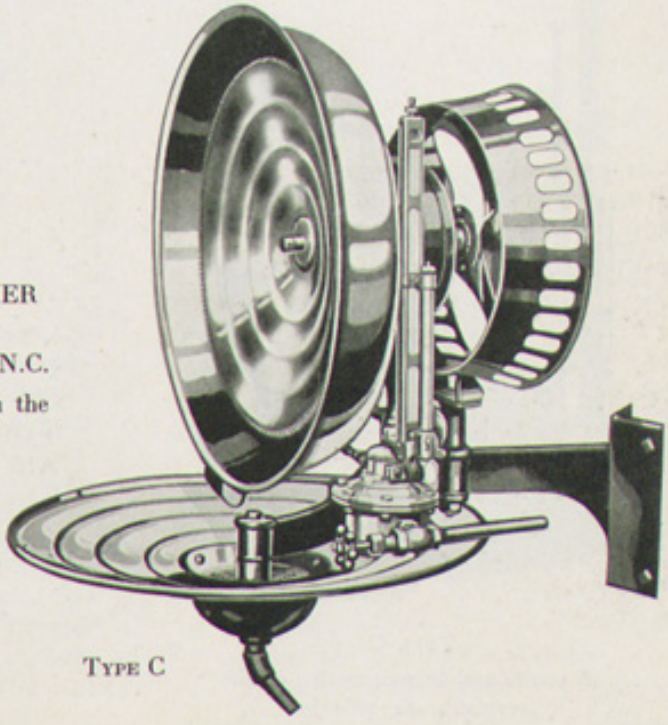
Group (*b*) consists of central station humidifiers (see page 36), the only type which will de-humidify.

All of the above types should be automatically controlled.

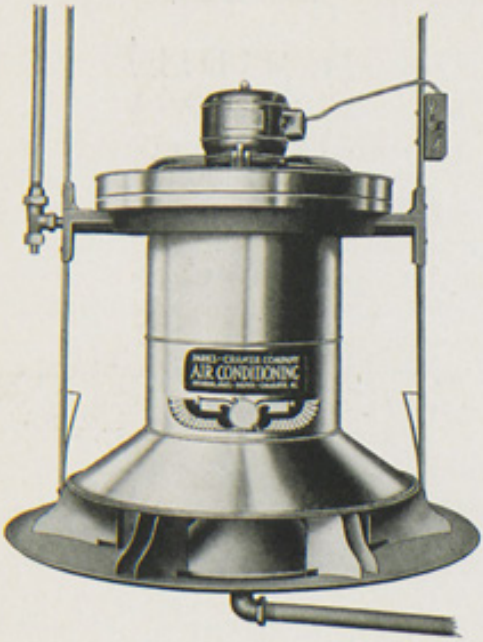
THE BAHNSON HUMIDIFIER

Manufactured by
The Bahnson Co., Winston-Salem, N.C.

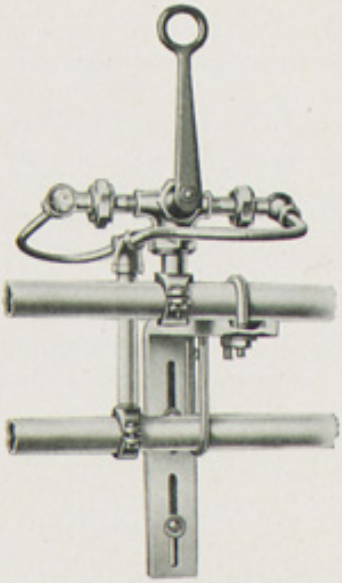
A centrifugal type operating on the revolving disc principle



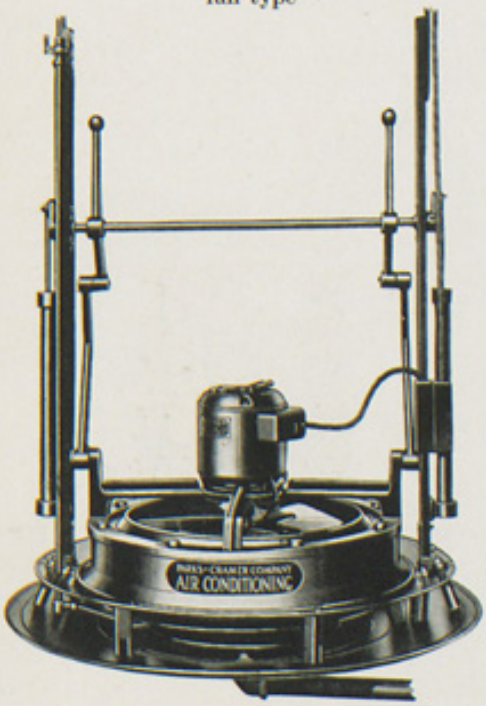
Type C



TYPE A
Unit water pressure humidifier
fan type



TYPE B
Turbo-atomizer type. Operates on compressed air



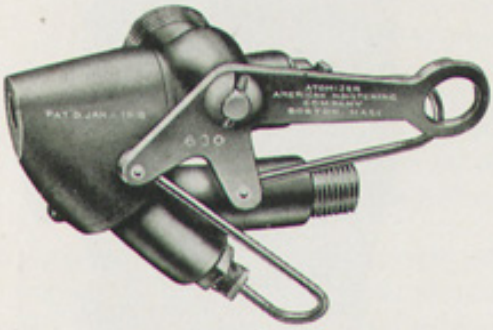
TYPE C
A centrifugal type operating on the
revolving disc principle

THREE TYPES OF
PARKS-CRAMER COMPANY'S
AIR CONDITIONING DEVICES
Manufactured by
Parks-Cramer Company
Fitchburg, Mass.

THREE TYPES OF AMERICAN MOISTENING COMPANY'S HUMIDIFIERS

Manufactured by
American Moistening Co.
Boston, Mass.

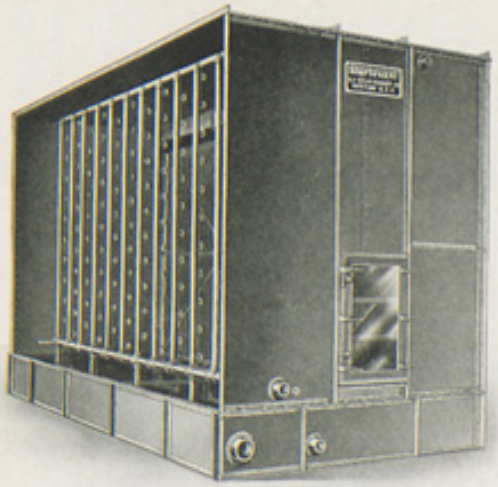
TYPE A
Unit water pressure humidifier



TYPE B
Atomizer type. Operates on compressed air

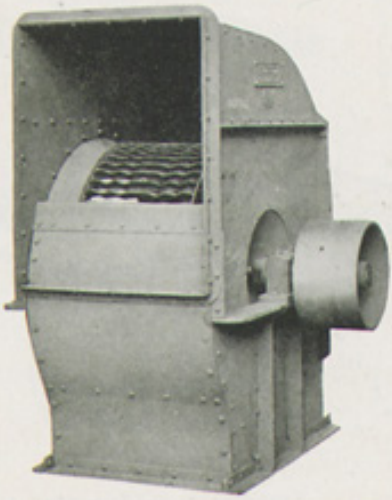
THE devices on this and the two previous pages are some of the more recent developments which have come to our attention for injecting moisture into a room when humidity falls below normal. We understand from the manufacturers that these devices may be obtained at prices which will now enable many medium size plants to make installations which will help materially in overcoming pressroom and bindery trouble resulting from radical changes in humidity. Illustrations are shown here by courtesy of the manufacturers

TYPE C
A centrifugal type operating on the revolving disc principle



STURTEVANT AIR WASHER SHOWING SPRAY CHAMBER AND ATOMIZING NOZZLES

Manufactured by
B. F. Sturtevant Co.
Boston, Mass.



THE STURTEVANT MULTIVANE FAN USED EXTENSIVELY IN STURTEVANT AIR CONDITIONING SYSTEMS

THE STURTEVANT AIR CONDITIONING SYSTEM

The principal equipment in this system consists of the air washer and fan blower.

The incoming air passes through a spray chamber where it picks up the required moisture. In the winter, when outside humidity is low, the water, which is ejected from spray nozzles, is heated by discharging steam right into the tank. Steam coils heat the incoming air directly.

Humidity and temperature are controlled automatically.

In the summer excessive humidity is reduced by heating the air before it leaves the fan.

The fan illustrated is Sturtevant, Size 8, Design 3 Multivane, with a capacity of 25,000 cu. ft. a minute; discharges the air directly into the pressroom.

POINTS TO REMEMBER REGARDING HUMIDITY

Most paper troubles during the winter months will be largely from excessive dryness and low or radical changes of temperature.

These will be in the form of:

1. Shrinking of sheet causing poor register—likely to occur if first color is run on paper directly from case before it has adjusted itself to humidity conditions of pressroom.
2. Curling—likely to occur when paper is exposed to dry or artificially heated air which has been given no opportunity to absorb moisture.
3. Electricity—likely to occur to excess with paper brought from cold room to warm, dry, artificially heated pressroom.
4. Surface cracks in folding—likely to be serious if the paper has been exposed in dry, artificially heated rooms for several days and been over gas flame attachments.

While it is true these troubles will prevail most generally in the winter months, they will also occur and interfere seriously with good pressroom and bindery performance during extended periods of warm, dry summer days.

It is during the spring and summer months, with their damp and sultry days and quick changes from high to low, or low to high relative humidity, that most paper troubles caused from excessive moisture will occur.

These will be in the form of:

1. Stretching and shrinking causing poor register—likely to occur with quick changes of humidity from day to day or even during day. (See table page 22.)
2. Wavy edges causing slur and wrinkles—likely to occur in short period with papers taken from case and piled, exposed to excessive humidity conditions.

All of these paper troubles can be controlled to a degree which will insure good pressroom and bindery performance with a careful checking of relative humidity in each plant. With the expenditure of only the small amount necessary for a good hygrometer any printer can check his humidity conditions and at least be warned in times of extreme changes and govern his production accordingly.

A little study of the various angles of this humidity question and its relation to good performance of paper on presses and folders will amply repay any printer and will help reduce production costs. It is a much simpler matter to forestall trouble from too much or too little humidity in the pressroom or bindery than to wait until the difficulty is encountered.

These are the
WARREN
Standard Printing Papers

Warren's Cameo—Dull Coated Book	*Dull Surface*
Warren's Cameo Post Card—Dull Coated	*Dull Surface*
Warren's Cameo Cover—Dull Coated	*Dull Surface*
Warren's Silkote—Dullo-Enamel Book	*Semi-dull Surface*
Warren's Silkote Post Card—Dullo-Enamel	*Semi-dull Surface*
Warren's Silkfold—Strong Dullo-Enamel	*Semi-dull Strong Coated*
Warrenfold—Strong Coated	*Glossy Strong Coated*
Warrenfold Coated Writing	*Glossy Strong Coated*
Warren's Lustro—Superfine Coated Book	*Glossy Surface*
Warrentown Coated Book	*Glossy Surface*
Warren's Cumberland Coated Book	*Glossy Surface*
Warren's Litho Coated	*Glossy Surface*
Warren's Litho Super	*Super-calendered*
Warren's Litho Machine	*Machine Finish*
Warren's Offset	*Offset*
Warren's Printone—Semi-Coated	*Extra Smooth Surface*
Warren's Library Text—Fine English Finish	*English Finish*
Warren's Olde Style—Antique Wove (Watermarked)	*Eggshell Finish*
Warren's Olde Style—Antique Laid (Watermarked)	*Laid Antique*
Warren's Olde Style Mimeograph—Laid (Watermarked)	*Mimeograph*
Warren's Cumberland Super Book	*Super-calendered*
Warren's Cumberland Machine Book	*Machine Finish*
Warren's "1854" Publisher's Book	*Medium Finish*
Warren's No. 66 Book—Bulking Antique	*Antique Finish*
Warren's Thintext—India Paper	*for Thin Editions*
Warren's Thinweave	*Carbon Copy Bond*
Warren's Fineleaf—Makeready Tissue	*Makeready Tissue*
Warren's Booklet Envelope Paper	

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better printing

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THE REFLECTED WORKS