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GROUND-WOOD PULP.

By J. H. THICKENS, *Chemical Engineer in Forest Products*, and G. C. McNAUGHTON,
Engineer in Forest Products.

CONTENTS.

	Page.		Page.
Object of the bulletin.....	1	Part I—Contd.	
Present status of the ground-wood industry.....	2	The effect of variable grinding conditions.....	17
Present methods of manufacture.....	6	Part II—	
Part I—		Experimental and commercial tests on	34
Equipment used in the experiments.....	7	various woods.....	67
Methods employed in experimental tests.....	9	Appendix A.....	
Effect of preliminary treatment of spruce.....	11	Appendix B.....	151

OBJECT OF THE BULLETIN.

This bulletin presents the results of tests on (a) the grinding of steamed or cooked spruce for mechanical pulp and (b) the results of tests on a number of American woods to determine their suitability as substitutes for spruce in the manufacture of ground-wood pulp.¹ If the price of news-print paper is to be kept at a reasonable figure, more efficient methods of converting spruce into pulp must be developed or else a cheaper wood substituted for the former. The results of experiments meant to develop greater efficiency in the grinding of uncooked spruce have already been presented in Forest Service Bulletin 127, "The Grinding of Spruce for Mechanical Pulp." That bulletin also discusses the influence of the many

¹ Acknowledgment is made to Mr. C. P. Winslow, Mr. Henry E. Surface, and Mr. S. D. Wells, engineers in forest products, and to Mr. S. E. Lunak, assistant chemist in forest products, Forest Service, for aid in the preparation of this report. Acknowledgment is also due Messrs. G. F. Steele, W. G. McNaughton, and L. M. Alexander, of the Nekoosa-Edwards Paper Co., and Mr. D. C. Everest, of the Marathon Paper Mills Co., for assistance rendered during the tests; also to Mr. C. W. Knapp, of the St. Louis Republic, and to Messrs. P. W. Schaeffer and E. D. De Witt, of the New York Herald, for providing the presses upon which the experimental papers were tried out. The maps in this bulletin showing the range of the various tree species were prepared in the Forest Service by Mr. William H. Lamb, assisted by Miss Georgia Wharton.

NOTE.—This bulletin contains valuable information as to the use of various species of wood in the manufacture of paper and is of interest to manufacturers and users of paper.

variable conditions in the manufacture of mechanical pulp, such as surface of stone, pressure with which the wood is forced upon it, peripheral speed, temperature of grinding, etc. Since the conclusions reached in regard to these are applicable to the production of pulp from coniferous woods in general, it is advisable to have a copy of Bulletin 127 at hand when reading the present one.¹

All the tests described in this bulletin were carried on at the Forest Service ground-wood laboratory at Wausau, Wis., a branch of the Forest Products Laboratory, Madison, Wis., in cooperation with the American Paper and Pulp Association, which furnished all the pulp-making equipment for the laboratory, and with an advisory committee consisting of Messrs. G. F. Steele, chairman, and W. G. McNaughton, secretary, Nekoosa-Edwards Paper Co.; D. C. Everest, Marathon Paper Mills Co.; W. L. Edmonds, Wausau Paper Mills Co.; A. M. Pride, Tomahawk Paper Co.; and William Eibel, Rhineland Paper Co.

PRESENT STATUS OF THE GROUND-WOOD INDUSTRY.

Thirty-five to forty-five years ago news paper was made almost entirely of rags. Upon the introduction of the sulphite process of wood-pulp manufacture varying amounts of that product were added to the rag pulp, and later ground wood was made a part of the mixture, but only in small quantities. Ground wood was for many years nothing more nor less than a filler and not expected to add any strength to the sheet produced. There is shown in figure 1 the average contract price (f. o. b. mill) of news-print paper from 1874 to 1912. The effect of the introduction of the cheaper processes is evident.

In 1870 there were only 8 establishments reported which made ground wood, and the product manufactured during that year was valued at \$172,000. Ten years later, in 1880, 50 establishments produced \$2,257,000 worth of ground wood. In 1890, 82 establishments reported products valued at \$4,628,000. In 1900 there were 91 plants reported, which produced 280,520 tons of ground wood for sale, and 77 mills which produced 306,520 tons of pulp for their own use, a total of 168 mills, producing 586,000 tons, valued at approximately \$9,300,000. In 1909 there were produced a total of 1,179,266 tons of mechanical pulp. Of this amount 310,747 tons were manufactured for sale or consumption in mills other than where produced, the value being \$5,649,466. The remainder, 868,519 tons, assumed to have the same value of that made for sale, was worth approximately \$15,780,000, or a total value of product of \$21,430,000.

¹ Copies of Forest Service Bulletin 127 may be procured from the Superintendent of Documents, Washington, D. C., for 15 cents each.

In 1911, 1,229,719 tons of mechanical pulp were produced, an increase of approximately 50,000 tons.

While the industry has developed very rapidly in the United States, the rate of development has not kept pace with the rate of consumption of the product. This is evident from a consideration of the imports and exports of both mechanical and chemical pulp over a period of years, as shown in figures 2 and 3. Figure 2 shows the imports of mechanical pulp, both free and dutiable, by months for a period of years, while figure 3 (curve *B*) shows the imports of mechanical pulp by years. The first of these curves is particularly

FIG. 1.—Average contract prices for news-print paper 1878-1912.

interesting, because it shows the seasonal fluctuation of imports. Figure 3 (curve *A*) shows the imports and exports of wood pulp, both mechanical and chemical. The increase in the amount of pulp imported is very marked, while the exports are comparatively small. It is evident from these curves that considerably more pulp will have to be manufactured at home before there can be any material expansion into the export trade.

Spruce furnishes by far the greater part of the wood at present used for mechanical pulp. Of the 1,314,141 cords consumed in the United States by the mechanical process in 1911, spruce supplied 1,121,703 cords, or 85 per cent, 822,743 cords of which were native

wood and 298,743 imported. Of the 4,328,052 cords of wood used in the United States in 1911 for pulp of all kinds, spruce furnished 2,505,730 cords, or 57 per cent.

FIG. 2.—Imports of mechanical pulp, July, 1908, to January, 1914, inclusive.

The annual consumption of spruce in this country for all purposes is something like 2,575,000,000 board feet. The available stand east of the Rocky Mountains was estimated in 1907 to be 35,000,000,000

feet, with an annual increment due to growth of 770,000,000 feet. While it is probable that the maximum annual consumption of spruce for lumber has been reached, and that that for pulp wood will scarcely go much higher, it is nevertheless clear that with the maintenance of anything like the present annual consumption the spruce forests of this country are threatened with exhaustion. Nor is it likely that the American consumer of spruce wood will be able to draw to whatever extent he wishes upon the Canadian supply. In 1900 the Province of Ontario prohibited the exportation of unmanufactured wood cut on Crown lands within the Province, and later the Provinces

FIG. 3.—Imports and exports of wood pulp, 1901-1913, inclusive.

of Quebec (1909) and New Brunswick (1911) passed similar legislation. Further restrictive measures regarding the exportation of unmanufactured wood will undoubtedly be taken by Canada if the need arises.

The rise in the price of spruce over the 10-year period from 1900 to 1909, inclusive, reflects a steady increase in the consumption of mechanical pulp and a decrease in the available supply of the wood. In 1900 the average cost of spruce used for pulp-making purposes in the United States was \$4.28 per cord for domestic and \$6.50 per cord for imported material. In 1909 the average price for domestic spruce

had risen to \$8.32 per cord, and for imported to \$11.34 per cord. During the same 10-year period the average cost of manufacturing ground-wood pulp increased from \$10.84 per ton to \$16.58, by far the greater part of this increase being due to the greater cost of the wood used. Thus the manufacturer of mechanical pulp is faced with a steady increase in the cost of his raw material, and one which promises to continue if he must rely almost wholly upon a single wood. The great bulk of mechanical pulp produced is used in the manufacture of news-print paper, and the problem which presents itself is whether woods other than spruce can be used for the purpose. It was to answer this question, at least in part, that the experiments described in this bulletin were undertaken.

PRESENT METHODS OF MANUFACTURE.

The present method of manufacturing ground-wood pulp has been in use for a long time. Since 1867, when the mechanical process was first introduced into this country, principles and methods have changed but slightly. The size and capacity of the grinders have been increased and the raw material changed from poplar to spruce, but otherwise the industry is following its first lines. As in any other industry, however, details of manufacture differ in different mills. Of two mills producing news-print paper, for example, one uses 135 horsepower to the grinder, the other 625. One employs a grinder cylinder pressure of 17.5 pounds per square inch; the other, with a cylinder of the same size, a pressure of 72 pounds. One runs at a peripheral speed of 2,660 feet per minute, the other at a speed of 3,540 feet. Such details of operation may differ among mills producing the same kind of paper even more widely than those just cited. Reports of power consumption show a range of from 31 to 135 horsepower per ton in 24 hours. The first value is undoubtedly wrong, since it has been demonstrated experimentally that such a low power consumption is impossible with the present grinding equipment.

Upon its receipt at the mill the wood is either stored for a considerable time in the yard or else is ponded. Before storage the wood is sometimes cut into 2-foot lengths, or in other cases is rossed.

The grinders ordinarily take a pulp-stone approximately 54 inches in diameter by 27 inches face. Some stones recently installed are as large as 60 inches in diameter and 48 inches face. Up to a few years ago natural quarried stones were the only kind used in the grinding process, but many mills are now experimenting with artificial stones. The grinding is usually carried on under conditions of high temperature brought about by admitting only small quantities of water to the pit of the grinder. In the cold-grinding process, which is sometimes used in the United States and very largely adhered to in Europe, an excess of water prevents any heating.

Upon leaving the grinder a large supply of water is added to the pulp, and the mixture is then screened. If it is to be shipped over a long distance, the pulp is run into laps by means either of wet machines or of hydraulic presses. Occasionally the pulp is dried on steam driers and run into rolls. When pulp is used where it is produced, except for the need of storing to provide a supply in times of low water, it is thickened by means of feltless wet machines or deckers and immediately manufactured into paper.

In the last few years a magazine pulp grinder has come into use, equipped with two pockets which are filled automatically from the magazine. The machine, however, has not been operated in this country to an extent which would enable a judgment to be formed regarding its efficiency and economy.

Part I.—THE GRINDING OF COOKED AND UNCOOKED SPRUCE.

EQUIPMENT USED IN THE EXPERIMENTS.¹

APPARATUS FOR COOKING.

Cooking treatments prior to grinding were carried on in a cylindrical closed steamer 3 feet in diameter by 8 feet high, designed for 75 pounds' working pressure. The "steamer" was fitted with steam, water, and vacuum connections and the necessary gauges and thermometers for determinations of pressure and temperature. An open steamer 6 feet wide, 8 feet long, and 3 feet deep was also available for cooking treatment at atmospheric pressure.

ELECTRICAL EQUIPMENT.

In order to satisfactorily vary the conditions of grinding, secure adequate data on power consumption, and maintain the speed constant, it was necessary to install a rather complex system of electrical drive and control for the grinder. The method of speed regulation was known as the Ward Leonard system, and by its means a very flexible arrangement was secured.

The installation consisted of a motor generator set of 460-kilo-volt-amperes full-load capacity and a direct-current, variable-speed motor having a full-load capacity of 500 horsepower at 300 revolutions per minute. With the overload capacity it was possible to secure fully 75 per cent more power than the rating from each of the machines.

Three-phase 60-cycle electric power was applied to the synchronous motor of the motor generator set at 2,300 volts. The generator of the motor generator set was separately excited and by means of a rheostat

¹ A more detailed description of the equipment of the Forest Service laboratory at Wausau, Wis., is given in an unnumbered publication of the Forest Service, "Experiments with Jack Pine and Hemlock for Mechanical Pulp."

in the field circuit direct current could be generated at any desired voltage from 100 to 700 volts. The direct-current motor connected to the grinder was also separately excited and the speed of rotation controlled by regulating the voltage applied to the armature, the voltage control being brought about by variation of the field current of the direct-current generator. The speed of the grinder motor could be varied from 100 revolutions per minute to 300 revolutions per minute, the capacity with overload at the same time varying from approximately 340 horsepower to 750 horsepower.

The efficiency of the direct-current motor could be determined very readily by means of curves showing the stray power and heat losses at different speeds and current loads and knowledge of the power supplied to the motor. The latter data were obtained by means of accurately calibrated indicating and recording electrical instruments.

The various pieces of apparatus used in the manufacture of the pulp were driven by individual direct-connected motors. The apparatus for wood preparation, 40-inch swing saw, and "Green Bay" barker, together with the wet machine vacuum pump, were driven from a single-belted motor. Some of the individual motors were of the variable-speed type, and as a result the pieces of apparatus to which they were connected could be driven at the most effective speeds.

PULP MACHINERY AND AUXILIARY EQUIPMENT.

All of the pieces of machinery installed in the Wausau laboratory were of commercial size and design and were loaned either by manufacturers or others interested in the work being carried on.

The grinder was built by the Friction Pulley and Machine Works. It took a stone 54 inches in diameter by 27-inch face and had three 14-inch cylinders. Each cylinder was provided with a pressure gauge and the water was supplied by two triplex pumps. The pressure at which the water was pumped was regulated by relief valves; pressures as high as 120 pounds per square inch could be obtained.

A recording thermometer gave a record of the temperature in the grinder pit. From the grinder pit the pulp was passed through a mechanically agitated sliver screen, then pumped to a storage tank by means of a 5-inch centrifugal pump, and from there pumped to a centrifugal screen. A variable-speed motor direct connected to the screen made it possible to obtain speeds of rotation from 400 to 600 revolutions per minute. Throughout the tests, however, the speed was maintained at 500 revolutions per minute. The plate in the centrifugal screen was perforated with holes 0.065 inch in diameter.

The tailings from the centrifugal screen were rescreened through a 12-plate Harmon diaphragm screen, the plates used being the Union Screen Plate Co.'s type B, cut with 0.012-inch slots.

The screened pulps from the centrifugal and the flat screen were united and run out on an Improved Paper Machinery Co.'s 3-roll hydraulic wet machine. The white water from the wet machine was pumped back to the sliver screen of the grinder by means of a 4-inch centrifugal pump. White water from the felts was run to the sewer, as was also the white water from the felt suction.

PAPER-MAKING EQUIPMENT.

Portions of the pulps secured from experimental runs were sent to the Forest Products Laboratory at Madison to be run into paper. The apparatus available for the purpose when the earliest tests were made consisted of a pulp shredder, 12-pound Emerson beater, 2-plate flat screen slotted with 0.012-inch slots, and a 12-inch Fourdrinier paper machine. Later a Noble and Wood's jordan engine was added to the equipment. This was used only, however, in the preparation for the paper machine of pulps made from miscellaneous woods. The stock which was run on the machine in carrying on series tests to determine the effect of variable grinding conditions on the strength of pulp was not jordaned.

METHODS EMPLOYED IN EXPERIMENTAL TESTS.

PREPARATION OF WOOD.

All of the wood received at the laboratory was stored on skids in the yard and in most cases allowed to season before being used. It was received in several different forms; some cut from very large trees was split before shipping; some was rossed in the woods; but the greater part was in the form of round rough logs varying from 4 to 14 inches in diameter. The wood for test was sawed as required into 2-foot sections and barked, samples being taken for the determination of moisture and dry weight per cubic foot. The amount desired for the test was weighed and the diameter of each piece was measured. Tests were conducted as soon as possible after the wood was prepared and weighed.

In some cases it was necessary to remove knots before grinding, especially when the knots were likely to cause dirt in the pulp. This procedure was more often required for jack pine and aspen than for other woods.

In case the wood was to be treated it was piled in the steamer after having been carefully weighed. Depending on the conditions of the cook, the pressure was maintained constant at the desired value for different lengths of time. Cooks were made at steam pressures of from 5 to 75 pounds per square inch and for different lengths of time, from 1 to 12 hours. In some cases the wood was steamed and the condensation was drawn off as it formed; in others, the wood was immersed in water and boiled at different steam pressures, the

condensation being blown off as soon as the temperature fell below that corresponding to the steam pressure in use. In some cases, after cooking the required length of time, the charge was allowed to stand until it had absorbed a large amount of water. After unloading, the wood was weighed and then ground as soon as possible. In several instances samples were taken after cooking and the bone-dry weight and the moisture were determined.

GRINDING.

Before starting the test the desired surface was placed on the stone by means of a mechanically controlled burr or bush roll. The stone was then washed until free from loose sand and an impression of the stone was taken by means of carbon and coated paper. (See Forest Service Bulletin 127.) The grinder pockets were filled, the pressure adjusted to the correct value, the recording instruments were placed in operation, and the test was then started.

The speed and pressure were maintained as constant as possible throughout each test. Pocket binding was eliminated by the constant observation of power applied to the grinder, a falling off in power consumption with pressure on indicating binding. When a piston was raised, instead of allowing the speed to increase, it was held constant by regulation of the voltage on the motor armature.

In series tests in which the surface of the stone was not altered, but the speed, pressure, or temperature were, the data secured may be more or less open to criticism, since the surface undoubtedly changed slightly from one test to another. However, this change was very slight.¹ Likewise, in short tests it was impossible to heat up the stone thoroughly and here also a very slight error was introduced.¹

During the tests readings were taken of power, speed, pressure, temperature, and the like, the intervals of reading being 15 minutes in most cases, although 5-minute intervals were sometimes employed.

LOSSES IN CONVERSION.

While it is highly desirable that the losses occurring in the barking of different woods be determined, it was impossible to investigate this point satisfactorily. Only small amounts of wood were used, in some cases not more than 8 cords, and determinations on such small amounts would not yield reliable results.

The amount of wood used during any test and the amount of wet pulp manufactured was accurately determined by weighing. Moisture samples were taken of both the pulp and the screenings and the bone-dry weight of each determined. In some cases the amount of wood fiber in the white water was secured by measuring the amount

¹ This point is discussed in more detail in Forest Service Bulletin 127, "The Grinding of Spruce for Mechanical Pulp."

of white water used and determining the wood fiber in a sample of it. This proved rather unsatisfactory, and was discontinued on account of the difficulty in removing the wood fiber from the white water sample.

The yield of pulp has been calculated to a basis of 100 cubic feet of solid rossed wood, this factor being thought more satisfactory and accurate than a measured cord, and representing approximately the solid content of a piled cord of 2-foot rossed wood containing 128 cubic feet.

TESTS ON THE PAPER.

The sample of pulp to be run into paper was first shredded and the moisture determined. The required amount was then weighed out and mixed and beaten with a weighed amount of bleached spruce slow-cook sulphite. In some runs, particularly those made on some of the pulps made from cooked woods, the sulphite was dispensed with. The mixture, usually 20 per cent sulphite to 80 per cent ground wood, was beaten until the fibers were separated, generally about 1 hour. The stock was then run out on the paper machine and an uncalendered sample was taken for strength and color tests.

No size, color, or loading was added to any of the sheets, the desire being to present the pulps made from different woods and under different conditions in as nearly comparable conditions as possible.

The uncalendered samples of paper were tested for tensile strength, lengthwise and crosswise, by means of a Schopper breaking length tester, and for bursting strength by means of a Mullen tester. The color tests were made with an Ives tintphotometer and measurements were made of the thickness of the sheet and weight per ream.

EFFECT OF PRELIMINARY TREATMENT OF SPRUCE.

Spruce has been used for many years as a raw material for ground-wood pulp, but the effect of the production of pulp from it under varying conditions has never been given very careful study. Depending on the quality of the product desired, different conditions of grinding must be selected, and in some cases the wood must even be given a cooking treatment prior to grinding. In the manufacture of container board, where great strength is desired and the color is of lesser consequence, strength is often increased by the addition of sulphite or sulphate pulp, screenings, or old paper stock. In the manufacture of news print paper, strength is desired too, but not nearly so much strength, the color, yield, and finishing characteristics here being the prime consideration. The work which has been done on spruce has been carried on with the idea of attempting to increase the efficiency of grinding both from the standpoint of reducing the power consumption and increasing the yield from a cord of the raw material in either the cooking or ordinary ground-wood process, and

to ascertain the influence on the quality and quantity of pulp produced by the variation of the grinding variables, such as surface of the stone, pressure on the cylinders, speed, temperature, etc.

The cooking of wood prior to grinding is attended with a number of changes in the physical characteristics of the wood which greatly influence the quality of the pulp manufactured from it. The cooking condition must be chosen according to the use to which the pulp is to be put. For the manufacture of news-print paper from pitchy woods it is essential that the treatment be a very mild one, and that the duration of boiling or steaming and the temperature at which it is carried on be such as to allow of the fiber being as light in color as possible. Either the pressure, or corresponding temperature, must be low and the cook of long duration, or the pressure higher and the

FIG. 4.—Effect of steaming pressure on color of pulp (average values of several runs on spruce).

cook of much shorter duration. It is generally claimed that cooking the wood under pressure while immersed in water will yield a lighter pulp than steaming at the same pressure and for the same length of time, but this result has not been noted.

Boiling wood has certain disadvantages which are not found when the steaming process is used. There is a considerable loss of heat, and it is necessary to draw off condensed liquors to maintain the temperature at any desired value. This makes it necessary to pay greater attention to the process. If the temperature and duration of the cook are the same, the steamed or boiled wood should be practically the same in color and other physical characteristics. One decided advantage of steaming is the possibility of draining off the condensed liquors in a concentrated form. This is of great benefit when by-products are to be recovered.

In all of the experiments conducted in cooking wood prior to grinding, the temperature corresponded to the temperature of boiling at the steam pressure under which the cook was being made. Attempts were made to secure by-products, but the amounts of wood used were so small that this could not be done satisfactorily.

INFLUENCE OF PRESSURE, TEMPERATURE, AND TIME OF COOKING.

When the length of time of the cook is kept constant and the cooking pressure or temperature is varied, it is found that the color of the pulp made darkens greatly when these factors are raised, all other conditions being the same. This is demonstrated by reference to the

FIG. 5.—Effect of duration of steaming on color of pulp. (Average values of several runs on spruce.)

curves in figures 4 and 5, where the amount of black in the color as determined by a tintphotometer is plotted against the cooking pressure and temperature. At some steam pressure the wood will char and the resultant pulp will be black; under this condition a maximum of 300 parts black would be secured. It is probable that this steam pressure would not be very high, since the values of parts of black increase rapidly after 60 pounds pressure is reached.

The strength of the pulp increases with the length of the steaming period (fig. 6) and seems to reach a maximum in about 8 hours for both pressures. In figure 7 is shown the variation of the yield of pulp per 100 cubic feet of solid rossed wood, with the pressure of steaming and the duration of the cook. The marked effect of the duration of the cook, especially at high pressure, is evident. The yield decreases

rapidly with increased pressure due to the dissolving action of the water and the transformation of portions of the wood into water soluble material which is washed out in the grinding process.

Variation of the period of cook also has a marked influence upon the horsepower consumption per ton of pulp. When wood is ground under the same conditions of grinder pressure, speed, temperature, etc., it is found that after a period of four to six hours of cooking the maximum value of power consumption is obtained. For a greater

FIG. 6.—Effect of duration of steaming upon the strength of the pulp. (Spruce runs 199–209, inclusive.)

or lesser length of time of cooking the horsepower consumption per ton decreases (fig. 8).

OTHER FACTORS.

The variation of the yield of pulp from 100 cubic feet of solid wood with the duration of cook and temperature of cooking has been pointed out. It would seem that most of the loss would occur in the cooking process itself, but determinations of the amount of bone-dry wood charged to the cooker and the amount of bone-dry material taken from it after steaming shows that the loss in cooking as volatile materials and water-soluble substances which leach out when the wood is in the 2-foot lengths is remarkably low, being from 5 to 8 per cent. It appears that the great loss which takes place in the produc-

tion of steamed wood pulp occurs in the grinding process, either due to the dissolving of material which has been converted to a soluble state or the grinding of the softer portion of the wood—the springwood—to flour and the subsequent loss of it in the white water. There is a characteristic odor of burned sugar during the steaming of wood, and possibly some of the wood fiber is converted into sugar.

The condensed liquor from the steamer has a very corrosive action on the iron and it is possible that in order to satisfactorily protect

Fig. 7.—Effect of duration and pressure of steaming on the yield of pulp. (Spruce runs 103 to 107 and 114 to 119, inclusive.)

the metal it might be desirable to add small quantities of sodium carbonate to the water when the boiling process is used. This, of course, would not apply when the wood is steamed.

The liquors which condense during the steaming of the woods may have considerable commercial value, particularly when resinous woods are used. The equipment employed in the Wausau laboratory was not of sufficient capacity to make it possible to study this problem carefully, but an indication of the nature of the condensed liquor can be obtained from the following analyses of material secured from a mill steaming wood commercially, in which case approximately 5 cords of wood were used for each charge. Unfortunately no means were available for measuring the total condensed

liquor, and for that reason the amount of the materials can not be expressed in quantity per cord.

It will be noted that two samples were analyzed, one of which was a residue from evaporation of a condensed liquor and the other a sample of the liquor from another cook. The woods steamed were a

FIG. 8.—Effect of duration of steaming on power consumption per ton of pulp. (Spruce runs 114-119, inclusive.)

mixture of jack pine and tamarack in the ratio of 67 per cent of the former to 33 per cent of the latter.

	Residue from evapo- ration of liquor.	Sample of liquor.		Residue from evapo- ration of liquor.	Sample of liquor.
	<i>Per cent.</i>	<i>Per cent.</i>		<i>Per cent.</i>	<i>Per cent.</i>
Total solids.....		2.05	Ash.....	9.85	0.049
Soluble solids.....	70.10	1.95	Acetic acid (total).....	5.71	.162
Reducing sugars.....	15.89	.83	Formic acid (total).....	1.41	.042
Tannins.....	13.60	.092	Moisture.....	4.31	97.95

The total and soluble solids and tannin were determined according to the methods outlined by the American Leather Chemists' Association.

The boiling or steaming of woods results in the formation of a natural size from the wood substance or some of its constituents. This sizing action is particularly noticeable in the production of pulps from the hardwoods—birch and aspen—which are not pitchy. All paper produced from cooked woods, pulped by the mechanical process, show the characteristic water-resistance qualities and hardness of hard sized papers.

Tests on papers made from steamed and unsteamed woods show that the unsteamed pulps do not give as high percentage stretch as the steamed, even though the unsteamed pulps were mixed with 20 per cent of bleached spruce sulphite. Pulps made from cooked woods should be given satisfactory beating treatments to make them usable for different purposes. Like chemical pulp, there is a marked influence on the resultant paper when the pulps are given different beating treatments. The sheets become more brittle after a prolonged beating, but give high strength tests.

THE EFFECT OF GRINDING STEAMED AND UNSTEAMED WOODS UNDER VARIABLE CONDITIONS.

SURFACE OF STONE.

There is shown in figure 9 a series of curves on steamed and unsteamed woods which were conducted on different surfaces of stone. It is evident that the horsepower consumption per ton when steamed wood is used decreases to a minimum value at a grinder pressure of approximately 65 pounds per square inch on a 14-inch cylinder, regardless of the surface which is used. The contrast in the form of the curves for steamed and unsteamed wood is shown in this same figure. Curves 2 and 3 were run under exactly the same conditions, except that in one case steamed wood and in the other unsteamed wood was used as a raw material.

Upon the condition of the surface of the pulp stone depends, to a great extent, the power consumption per ton of pulp made, the rate of production, and the quality of the resultant material. The pulp stone used in the tests was burred in many different ways, and it was generally found that if the grit were brought to the same condition of sharpness, the power consumption, rate of production, and quality of pulp would be practically the same. When the stone is rough but the sand particles are not sharp, a coarser pulp is produced which acts more free on the wire of the paper machine. It was also found that regardless of the degree of sharpness of the stone it was impossible to obtain pulp for news print if the expenditure of power remain 50 horsepower per ton.

Figure 10 shows by curves obtained at different pressures the relation of three different surfaces of stone to the power consumption per ton, power to the grinder, and production in 24 hours. These typical curves show how greatly the above-mentioned factors are influenced by varying the sharpness of the pulp stone.

Plates I and II show the effect of different degrees of sharpness of stone on the quality of pulp produced as represented by the character of fibers. Plate I, figure 1, shows the fiber produced on the sharper medium grit stone with the consumption of a small amount of power,

Fig. 9.—Relation of power consumption and rate of production to pressure. 1. Steamed spruce runs 182-187, inclusive. 2. Unsteamed spruce runs 177-181, inclusive. 3. Steamed spruce runs 172-176, inclusive. 4. Steamed spruce runs 167-171, inclusive.

while figure 2 shows that the consumption of a greater amount of power on a duller stone yields a much finer and better fibered pulp.

FIG. 10.—Relation of power consumption and rate of production to sharpness of stone. (Spruce runs 6 to 8, 12 to 14, and 18 to 20, inclusive.)

The fibers in Plate II, figure 1, were produced on a stone having a degree of sharpness between the above two, and those shown in figure 2 were obtained on a sharp, coarse grit stone.

GRIT OF STONE.

If a stone of coarse grit is used considerably less dressing with the burr is necessary to attain the conditions of a sharp stone. In fact, it is difficult to produce a pulp that is not coarse and full of shives. Although a somewhat lower consumption of power per ton of pulp is easily obtained, on account of its coarseness the pulp is not satisfactory from a news-print standpoint. The yield of screenings is much greater, as one would anticipate. As indicated by the Mullen tester, the strength of pulp ground on a coarse grit stone is a trifle less than when made on a finer grit stone and consuming the same amount of power per ton; but when compared as to their respective breaking lengths, there is no difference. However, when the wood is steamed prior to grinding, a strong pulp may be obtained at lower horsepower consumption on the coarse grit stone than on a finer one. A comparison of the grits of the stones may be obtained by referring to Plate III, figures 1 and 2.

In general, a stone of fine grit yields a fine-fibered pulp and a coarse stone a shivy and coarse pulp.

PRESSURE OF GRINDING.

In any commercial grinder the pressure at which the wood is forced upon the revolving grindstone—that is, the pressure per square inch of wood surface in contact—varies greatly. The variations in pressure are brought about by the binding of the wood in the pockets; the grinding of wood of different lengths and diameters; the variation of pressure on the grinder cylinder, due to the removal of pressure from one or more of the cylinders, and the use of varying amounts of split wood. For any cylinder pressure, however, it is reasonable to assume that the pressure per square inch on the stone varies between certain limits.

Figure 11 shows the relation of the pressure on the grinder cylinder, the horsepower consumption per ton, power to grinder, and production in 24 hours, the three curves being obtained on surfaces of different degrees of sharpness. It will be noted that with increasing pressure the horsepower consumption per ton decreases, and that the horsepower to the grinder and production in 24 hours increases at a fairly definite rate.

The yield and quality of pulp produced vary to a considerable degree with the pressure of grinding. Finer, although shorter-fibered, pulps are obtained when grinding at higher pressure, the advantage of the use of higher pressure being that it is possible to use a duller stone and obtain finer-fibered pulp with a consumption of the same amount of power as would be used at lower pressure and sharper condition of the stone.

FIG. 1.—SPRUCE MECHANICAL PULP (RUN No. 11).

F-LAB. 4

FIG. 2.—SPRUCE MECHANICAL PULP (RUN No. 5).

F-LAB. 5

FIG. 1.—SPRUCE MECHANICAL PULP (RUN No. 17).

F—LAB. 6

FIG. 2.—SPRUCE MECHANICAL PULP (RUN No. 275).

F—LAB. 7

FIG. 1.—MEDIUM GRIT PULPSTONE.

F-LAB. 8

FIG. 2.—COARSE GRIT PULPSTONE.

F-LAB. 9

Figure 12 shows the effect of increasing pressure on the yield per 100 cubic feet of solid rossed wood. There is a material increase in

FIG. 11.—Relation of power consumption and rate of production to pressure. (Spruce runs 6 to 8, 12 to 14, and 18 to 20, inclusive.)

the amount of pulp produced from this quantity of wood if the pressure of grinding is increased from 20 pounds per square inch on a 14-inch cylinder to 100 pounds.

The effect of pressure on the quality of pulp as indicated by the strength of paper made from it is shown in figure 13. The strength factor, or bursting strength per square inch divided by the weight per ream, decreased with increasing pressure. The decrease in power consumption per ton is also shown.

PERIPHERAL SPEED OF STONE.

In figure 14 is shown the variation of the horsepower consumption per ton, horsepower to the grinder, and production in 24 hours, with

FIG. 12.—Relation of yield to pressure. (Spruce runs 52 to 56, inclusive.)

varying speed of pulp stone. The decrease in the power consumption per ton from 100 to 250 revolutions per minute when steamed wood is used is much greater than when unsteamed wood is ground under the same conditions. (See fig. 15.)

The pressure at which wood is steamed prior to grinding has a marked influence on the speed of rotation of the pulp stone necessary to consume a certain amount of power when the grinding pressure is maintained constant. This is shown in figure 16. The wood was

steamed at varying pressures for periods of three and six hours and then ground in two pockets of the grinder at a cylinder pressure of 60 pounds per square inch. The power to the grinder was maintained at 345 horsepower, and it was utilized by adjusting the periph-

FIG. 13.—Relation of strength of paper and power consumption to pressure. (1) Spruce runs 9-1 to 11 and (2) 6 to 8, inclusive.

eral speed of the stone to such a value as was necessary for the sample being tested. When wood which had been steamed for 6 hours at 75 pounds pressure was ground a cylinder pressure of 60 pounds on two pockets and speed of 225 revolutions per minute were necessary

to consume the 345 horsepower. When the wood was steamed for 6 hours at 20 pounds, a cylinder pressure of 60 pounds and speed of 187 revolutions per minute were necessary to use up the power.

There are shown in figure 17 the relation of horsepower consumption per ton, horsepower to the grinder, and production in 24 hours to the steaming pressure when wood, which had been cooked at different pressures, was ground at constant cylinder pressure and varying speed of rotation of the pulp stone. It will be noted that the horsepower consumption per ton increases with the speed, corresponding

FIG. 14.—Relation of power consumption and rate of production to speed. (Spruce runs 188 to 191, inclusive.)

to increase in the pressure of steaming, and this increase is due to a reduction in the rate of production of the pulp.

When wood is steamed for a certain number of hours and at a fixed pressure, then ground with a certain amount of power to the grinder but under varying speed of rotation of the pulp stone, it is found that the horsepower consumption per ton increases in a similar manner to that given in figure 18. In other words, at low speed and high pressure more power is necessary to grind a ton of pulp in 24 hours than at high speed and low pressure. This is due, again, to the reduction in the rate of production.

The peripheral speed of the pulp stone influences the power consumption only slightly. The power consumption per ton decreases somewhat when the speed is increased (fig. 15). It is also shown that

the horsepower to the grinder and production in 24 hours increase directly with the speed of the pulp stone. The speed has much less effect upon the quality of the pulp than either the pressure or surface

of the stone. Stronger pulp is obtained, however, at conditions of low speed and high pressure than is obtained at conditions of high speed and low pressure. It is believed, however, that the pressure is more responsible here than the speed. Figure 19 shows that the strength of paper, when the same amount of power is applied, is much less when the power is utilized at high speed and low pressure than at high pressure and low speed.

TEMPERATURE OF GRINDING.

There has always been more or less discussion about the effect of grinding hot or cold. Throughout the experimental work discussed little influence has been noted in grinding under conditions of varying temperature. It is true that the production in 24 hours is less when

FIG. 16.—Effect of steaming pressure on speed—horsepower to grinder constant. (Spruce runs 233 to 242, inclusive.)

grinding cold than when the hot process is used, but the variation of the temperature from 125° to 190° F. does not materially influence the rate of production. The pulp is somewhat finer when ground cold, but there is not as much difference between pulps manufactured by the cold and hot processes as is generally believed.

OTHER FACTORS.

Among the other factors which influence the power consumption, production in 24 hours, and the quality and yield of pulp are the amount of seasoning the wood has undergone before grinding, the dry weight per cubic foot, the size of bolts, and the rate of growth.

It is easier to grind green wood and secure a satisfactory pulp than it is to grind seasoned wood. Seasoned wood almost invariably

yields a shorter fibered pulp, with a color inferior to that obtained from the green material. Green wood likewise requires less power to grind it, although the difference in the power consumption per ton between that obtained from green and seasoned wood is very small.

The weight per cubic foot of wood is a most important factor, since upon it depends almost entirely the yield per cord. This is best shown in figure 20, where the dry weights of a number of different species are plotted against the yield of pulp per 100 cubic feet of solid rossed wood. It has been found that the yield is almost directly proportional to the bone-dry weight per cubic foot.

FIG. 17.—Relation of power consumption and production to steaming pressure—horsepower to grinder constant. (Spruce runs 233 to 242, inclusive.)

The following is a list of woods corresponding to the numbers shown on the curves in figure 20:

No. 1. Balsam fir.	No. 14. Western yellow pine.
2. Red fir.	15. Jack pine.
3. White fir.	16. Loblolly pine (fall cut).
4. Alpine fir.	17. Loblolly pine (spring cut).
5. Amabilis fir.	18. White pine.
6. Lowland fir.	19. Engelmann spruce (Montana).
7. Noble fir.	20. Engelmann spruce (Colorado).
8. Eastern hemlock.	21. Sitka spruce.
9. Western hemlock.	22. White spruce.
10. Tamarack.	23. White birch.
11. Western larch.	24. Aspen. ¹
12. Montana lodgepole pine.	25. Black gum.
13. California lodgepole pine.	

¹ Commonly called "popple" in Wisconsin.

The rate of growth seems to have little effect upon the power consumption or rate of production. When the wood is of large diameter it is necessary to split a considerable portion of it and more or less binding is caused, this resulting in a higher power consumption per ton of pulp. The yield and quality are both slightly influenced by the rate of growth of the wood. The yield is lower from wood of rapid growth than from wood which has grown slowly. The pulp is softer when rapid-growth wood is used, although the strength is practically the same. Generally woods which are highly lignified

FIG. 18.—Relation of power consumption and production to pressure and speed—horsepower to grinder constant. (Tamarack runs 62 to 68, inclusive.)

yield shorter fibered pulps than those having large amounts of sapwood.

The condition of the wood as regards decay has a marked effect on the pulp. With the use of partially decayed wood the yield of pulp from a cord is greatly decreased, and while the wood grinds faster than entirely sound wood, giving an increased production and a correspondingly lower power consumption per ton of pulp, the pulp consists principally of extremely short fibers and wood flour, which greatly decrease its strength. (Spruce runs 255 and 256.) At the same time the color is materially darker than that of the pulp produced from sound wood.

POWER CONSUMPTION PER UNIT OF STRENGTH.

It has always been known that the consumption of a great amount of power will produce pulp of a greater strength. The relative effect, however, in using different amounts of power is probably best shown in figure 21. The strength as represented by Mullen or Schopper tests increases with increasing power consumption per ton.

Figure 22, curve A, shows the relation between horsepower consumption per ton of pulp per meter of breaking length of paper made

FIG. 19.—Relation of strength of paper to pressure and speed. (Spruce runs 32 to 38, inclusive.)

from it, and the power consumption in grinding a ton of the pulp. At low values of power consumption greater strength is produced per horsepower than at high values. The horsepower per ton per point per pound is also shown in the same figure, curve B.

STEAMED WOOD PULP AND ITS USES.

The pulp made by grinding steamed wood can be used for different purposes, depending largely upon the nature of the grinding process. If a sharp and coarse stone is used a large number of shives will be present and the pulp will serve for the manufacture of box board or

FIG. 20.—Relation of yield to dry weight of wood—steamed and unsteamed.

similar materials. When ground to a finer state, however, it has been demonstrated that with a mixture of a small amount of chemical fiber bogus kraft paper can be produced which will serve for a cheap

Fig. 21.—Relation of strength of paper to power consumption per ton of pulp. (Average of all tests on spruce.)

wrapping paper. It is hardly likely that spruce could be used for the manufacture of cheap wrapping paper in this manner on account of its price, but other woods, which will be discussed later, also give

remarkably good results, and, being available in large quantities, should serve as a raw material for this purpose. Tests made on sheets composed entirely of boiled and steamed ground-wood pulp show that wrapping papers which will test from 0.50 to 0.75 of a point to the pound are easily produced. Wrapping papers of this kind are inclined to be brittle and do not have sufficient strength in tearing or folding without the addition of a small amount of chemical fiber.

Resinous woods, if given a mild steaming or boiling treatment prior to grinding, are rendered much more free from pitch, although the pulp is made very soft and darkened to some extent. The use of this method for the production of news print paper would undoubt-

FIG. 22.—Relation of strength of paper per horsepower to power consumption per ton of pulp.

edly be costly on account of the handling necessary, the cost of steaming, and the loss in yield.

SUMMARY OF INFLUENCE OF GRINDING AND COOKING CONDITIONS IN THE PRODUCTION OF SPRUCE PULP.

The experiments conducted by the Forest Service, both in cooking spruce prior to grinding and in varying conditions of producing pulp, have led to the following conclusions:

COOKED WOOD.

(1) Cooking spruce prior to grinding results in a stronger fibered pulp, although at least 25 per cent more power per ton is required than is used in grinding untreated wood. The horsepower consumption per ton when grinding under conditions of varying cylinder pressure decreases to a minimum at approximately 65 pounds pressure on a 14-inch cylinder; this holds for dull or sharp stones.

(2) When wood is cooked under conditions of constant pressure and varying lengths of time the maximum power consumption per ton of pulp is obtained after cooking for six hours. This holds true regardless of the pressure at which the cooking takes place, between 0 and 75 pounds gauge pressure.

(3) Wood which is cooked at high pressure requires more power per ton of pulp when ground under the same conditions of cylinder pressure, speed, and surface of stone than wood which is cooked at lower pressure, if the duration of the cook is the same. Likewise, the production of pulp in 24 hours is materially less when the wood ground has been cooked at high pressure than if it had been cooked at low pressure.

(4) The yield per cord is influenced very greatly by the length of time the cooking is carried on and the pressure of the cook, being much lower for high pressures than for low and also for long cooking periods than for short.

(5) The power to the grinder increases with speed and pressure of grinding and decreases with the degree of sharpness of stone. There is also a very slight increase in the power required with increase of temperature, other conditions remaining constant, while the thickness of stock in the grinder pit has almost no influence. Under like conditions of all other factors the power to the grinder is less for steamed wood than for green or seasoned wood untreated.

(6) With a fixed amount of power to the grinder and a fixed grinding pressure, the speed of the pulp stone will vary greatly, depending on the length of time the wood has been steamed and the steaming pressure. Unsteamed wood will grind at low speed, while that steamed a long time will grind at high speed with the same amount of power to the grinder.

(7) There is little if any difference in the quality of pulp obtained as a result of using either the boiling or steaming process. The color, length of fiber, and yield are practically the same if the boiling or steaming is carried on at the same temperature.

(8) The amount of pulp produced in grinding cooked wood with a fixed amount of power to the grinder is less at high pressure and low speed than it is at low pressure and high speed. This results in a greater horsepower consumption per ton of pulp at high pressure and low speed.

UNCOOKED WOOD.

(1) The rate of production varies directly with pressure, speed, and degree of sharpness of stone. Less pulp is obtained in 24 hours using seasoned wood than with green, and still less using steamed wood, all other conditions being the same. The temperature influences the rate of production to some extent; less pulp is produced at low temperatures.

(2) The horsepower consumption per ton of pulp when untreated wood is ground increases as the pressure decreases according to a fairly definite law; it is lower on sharp stones than on dull ones, and increases as the speed decreases in much the same manner as it does with pressure. There is, however, not as much difference between the power consumption per ton at low speed and high speed as there is between power consumption at low pressure and high pressure. The power consumption is very little influenced by temperature, but it is slightly lower at high temperature. The power consumption is higher for seasoned wood than for green wood, and higher for steamed wood than for either seasoned or green material ground under the same conditions.

(3) The yield of pulp per cord is greater at high pressure than at low, and, while this is true also of the screenings, there is not as much fine material lost in white water when high pressure is used. The yield is not greatly influenced by the surface of the stone, but is slightly higher at high speed than at low. The yield is proportional to the bone-dry weight per cubic foot of wood.

(4) The quality of pulp varies greatly with the surface of the stone, less with the pressure, and least with the speed. The weight per cubic foot and character of wood influence quality to a marked extent, especially the latter; temperature also has a marked influence; pulp of greater strength is obtained at higher temperature; pulp produced at low temperature will take a better finish. Pulp of better color can be obtained from green wood than from seasoned, and stronger pulp can be obtained by cooking the wood prior to grinding. The quality of paper manufactured under exactly the same conditions, but made of pulp produced at different grinder pressures, varies greatly with the grinder pressure and the horsepower consumption per ton of pulp. Mechanical pulp of greatest strength can be produced only by the expenditure of a relatively large amount of power.

PART II.—SUBSTITUTES FOR SPRUCE IN THE MANUFACTURE OF GROUND-WOOD PULP.

EXPERIMENTAL AND COMMERCIAL TESTS ON VARIOUS WOODS.

Grinding tests of 22 different woods were made at the Wausau laboratory. Samples of the experimental pulps were sent to the Madison laboratory for tests to determine their quality. The experimental apparatus and the methods of operation were the same as those used in the case of spruce and described in Forest Service Bulletin 127.

In addition to the experimental tests, "commercial" tests were made of the production of pulp and of the manufacture of paper. The methods employed in the preparation of the wood and the production of pulp were identical with those in the qualitative and quantitative

tests, except that more wood was employed and more pulp produced. As a rule, 2.5 tons of bone-dry pulp were manufactured during each test, though in some cases 5 tons were made. Data were recorded on power consumption, rate of production, yield, etc., and as soon as practicable the pulp was shipped to mills in the vicinity of Wausau to be made into paper. The aim in making the paper was to produce as good a grade of news print as possible from the experimental pulps under the standard mill practice of the company to which the pulps were sent. The one divergence from this practice was in the treatment of the pulp in the beater, as in some cases different amounts and kinds of color had to be added to secure the best results. The amount of size, alum, loading, color, etc., was recorded for each beater of pulp, as also were the amounts of sulphite and ground wood used. The size of screen slots, speed of machine, width of wire, etc., were also recorded.

The paper produced from the experimental pulps was given a practical try out on the presses of the New York Herald and the St. Louis Republic. The tests were conducted under the ordinary operating conditions of the pressrooms of the two newspapers. The color of the different papers varied considerably, but this was not assumed to detract from their value for news-print purposes within certain limits. Record was made of the amount of waste, the number and causes of breaks, and the number of papers run from a given quantity of material. Observations were also made on the general operating conditions and the appearance of the sheet when printed. Judgment of these latter factors was left very largely to the practical pressmen.

KINDS OF WOOD TESTED.

The woods tested to determine their suitability for mechanical pulp were as follows:

Balsam fir (<i>Abies balsamea</i>).	Western yellow pine (<i>Pinus ponderosa</i>).
Red fir (<i>Abies magnifica</i>).	Jack pine (<i>Pinus divaricata</i>).
White fir (<i>Abies concolor</i>).	Loblolly pine (<i>Pinus taeda</i>).
Alpine fir (<i>Abies lasiocarpa</i>).	White pine (<i>Pinus strobus</i>).
Amabilis fir (<i>Abies amabilis</i>).	Engelmann spruce, Montana (<i>Picea engelmanni</i>).
Lowland fir (<i>Abies grandis</i>).	Engelmann spruce, Colorado (<i>Picea engelmanni</i>).
Noble fir (<i>Abies nobilis</i>).	Sitka spruce (<i>Picea sitchensis</i>).
Eastern hemlock (<i>Tsuga canadensis</i>).	White spruce (<i>Picea canadensis</i>).
Western hemlock (<i>Tsuga heterophylla</i>).	White birch (<i>Betula papyrifera</i>).
Tamarack (<i>Larix laricina</i>).	Aspen ¹ (<i>Populus tremuloides</i>).
Western larch (<i>Larix occidentalis</i>).	Black gum (<i>Nyssa sylvatica</i>).
Lodgepole pine, Montana (<i>Pinus murayana</i>).	
Lodgepole pine, California (<i>Pinus murayana</i>).	

¹ Called "popple" in Wisconsin.

TABLE 1.—Amounts of different species used and where cut.

Kind of wood.	Ship- ment No.	Amount used.	State where grown.	County where grown.	Remarks.
		<i>Cords.</i>			
Tamarack (<i>Larix laricina</i>).....	1	15	Wis...	Lincoln.....	Swampy land, close stand.
Do.....	2	15	do....	do.....	Do.
Jack pine (<i>Pinus divaricata</i>)...	3	15	do....	do.....	Side hill, sloping south and east, sandy soil, close stand.
Do.....	4	15	do....	do.....	Swampy land, close stand.
Do.....	5	15	do....	do.....	Side hill, sloping south and east, sandy soil, close stand.
White spruce (<i>Picea cana- densis</i>).....	6	8	do....	do.....	No further description.
Hemlock (<i>Tsuga canadensis</i>)..	6	8	do....	do.....	Do.
Jack pine (<i>Pinus divaricata</i>)...	7	15	do....	do.....	Side hill, sloping south and east, sandy soil, close stand.
Do.....	8	10	do....	do.....	Stock of Grand Rapids Paper Co.
Hemlock (<i>Tsuga canadensis</i>)..	9	10	Mich.....		
Balsam fir (<i>Abies balsamea</i>)...	9	2	do....		
White spruce (<i>Picea cana- densis</i>).....	9	4	do....		
Do.....	10	20	Wis.....		Stock of Marathon Paper Mills Co.
Hemlock (<i>Tsuga canadensis</i>)..	11	16	do....		Do.
Do.....	12	18	do....		Stock of Nekoosa-Edwards Paper Co.
Lodgepole pine (<i>Pinus mur- rayana</i>).....	13	15	Mont.	Deerlodge.....	Slope south, 7,000 feet eleva- tion, clay soil.
Western yellow pine (<i>Pinus ponderosa</i>).....	14	16	do....	Missoula.....	Elevation 3,500 feet, glacial loam soil.
Red fir (<i>Abies magnifica</i>).....	15	8	Cal....	Nevada.....	Stock of Floriston Pulp & Paper Co.
Lodgepole pine (<i>Pinus mur- rayana</i>).....	16	7	do....	do.....	Do.
Western larch (<i>Larix occi- dentalis</i>).....	16	12	Mont..	Lincoln.....	Elevation 3,100 feet, heavy forest, dry, deep clay soil.
White spruce (<i>Picea cana- densis</i>).....	17	8	Wis...	Price.....	Stock of Nekoosa-Edwards Paper Co.
Balsam fir (<i>Abies balsamea</i>)...	17	8	do....	do.....	Do.
White spruce (<i>Picea cana- densis</i>).....	18	18	do....	do.....	Do.
Aspen (<i>Populus tremuloides</i>)..	19	8	do....	do.....	No other data available.
White birch (<i>Betula papy- rifera</i>).....	19	11	do....	do.....	Do.
White spruce (<i>Picea cana- densis</i>).....	20	16	do....	do.....	Stock of Nekoosa-Edwards Paper Co.
Western hemlock (<i>Tsuga heterophylla</i>).....	21	8	Wash.	Chehalis.....	Aberdeen Chamber of Com- merce.
Sitka spruce (<i>Picea sitchensis</i>)..	21	8	do....	do.....	Do.
White spruce (<i>Picea cana- densis</i>).....	22	18	Wis...	Price.....	Stock of Nekoosa-Edwards Paper Co.
Lodgepole pine (<i>Pinus mur- rayana</i>).....	23	9	Cal....		Stock of Floriston Pulp & Paper Co.
Red fir (<i>Abies magnifica</i>).....	23	9	do....		Do.
White spruce (<i>Picea cana- densis</i>).....	24	15	Wis...	Price.....	Stock of Nekoosa-Edwards Paper Co.
Balsam fir (<i>Abies balsamea</i>)...	25	8	do....	do.....	Do.
White pine (<i>Pinus strobus</i>)...	25	8	do....	do.....	Do.
Engelmann spruce (<i>Picea engelmanni</i>).....	26	6	Colo...	(Cochetopa Nat. For.)	Elevation 9,200 feet, deep black soil.
White fir (<i>Abies concolor</i>).....	27	17	Cal....	Plumas.....	Elevation 3,220 feet, red clay and shale soil.
Amabilis fir (<i>Abies amabilis</i>)..	28	8	Wash.	Whitcom.....	Elevation 2,150, fragmentary rock soil.
Lowland fir (<i>Abies grandis</i>)...	29	5½	Mont..	Missoula.....	Elevation 3,400 feet, sandy loam.
Alpine fir (<i>Abies lasiocarpa</i>)...	29	6	do....	do.....	Elevation 3,300 feet, sandy loam.
Engelmann spruce (<i>Picea engelmanni</i>).....	29	5	do....	do.....	Elevation 3,300 feet, gravelly loam.
White spruce (<i>Picea cana- densis</i>).....	30	10			Stock of Nekoosa-Edwards Paper Co.
Loblolly pine (<i>Pinus taeda</i>)...	31	6	N. C....		Stock of Beaver Co., Weldon, N. C.
Black gum (<i>Nyssa sylvatica</i>)..	32	5	La....	Winn.....	Hard wood bottoms.
Tamarack (partially decayed).	33	½			Selected from culls of stock of Marathon Paper Mills Co.
Noble fir (<i>Abies nobilis</i>).....	34	6	Oreg..	Multnomah...	Elevation 3,500 feet, rocky soil.

The region in which the different species grow is shown on the maps, figures 23 to 44. Table 1 gives source of shipments tested. Information concerning the amount of each kind of timber available

FIG. 23.—Balsam fir (*Abies balsamea*).

and other facts relating to the stand and supply will be furnished by the Forest Service upon request.

RESULTS OF GRINDING TESTS.

On the whole, very little difficulty was encountered in producing pulp from the woods tested. With the conifers, at least, grinding could be done under practically the same conditions employed for

spruce. All the substitutes, however, with the possible exception of noble fir and amabilis fir, required the use of more power per ton of pulp. Also, while a good grade of spruce pulp can be produced under widely varying conditions of grinding, the best results were generally obtained from the other woods when the stone was somewhat dull, the pressure high, and the speed of grinding rather slow.

FIG. 24.—Red fir (*Abies magnifica*).

Such pulp is as light in color as, if not lighter than, spruce, and a fairly sharp stone can be used in grinding it. Seasoned wood, however, usually shows decay and insect attack, and it is practically impossible to grind it into pulp which will not contain many shives and be somewhat soft. The yield from balsam fir is about 1,910 pounds (bone-dry pulp) per hundred cubic feet of solid rossed wood, or approximately 490 pounds less than the yield from an equal quantity of white spruce.

Red fir, like balsam, is easily ground to a pulp satisfactory for news-print purposes. It required, however, more power per ton of pulp, due possibly to the fact that the wood used in the experiments was of such a large diameter that it had to

THE FIRS.

The firs tested were balsam fir (*Abies balsamea*), red fir (*Abies magnifica*), white fir (*Abies concolor*), amabilis fir (*Abies amabilis*), alpine fir (*Abies lasiocarpa*), lowland or grand fir (*Abies grandis*), and noble fir (*Abies nobilis*).

A good sheet of pulp can easily be obtained from balsam fir if the wood is in a green state.

FIG. 25.—White fir (*Abies concolor*).

be split before it could be ground. The pulp had a reddish tinge, which made it less suitable for news-print purposes than that of some other woods which grow in the same region. The yield was approximately 1,915 pounds (bone dry) per hundred cubic feet of solid rossed wood, or nearly 500 pounds less than for white spruce. On the basis of a cord of rough wood the difference in yield would be even greater on account of red fir's extremely thick bark.

White fir yields a very satisfactory pulp, especially when the wood is green and comes from young trees. Tests conducted on this species, to note the influence of age of the trees on the quality of the pulp produced, showed that pulp from the split wood of trees 40 inches in diameter and 130 feet high was inferior in color, fiber, and yield to pulp obtained from trees of 18 inches in diameter or less. Pulp obtained from the older wood was inclined to be soft and shivy; that from the younger wood did not show these defects. The color of white-fir pulp is better than that of red fir, though not as good as that of balsam. White-fir pulp is rather soft. The yield is approximately 2,000 pounds (bone dry) per hundred cubic feet of solid rossed wood, or about 400 pounds less than white spruce.

Alpine fir yields a very good quality of pulp, which in color is as light as, if not lighter than, spruce pulp. It can be ground with a

FIG. 26.—Alpine fir (*Abies lasiocarpa*).

fairly sharp stone and without an unusual expenditure of power. The result is a pulp very satisfactory for news-print purposes. The yield is approximately 2,060 pounds (bone dry) per hundred cubic feet of solid rossed wood. This wood is usually free from knots and other irregularities, and has a fairly thin, smooth bark.

FIG. 27.—Amabilis fir (*Abies amabilis*).

Amabilis fir readily grinds to a pulp suitable for news-print purposes. The color of the pulp is slightly grayish, but an excellent fiber can be produced with a sharp stone and a reasonable amount of power. In strength the pulp is about equal to that obtained from spruce. The wood used in the tests was split from large logs having a number of good-sized knots. The yield is approximately 1,870 pounds (bone dry) per hundred cubic feet of solid rossed wood. As in the case of red fir, the thick bark of amabilis fir would result in decreasing the yield were the latter figured on the basis of a rough-piled cord.

Lowland or grand fir can be ground on a fairly sharp stone to produce pulp well adapted for news-print paper. The quality is not up to that of balsam or amabilis fir, but is better than that of white, alpine, or red fir. The pulp produced at the laboratory had a slightly grayish cast, which in some measure might be due to the heart rot that was beginning to attack many of the logs. The yield was approximately 1,950 pounds (bone dry) per hundred cubic feet of solid rossed wood.

Noble fir readily yields a pulp satisfactory for news-print purposes. Like white spruce, it can be ground with a wide variation of power consumption. The pulp has a marked pinkish tinge, which is objectionable, but the fibers are of unusual length and strength, though with a tendency to coarseness. The wood tested was supplied from a large tree freshly cut and was remarkably free from knots. The yield was approximately 1,920 pounds (bone dry) per hundred cubic feet of solid rossed wood, or about 480 pounds less than that from an equal amount of spruce.

FIG. 28.—Lowland fir (*Abies grandis*).

THE HEMLOCKS.

Eastern hemlock (*Tsuga canadensis*) requires a considerable amount of power for the production of satisfactory pulp. The wood must also be of fairly small diameter and of very good quality. Even under the best conditions, eastern hemlock pulp does not present a good appearance; the fibers are short, and it has a decided reddish tinge. Moreover, it is very hard to produce pulp which will not crack along the edges when the laps are folded. However, even with the handicap of short fibers, a pulp satisfactory for news-print purposes can be produced. The yield from eastern hemlock is approximately 2,030 pounds per hundred cubic feet of solid rossed wood (370 pounds less than from an equal amount of white spruce), though the same ratio would not be evident if the basis were a cord of rough wood.

Western hemlock (*Tsuga heterophylla*) can be ground at much higher pressures and with a sharper stone than eastern hemlock. The pulp produced is of very good quality and aside from its grayish color compares well with white spruce. It is far superior to that from eastern hemlock. The yield is about 2,160 pounds per hundred cubic feet of solid rossed wood, or 240 pounds less than that from white spruce, though the bark of western hemlock is much heavier than that of the latter species.

THE LARCHES.

Tamarack (*Larix laricina*) produces a very good quality of pulp with a reasonable amount of power. In color, however, the pulp is a decidedly grayish green. It would probably serve for news-print paper if used with spruce sulphite or mixed with spruce ground wood. In any event, it could be used for wrapping paper. The yield is approximately 2,620 pounds per hundred cubic feet of solid rossed wood, or about 220 pounds more than from an equal amount of white spruce.

Western larch (*Larix occidentalis*) yields a very inferior pulp. The product is difficult to operate on the wet machine, and the pulp stone must be rough, but not sharp, to secure the best results. In other words, the pulp must have coarse fibers and a relatively large number of shives. The color, a decided brown, is objectionable. The yield from western larch was only 2,100 pounds per hundred cubic feet of solid rossed wood, though on the basis of the dry weight of the wood it should have been at least 2,300 pounds. This difference is probably due to the high proportion of the wood substance that is soluble in water and to the brittleness of the heartwood, so that a large percentage of the yield is lost in the white water.

FIG. 29.—Noble fir (*Abies nobilis*).

THE PINES.

Both the California and Montana lodgepole pine (*Pinus murrayana*) yield pulp of very good quality. The wood can be ground under ordinary conditions and does not require the consumption of a large amount of power. Satisfactory results are obtained when the wood is ground at high pressures and at high speed, provided the stone is somewhat dull. The color of the pulp from both varieties compares favorably with that of white spruce, though the Montana wood is somewhat lighter than the California. The resin did not prove objectionable. Montana lodgepole pine yielded

FIG. 30.—Eastern hemlock (*Tsuga canadensis*).

approximately 2,140 pounds of pulp (bone dry) per hundred cubic feet of rossed wood, while California trees yielded about 1,920 pounds. The difference was due to the greater age, larger size, and lighter weight of the California wood.

Western yellow pine (*Pinus ponderosa*) can be ground under a wide variety of conditions. The pulp has a fairly long, coarse fiber and is invariably soft. In color it tends toward a creamy, resembling to some extent that obtained from jack pine. While the wood used in the test contained considerable pitch, this did not cause much trouble either in the grinding process or in the operation of the wet machine. The wood used was cut in October, and it is reasonable to suppose that material cut after the sap had gone down would

have been better. The fact that the majority of the tests were made after the wood had seasoned from one to one and one-half years might also account for the more satisfactory operation of the material. The yield was approximately 2,060 pounds per hundred cubic feet of solid rossed wood.

FIG 31.—Western hemlock (*Tsuga heterophylla*).

Jack pine (*Pinus divaricata*) yields a very good pulp when ground with a rather dull stone, necessitating, of course, a high power consumption. The pulp produced at a consumption of from 90 to 100 horsepower per ton for 24 hours compares favorably with white spruce pulp made with a somewhat lower power consumption. In

color jack pine is creamish or even brownish, and the pitch may cause trouble on the felts, especially if the wood is not seasoned or has not been ponded for a considerable period of time. The best results can be obtained from pitchy woods if the trees are cut when the sap is down. The yield of jack-pine pulp per hundred cubic feet of solid rossed wood was about 200 pounds less than that from an equal amount of white spruce.

Loblolly pine (*Pinus taeda*) requires a dull stone and consequently an expenditure of a large amount of power, but does not yield a pulp of as good a quality as may be obtained from the other pines

FIG. 32.—Tamarack (*Larix laricina*).

tested. Although hardly suitable for news-print purposes, loblolly-pine pulp could no doubt be used as a filler. Tests were made on wood cut in the spring and allowed to remain in the forest until the bark became loosened and on wood cut in the fall and split for firewood. The fall-cut wood produced a creamy colored pulp, while the spring-cut wood gave one of a brownish shade. Practically no other difference was noted in the quality. The yield from the fall-cut wood was about 2,500 pounds per hundred cubic feet of rossed wood, while that from the spring-cut wood was 2,400 pounds, the amount in each case being proportional to the weight per cubic foot of the wood.

Through a mistake in shipment a quantity of white pine (*Pinus strobus*) was received at the laboratory. It had not been the intention to test this wood, since its value for lumber eliminates it from consideration as a possible substitute for spruce. Tests were made on it, however, since it was at hand. It can be ground on a fairly sharp stone to yield fibers of good strength and excellent color. The pulp contains a considerable amount of pitch, and, like that from the other pines, is inclined to be soft. The yield was approximately 1,885 pounds per hundred cubic feet of solid rossed wood.

THE SPRUCES.

Engelmann spruce (*Picea engelmanni*) can be ground under the same conditions used for white spruce. The pulp has an excellent color and a long strong fiber. The fact that the wood ground at the laboratory was in a green state undoubtedly made it easier to produce a good grade of pulp. Wood obtained from Colorado in the form of small logs showed no difference in quality from similar material obtained from Montana, though the latter, owing to its greater weight per cubic foot, yielded about 2,250 pounds of pulp (bone dry) per hundred cubic feet of rossed wood against 2,000 pounds for the Colorado material.

FIG. 33.—Western larch (*Larix occidentalis*).

Sitka spruce (*Picea sitchensis*) yields a pulp of very good quality, though not equal to that from white spruce. Although the wood can be ground under practically any condition of speed, sharpness of stone, and grinder pressure, the fibers are not as fine and long as those of the white spruce. In color, moreover, Sitka spruce pulp is inclined to be grayish. The wood tested was cut during the latter part of April and contained considerable pitch. It undoubtedly would have run better had it been cut earlier in the year. The yield was 2,100 pounds per hundred cubic feet of solid rossed wood, or about 200 pounds less than that from an equal amount of white spruce.

THE HARDWOODS.

Aspen (*Populus tremuloides*) requires the consumption of a large amount of power to produce pulp which will run satisfactorily on the wet machine. If the pulp stone is too sharp or a less amount of power is used, the pulp will be very short. When mixed with spruce, however, it operates very satisfactorily. Aspen pulp possesses good

color, although it is likely to contain black specks of bark unless knots are removed from the wood before it is ground. The yield was approximately 2,200 pounds per hundred cubic feet of solid rossed wood.

FIG. 34.—Lodgepole pine (*Pinus contorta*).

White birch (*Betula papyrifera*) yields a pulp in which the fibers are short, though very fine. It is necessary to use a very dull stone in the grinding process, and even then laps crack along the edges when folded. The pulp, moreover, has a decidedly pinkish tinge, but the ground wood could undoubtedly be used as a filler in the produc-

tion of certain grades of paper. The yield per hundred cubic feet is very high, approximately 2,950 pounds, or 550 pounds more than that from an equal amount of spruce. On the basis of a rough cord, however, this difference would be materially reduced, since white birch logs have a thick bark and are often crooked.

Black gum (*Nyssa sylvatica*) yields a fiber that in many ways resembles that obtained from white birch. It is extremely short, but forms a tougher sheet than coniferous fibers of the same length. Considerable power must be expended to produce laps that can be

FIG. 35.—Western yellow pine (*Pinus ponderosa*).

taken off the wet machine satisfactorily. The pulp is not promising from a news-print standpoint, but could be used as a filler or mixed with pulp of a better grade. In color it is very white, ranking high in this respect among the woods tested. Steaming the wood prior to grinding gives a stronger pulp, but not to the extent observed in the case of birch similarly treated. The yield of pulp from black gum is approximately 2,600 pounds per hundred cubic feet of solid rossed wood.

WOODS STEAMED PREVIOUS TO GRINDING.

In addition to the tests on untreated wood, other tests were made on steamed material. Practically all of the conifers yielded fairly strong, brownish-colored pulps suitable for the production of board and cheap grades of brown wrapping paper. Balsam fir, noble fir, amabilis fir, Alpine fir, and white and Engelmann spruce pulps showed longer fibers and felted somewhat better than those from the other woods. When steamed all of the conifers required the consumption of a relatively large amount of power for the production of satisfactory pulps. This was not the case, however, with aspen and

FIG. 36.—Jack pine (*Pinus divaricata*).

white birch, which produce much stronger pulps when treated before grinding, the product comparing favorably in color and toughness with spruce pulp. The fibers of the aspen and white birch were shorter, it is true, than those of spruce, but the felting qualities of the hardwood pulps are better than those of spruce pulp. Steamed aspen and white birch can be ground with a comparatively small amount of power to produce the kind of pulp just described.

A heavy loss in wood substance was noted in the case of all the species tested except western larch. The fibers of the latter wood seem to become tougher as the result of cooking and do not grind up to a fine powder which passes through the meshes of the cylinder mold.

FIG. 1.—UNSTEAMED (RUN No. 2).

F-LAB. 10

FIG. 2.—STEAMED (RUN No. 3).

F-LAB. 11

WHITE BIRCH MECHANICAL PULP.

FIG. 1.—STEAMED (RUN No. 5).

F-LAB. 12

FIG. 2.—UNSTEAMED (RUN No. 2).

F-LAB. 13

ASPEN MECHANICAL PULP.

FIG. 1.—UNSTEAMED (RUN NO. 56).

F-LAB. 14

FIG. 2.—STEAMED (RUN NO. 62).

F-LAB. 15

HEMLOCK MECHANICAL PULP.

FIG. 1.—STEAMED (RUN NO. 30).

F-LAB. 16

FIG. 2.—UNSTEAMED (RUN NO. 27).

F-LAB. 17

JACK PINE MECHANICAL PULP.

FIG. 1.—STEAMED (RUN No. 25).

F-LAB, 18

FIG. 2.—UNSTEAMED (RUN No. 26).

F-LAB, 19

TAMARACK MECHANICAL PULP.

F-LAB. 20

FIG. 1.—RED FIR MECHANICAL PULP UNSTEAMED (RUN No. 4).

F-LAB. 21

FIG. 2.—WESTERN LARCH MECHANICAL PULP UNSTEAMED (RUN No. 2).

F-LAB. 22

FIG. 1.—WESTERN HEMLOCK MECHANICAL PULP UNSTEAMED (RUN NO. 1).

F-LAB. 23

FIG. 2.—LODGEPOLE PINE (CALIFORNIA) MECHANICAL PULP UNSTEAMED (RUN NO. 2).

F-LAB. 24

FIG. 1.—WESTERN LARCH MECHANICAL PULP STEAMED (RUN No. 1).

F-LAB. 25

FIG. 2.—LODGEPOLE PINE (CALIFORNIA) MECHANICAL PULP STEAMED (RUN No. 1).

F-LAB. 26

FIG. 1.—BALSAM FIR MECHANICAL PULP UNSTEAMED (RUN No. 14).

F-LAB. 27

FIG. 2.—NOBLE FIR MECHANICAL PULP UNSTEAMED (RUN No. 2).

MICROSCOPIC COMPARISON OF GROUND-WOOD FIBERS.

Plates IV to XII are photomicrographs of the ground-wood fibers obtained from the various species tested. It is not possible, of course, to gauge accurately from such photographs the pulp-making qualities of the fibers. Length of fiber does not necessarily mean strength, for a stronger pulp can be obtained from fibers which, though quite short, will felt well. Steamed white birch pulp, for example, will test as high in strength as longer-fibered material from the pines, larches, and hemlocks. However, the photographs make it possible to compare the characteristics of the fibers of one kind of wood with those of another kind, especially since the lodgepole pine,

FIG. 37.—Loblolly pine (*Pinus taeda*).

western hemlock, western larch, red fir, balsam, white birch, jack pine, hemlock, and tamarack were ground under the same conditions of pressure, speed, surface of stone, etc. For some of these species photographs of both cooked and uncooked fibers are shown. The cooked-wood specimens were not treated in the same manner, nor were they ground under like conditions.

In the case of birch (Pl. IV) it will be seen that the uncooked pulp is very short and contains much wood flour, while the cooked fibers are fairly long and very fine. When run into paper without the addition of sulphite the steamed pulp showed a strength under test of 0.51 point per pound and 5.8 points per thousandth inch of thickness.

The aspen fibers (shown in Pl. V) appear to be even shorter than those of the birch. The steamed pulp when run into a 63-pound sheet gave a Mullen test of 0.51 point per pound and 6.2 points per thousandth inch of thickness.

Between the cooked and uncooked hemlock fibers (shown in Pl. VI) there is more contrast in respect to length than in the case of birch and poplar. The cooked hemlock when run into a 55-pound sheet without sulphite gave a Mullen test of 0.51 point per pound and 6 points per thousandth inch of thickness.

Both the steamed and unsteamed jack pine (shown in Pl. VII) are remarkably free from wood flour and short fiber. The steamed-

FIG. 38.—White pine (*Pinus strobus*).

wood sample, when run into a 43-pound sheet without sulphite, gave a Mullen test of 0.47 point per pound and 4.5 points per thousandth inch of thickness.

In Plate VIII, which shows steamed and unsteamed tamarack fibers, the much greater length of the former is apparent.

Plates IV, VI to X, and XII, figure 1, show the fibers from a number of different woods ground in the natural state under the same conditions. With the exception of western larch, the fibers are of very good quality and compare well with those of spruce. So far as length and fineness go, the fibers shown in Plates VII, X, and XII are fully equal to spruce.

EXPERIMENTAL MANUFACTURE OF PAPER.

A limited amount of paper (waterleaf) was made experimentally at the Madison laboratory from the various pulps and tested for strength and color. In every case the conditions of manufacture were identical, and no coloring matter was added to any of the pulps in the beater. The paper machine used was too small to permit of

FIG. 39.—Engelmann spruce (*Picea engelmanni*).

reliable data being obtained upon such points as operation of the pulp on the machine, calendering, and the like.

In the matter of color the various wood fibers (unsteamed) may be arranged in the order given below, the basis being the number of parts of black which each sample contained, that with the smallest number ranking first. It should be remembered that the arrangement is made as the result of tests on many different samples of paper from the same wood, rather than on the particular samples

which accompany this bulletin, and also that the different woods were in various stages of seasoning when ground into pulp, a fact which might materially influence their relative color rating:

1. Alpine fir.	14. Jack pine.
2. White spruce.	15. White fir (old and young trees mixed).
3. Engelmann spruce.	16. Noble fir.
4. Black gum.	17. Loblolly pine (spring cut).
5. Lowland fir.	18. Aspen.
6. Montana lodgepole pine.	19. White birch.
7. Loblolly pine (fall cut).	20. Sitka spruce.
8. White pine.	21. Eastern hemlock.
9. Balsam fir.	22. Red fir.
10. White fir (young wood).	23. Tamarack.
11. Western yellow pine.	24. Western hemlock.
12. California lodgepole pine.	25. Larch.
13. Amabilis fir.	

FIG. 40.—Sitka spruce (*Picea sitchensis*).

White, Alpine, amabilis, and balsam fir are light in color, comparing very favorably in this respect with white spruce. Red fir and noble

fir, however, have a pinkish tinge, as has eastern hemlock and white birch. Western hemlock is grayish. Lodgepole pine has a good color, but western yellow pine is a yellowish white, and jack pine and loblolly have a brownish tinge. Both western larch and eastern larch

FIG. 41.—White spruce (*Picea canadensis*).

(tamarack) are of poor color for news-print purposes, the former being very brown and the latter dark gray. Aspen and black gum have a good color. Sitka spruce is gray, but Engelmann spruce is fully as bright as white spruce.

It is very difficult to obtain reliable data on the relative strength of pulps from different woods, owing to the fact that it is almost impossible to produce them under identical conditions of grinding, especially as regards power consumption per ton, a factor which largely influences their strength. The result of strength tests made at the laboratory on the experimental pulps seems to indicate, however, that but one of them surpasses white spruce pulp. This refers,

FIG. 42.—Aspen (*Populus tremuloides*).

of course, to the uncooked pulps. Tests made on the steamed pulps indicate that those from the hardwoods produced with a smaller consumption of power surpass white spruce in bursting strength. If the results of tests on the breaking length in meters per horsepower per ton and those of the horsepower per ton per point per pound are averaged for power consumptions of from 80 to 100 horsepower, the experimental woods can be arranged in the following order as regards their strength, the strongest coming first:

1. Noble fir.	13. California lodgepole pine.
2. White spruce.	14. White pine.
3. Amabilis fir.	15. Western yellow pine.
4. Engelmann spruce.	16. Tamarack.
5. Western hemlock.	17. Jack pine.
6. Sitka spruce.	18. Loblolly pine.
7. Balsam fir.	19. Hemlock.
8. Lowland fir.	20. Larch.
9. Red fir.	21. Aspen.
10. Montana lodgepole pine.	22. Black gum.
11. White fir.	23. Birch.
12. Alpine fir.	

COMMERCIAL MANUFACTURE OF PAPER.

To secure reliable data on the operation of the pulps on the paper machine approximately 5,000 pounds of bone-dry pulp were manufactured from each kind of wood. At the start 5 tons of pulp were made, but it was found later that the smaller amount would be sufficient for the purpose of the test. The papers were made at the mills of the Rhinelander Paper Co., Rhinelander, Wis., and the Nekoosa-Edwards Paper Co., Port Edwards, Wis. The woods and mixtures of woods used were as follows:

Jack pine, green.	7. California lodgepole pine.
Jack pine, seasoned.	8. Red fir.
Hemlock.	9. One-half spruce and one-half hemlock.
One-third spruce, two-thirds hemlock.	10. One-half balsam fir and one-half spruce.
One-third spruce, one-third hemlock, and one-third jack pine.	11. Tamarack.
Two-thirds hemlock, one-third jack pine.	12. One-half tamarack and one-half spruce.
1. Spruce.	13. Noble fir.
2. Western hemlock.	14. Alpine fir.
3. Sitka spruce.	15. White spruce.
4. Montana lodgepole pine.	16. Engelmann spruce (Colorado).
5. Western yellow pine.	17. Amabilis fir.
6. Balsam fir.	

As the former group of tests has been previously reported upon (Forest Service Bulletin, "Experiments with Jack Pine and Hemlock for Mechanical Pulp"), only the last 17 papers manufactured at the Nekoosa-Edwards Paper Co. will be considered.

Table 57 gives the results of the commercial runs. Samples of the printed and unprinted sheets accompany this bulletin.

For the first 12 runs the same furnish of ground wood and sulphite to the beater was used in each case, the pulp consisting of quick-cook hemlock sulphite 25 per cent and experimental ground wood 75 per cent. In the last five tests the pulp was made up of 20 per cent of

FIG. 43.—White birch (*Betula papyrifera*).

quick-cook sulphite and 80 per cent of ground wood. The complete list of material furnished the beaters is given in Table 2.

The quantities of the different colors added varied with the color of the pulp. In every case attempt was made to duplicate the standard news color used by the company manufacturing the paper. It is very probable that if the sheets had been left uncolored, or had

FIG. 44.—Black gum (*Nyssa sylvatica*).

been colored a cream white, they would have presented a better appearance than they did.

Of the first series of 12 tests, those on white spruce, balsam fir, and Sitka spruce were run on a Fourdrinier paper machine trimming 109 inches wide and having a jacketed upper couch roll. On account of the slowness of the stock and insufficient suction the operation of the pulps in these three tests was somewhat unsatisfactory. There was sticking of the pulp to the couch and difficulty in securing good formation.

TABLE 2.—*Furnish to beater on basis of 1,000 pounds of paper. Commercial tests on experimental pulps.*

Stock No.	Kind of ground wood.	Weight.	Sulphite.	Size.	Alum.	Soluble blue HA.	Rhodamine B extra.
		<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Ounces.</i>	<i>Ounces.</i>
1	Spruce.....	750	250	3.33	6.67	3.2	0.167
2	Western hemlock.....	750	250	3.33	6.67	4.27	.10
3	Sitka spruce.....	750	250	3.33	6.67	3.37	.167
4	Lodgepole pine (Montana).....	750	250	3.33	6.67	3.33	.20
5	Western yellow pine.....	750	250	3.33	6.67	4.27	.267
6	Balsam fir.....	750	250	3.33	6.67	2.53	.167
7	Lodgepole pine (California).....	750	250	3.33	6.67	3.2	.167
8	Red fir.....	750	250	3.33	6.67	3.73	.133
9	Hemlock and spruce.....	¹ 750	250	3.33	6.67	3.73	.20
10	Balsam and spruce.....	¹ 750	250	3.33	6.67	2.6	.167
11	Tamarack.....	750	250	3.33	6.67	5.33	.667
12	Tamarack and spruce.....	¹ 750	250	3.33	6.67	4.00	.4
13	Noble fir.....	800	200	3.33	10.0	5.4	.40
14	Alpine fir.....	800	200	3.33	10.0	4.4	.40
15	White fir.....	800	200	3.33	10.0	6.8	.30
16	Engelmann spruce (Colorado).....	800	200	3.33	10.0	4.8	.375
17	Amabilis fir.....	800	200	3.33	10.0	5.0	.400

¹375 pounds each.

The remainder of the 12 tests were run on a Fourdrinier machine trimming 100 inches and provided with a suction couch roll. The operation of pulp on this machine was much more satisfactory than on the other, although slowness of the stock made it impossible to use the dandy and a good formation could not be secured. Both of the paper machines ran at a speed of 460 feet per minute, and the screen plates were cut with slots 0.011 inch wide. In calendering the paper, 9 nips of a 12-roll calender stack were used.

So far as appearance and strength went, all the sheets manufactured at this time were considered very creditable. The No. 9 paper, containing 37½ per cent of hemlock ground wood, 37½ per cent of spruce ground wood, and 25 per cent of quick-cook hemlock sulphite, had a very high strength and took an excellent finish, though the color was slightly off. Both of the balsam sheets—No. 6 and No. 10—were very good both in strength and color. The western yellow-pine sheet ran very foamy and showed a number of scum spots, due largely to the pitch. Sheets of better formation undoubtedly could have been made if the pulp had been ground in a way to make it somewhat more “free.” The jordan machine was not used except to brush out the sulphite.

For the last 5 of the 17 commercial runs it was necessary to return to the first paper machine. In this series the paper was run at a speed of 450 feet per minute and passed through 11 nips of a 12-roll calender stack. All of the stocks were somewhat slow, but not so slow as were those of the previous series. The formation of the sheets, however, left much to be desired. Engelmann spruce (stock 16) and Alpine fir (stock 14) operated very satisfactorily with the dandy in use, but the stock from amabilis fir (stock 17) was very slow and sticky, and the dandy was removed for noble fir (stock 13) and white fir (stock

15). In this series the jordan in every case brushed as close as, or closer than, when the regular mill stock was being used.

The ground wood from Alpine fir and Engelmann spruce gave the best results from the standpoint of operation on the paper machine. All of the sheets in this series exhibited very good strength, while the color of those from Alpine fir, amabilis fir, and Engelmann spruce compared favorably with that of the spruce standard. So far as the paper-making qualities of the pulps are concerned, the 17 tests demonstrate that all of the woods used are satisfactory for news-print paper. It was suggested by the men operating the paper machines that even more satisfactory results could have been secured had a lighter sheet been run, such as is used for catalogues. Table 58 summarizes the results of strength and color tests on the papers manufactured from the commercial pulp samples. If the results of the single trial to obtain a good color for each experimental sheet are compared with the color ratings given in Table 3 for a few actual trade news-print sheets, it will be seen that the latter vary almost as widely in color as the experimental papers.

TABLE 3.—*Color ratings of commercial news-print sheets.*

	Red.	Green.	Blue.	Black.		Red.	Green.	Blue.	Black.
A.....	61	59	54	126	K.....	66	61	59	114
B.....	61	57	50	132	L.....	68	60	58	114
C.....	66	62	59	112	M.....	71	61	59	109
D.....	61	59	54	126	N.....	58	56	56	130
E.....	69	65	60	106	O.....	65	58	57	120
F.....	70	66	54	110	P.....	56	55	55	134
G.....	61	59	54	126	Q.....	61	59	58	122
H.....	69	61	59	111	R.....	69	57	57	117
I.....	60	54	54	132	S.....	64	54	54	120
J.....	65	59	59	116					

TESTS ON NEWSPAPER PRESSES.

The final test of news-print paper is, of course, its behavior on the presses and the way it takes ink. Defects which are not apparent when the material is run over the machine become very evident when the paper is run through a high-speed press. Under such conditions, holes, calender cuts, and the like cause the paper to break.

The first 12 experimental papers were tested on the presses of the St. Louis Republic, St. Louis, Mo. They were run on two duplicate machines of the Hoe sextuple rotary type. Some of the rolls of experimental paper were 67 inches wide, others were 50½ inches, and still others 33½ inches wide. One entire city edition and a portion of another were printed on the experimental papers.

On one press the papers were run at the rate of 369 copies per minute, and on the other at the rate of 372 per minute, or 22,150 and 22,300 copies per hour, respectively. This corresponds to a speed of paper through the press of approximately 760 feet per minute.

Allowing for breaks and other interruptions, the actual number of papers printed per hour under ordinary conditions ranges from 10,000 to 19,000, depending on the quality of the paper used. In the case of the experimental papers none of the ordinary conditions of operation in the pressroom were changed in any particular. A single speed was maintained throughout the tests and the only adjustments made were those necessary to secure a good-looking sheet, such as changing the supply of ink to various portions of the type and adjusting the tension on the paper. Under ordinary conditions of operation in the pressroom of the St. Louis Republic there is one break to each ton (2,000 pounds) of paper run through the press. With the paper ordinarily used, 1,000 eight-page papers weigh 113 pounds. This corresponds to a sheet weighing approximately 31 pounds per ream of 500 sheets, 24 by 36 inches in size.

From Table 4, which gives the results of the printing tests, it will be seen that in some of the rolls, particularly those of white and Sitka spruce, there were a great many breaks. Almost all of these were due, however, to calender cuts on the edges of the sheets, scum spots, defective mill pasters, and poor winding. In the main, they were the result of inability to secure the best operating conditions on the paper machine before the supply of experimental pulp became exhausted. Difficulty with the spruces led us to believe that with proper operation on the machine practically all the trouble could have been eliminated.

TABLE 4.—*Printing-press data—experimental papers.*

ST. LOUIS REPUBLIC, APR. 29-30, 1913—67-INCH ROLLS.

Stock No.	Weight at mill.	Tare. ¹	Loss in transit.	Weight of wrapper.	Weight of paper at press.	Number of 8-page papers produced. ²	Weight per 1,000 8-page papers.	Weight per 500 24 by 36 inch sheets.	Number of breaks.	Remarks.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Lbs.	Lbs.		
6	1,015	50	12	13.5	939.5	8,950	104.97	28.64	-----	Run good.
10	1,478	44	17	20.0	1,397	13,020	107.29	29.24	5	Breaks due to bad winding.
4	1,494	60	23	25.0	1,386	12,660	109.47	29.85	8	Breaks due to calender cut (and holes).
2	1,567	53	16	18.0	1,480	13,710	107.95	29.41	-----	Run good.
8	1,513	44	-----	20.0	1,449	11,890	121.86	33.22	-----	Do.
7	1,516	43	16	18.0	1,439	12,030	119.61	32.61	-----	Do.
5	1,425	56	21	22.0	1,326	11,850	111.89	30.49	6	Breaks due to calender cuts.
11	1,321	41	82	19.0	1,179	10,220	115.36	31.44	3	Breaks due to calender cuts (and holes).
12	1,473	44	11	19.5	1,398.5	11,370	123.00	33.56	1	Unknown (cuts on end of roll).

ST. LOUIS REPUBLIC, APR. 29-30, 1913—50½-INCH ROLLS.

1	1,046	44	10	12.0	980	11,600	112.64	30.71	8	Breaks due to bad winding.
1	1,191	33	-----	6.0	1,152	13,580	113.10	30.84	3	2 breaks from scum spots, 1 from mill paster.
3	927	32	25	7.0	863	9,920	115.99	31.62	14	11 due to calender cuts, 3 to bad winding.
3	873	45	6	7.0	815	9,400	115.60	31.53	3	Due to calender cut and mill paster, cuts, and holes.
9	1,134	31	-----	15.0	1,088	12,270	118.22	32.22	4	Do.
9	1,027	32	-----	9.0	986	11,020	119.29	32.52	-----	Run good.

TABLE 4—*Printing-press data—experimental papers—Continued.*

ST. LOUIS REPUBLIC, APR. 29-30, 1913—33½-INCH ROLLS.

Stock No.	Weight at mill.	Tare, ¹	Less in transit.	Weight of wrapper.	Weight of paper at press.	Number of 8-page papers produced.	Weight per 1,000 8-page papers.	Weight per 500 24 by 36 inch sheets.	Number of breaks.	Remarks.
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Lbs.	Lbs.		
6	464	22	9	12.0	421	8,590	98.02	26.74	1	Run good; mill paster.

NEW YORK HERALD, FEB. 14, 1914—66-INCH ROLLS.

13	1,386	145	72	19.0	1,241	\$12,170	101.96	30.0	.....	Run fair; breaks due to bad winding.
14	1,361	97	44	19.0	1,245	\$11,422	109.00	31.5	.....	Run good.
15	1,346	340	280	19.0	987	\$9,055	109.00	31.5	.....	Do.
16	1,224	103	50	19.0	1,102	\$9,325	118.18	34.0	.....	Run fair.
17	1,181	80	40	19.0	1,082	\$9,155	118.18	34.0	.....	Run good.

¹ Figures for New York Herald run include waste and core.³ 150 spoils.² No data on number of spoils taken at St. Louis.⁴ 100 spoils.

So far as inking qualities and finish were concerned, the experimental papers were entirely satisfactory. Many of the sheets, however, had a muddy appearance, particularly when placed beside the light-colored all-spruce sheet. It was the opinion of the pressmen that, notwithstanding this, most of the sheets were very fair. Those which seemed most promising were the balsam sheet (stock 6,) which ran very satisfactorily, though light in weight, and in color compared favorably with the all-spruce sheet, and stock 9, containing 37½ per cent of hemlock ground wood and 37½ per cent of spruce ground wood, which compared very favorably in color and printing qualities with ordinary news-print paper. Both of the lodgepole sheets and the red-fir sheet also had a good color. The tamarack sheets (stocks 11 and 12) ran well, but were dark. The following is an extract from the St. Louis Republic regarding the trial runs of the experimental papers.

The paper was used to print a part of the issue of the Republic on both Tuesday, April 29, and Wednesday, April 30, these trial runs being the first and only efforts so far made to use the experimental paper in a commercial way. The Republic volunteered to cooperate with the Government laboratory, and is gratified that it can report the paper used was of a quality to justify hopeful anticipation that substitute woods can be used which will serve to hold a good part of the paper-making industry on American soil. * * *

RESULTS ENCOURAGING.

As already remarked, the experimental runs developed results that were quite distinctly encouraging. These, however, can not be appraised with any measure of exactness for several reasons. First of these was the fact that there was not enough of any one particular make of paper to enable the pressmen in charge of the Republic's presses to acquire the familiarity that tends to good results. Sixteen rolls were sent for trial, and in only three instances were there as many as two rolls of the same par-

ticular composition. To make this handicap greater, it was necessary to constantly run two rolls of wholly different component materials at the same time, so that the press data was inevitably mixed and breaks in the running couldn't be traced with the same satisfactory certainty that would have followed if only one kind of a paper at a time had been running on a press. The weight of the paper was also extremely variable, and tension set for a roll running heavy would, of course, have to be set differently for another roll running much lighter in weight. Despite these handicaps the demonstration was notably satisfactory in respect to running strength in more than one instance.

The conventional standard of the paper mills, in the matter of weight, is 32 pounds for 500 sheets measuring 24 by 36 in size, yet one roll of the experimental paper, which weighed only 26.74 pounds, had but one break. This particular paper was made from balsam fir and was of unmistakably good quality apart from its quite surprising strength. Another roll of the same composition ran without a single break, and the trials apparently gave conclusive proof that balsam fir is good paper-making material. The red-fir paper also showed good results, but the weight being 33.22 pounds, the demonstration was not quite so conclusive.

SUCCESS WITH NEW MATERIALS.

Taking all factors into consideration, strength, color, and finish, the paper made from balsam and spruce ground wood in equal proportions, roll No. 10, stock number, was the most completely satisfactory. This paper weighed only 29.24 pounds, and the five breaks that occurred in running it were attributed entirely to improper winding. The paper made from white spruce ground wood showed unexpected lack of strength, speaking relatively, but, as might be assumed, was comparatively good in color. The matter of color is the point on which the most serious criticism can be made, but there is good reason for believing that this fault can be remedied. Consumers of paper always count on more or less difficulty at the start in getting the color established at a satisfactory standard, so this experimental paper can not be fairly condemned on that ground.

But one kind of chemical pulp was used in the manufacture of these rolls, as the list already given indicates. It was hemlock sulphite in every instance. One roll, stock No. 2, was made entirely from hemlock, both ground wood and chemical pulp. This paper was somewhat dark, but it showed good strength. The press report shows five breaks, but they are attributed to winding rather than to the weakness of the paper notwithstanding it averaged only 29.24 pounds. Paper manufacturers have used hemlock pulp for years to more or less extent, but usually mixed with spruce, and it has never been ranked in the same class as spruce in the matter of quality. Ground wood made from hemlock has a tendency to develop unfelted fiber that stands up like whiskers on the surface of the paper, but the paper made from the Wausau laboratory pulp was notably free from this particular bad quality.

The last five experimental paper stocks were tested on the presses of the New York Herald, New York City. A 66-inch roll of each paper, weighing approximately 1,200 pounds, was used. This amount was sufficient for only a part of one city edition. It was impossible, moreover, to run each stock over the same press, and the five rolls were divided among three Goss sextuple presses. In all cases the sheet was printed at the rate of 400 eight-page papers per minute, or 24,000 per hour, equal to a speed through the press of 760 linear feet per minute. As in the case of the tests at St. Louis, the pressmen did not depart from their ordinary practice except for slight adjustment of tension upon the sheet and impression

of the type required by the particular stock being printed. During shipment to New York the roll made from white fir (stock 15) and that from amabilis fir (stock 17) were considerably battered and torn at the edges. This caused the rolls to run unevenly at the start, though after a short time no trouble was experienced.

The paper from Alpine fir (stock 14) gave a good, clean, white sheet, had a good surface, took ink well, and from the printer's standpoint was considered the best sheet of the series. The amabilis fir paper (stock 17), although not as well formed, had a good surface, brought out the cuts fairly well, and was ranked second in the series. In general, the papers fed smoothly and the few irregularities met with were due to defects which could be easily prevented after a little experience in manufacture.

Following is an extract from the New York Herald in regard to the tests:

WORKS WELL ON PRESSES.

When the paper was all run off the foreman said he had had no more difficulty with the experimental Government paper than with any other that ever had been used on the presses. It fed smoothly, and while a slight imperfection appeared here and there, this was attributed to the mechanical irregularities and not to a fault of the pulp stock. The amabilis fir and the Alpine fir were credited with being the best, having a better finish, better surface, better color, and with a much better formation. * * *

The experimental runs developed results that showed that the Government paper was being printed under a handicap. In the first place, there was not enough of any one particular sample of the paper to enable the pressmen to acquire the familiarity that tends to the most perfect results.

With all the paper different in texture, thickness, weight, and formation, it was necessary to run rolls of differing texture together, so that the press data naturally were constantly mixed and the few breaks in the running could not be traced with the same satisfactory certainty that is the case when one kind of paper is feeding through all the parts of the press. The weight of the paper was also variable, compared one roll with another, and the tension set for a roll running heavy would, of course, have to be set differently for another roll running much lighter in weight.

DEMONSTRATION SATISFACTORY.

Another handicap under which the Government experts worked lay in the fact that they had made up such a small quantity of the paper that they naturally did not have as fine a quality as if they had been able to experiment with a dozen rolls before they finally adjusted their machines to the ultimate product. Moreover, in its shipment it had been damaged, so that it rolled unevenly. Despite these handicaps the demonstration was notably satisfactory.

The general impression of the press experts was that the amabilis fir and the Alpine fir had given the best results in the press. These rolls had a blue-white surface and general softness that made it almost impossible to distinguish them from spruce papers.

To obtain the opinions of paper producers and users, samples of the experimental sheets were submitted to a number of manufacturers and publishers. Their comments tend to show that different sheets are favored by different individuals, a fact which

would seem to indicate that almost every sheet is satisfactory to some critic. Some of the comments are as follows:

Some of the papers, especially Nos. 3 and 6, have beautiful color, but none of the samples are any darker than paper I have seen printed commercially, made from spruce ground wood and hemlock sulphite pulp. * * *

Personally I like the appearance of sheets Nos. 6, 9, and 10. Of these, I think sheet No. 9 shows up very well. I can not see why any one of these sheets could not be used for printing newspapers.

I find considerable variation in color when the samples are placed next to each other, but I do not think that the variation is so great that the reader's attention will be called to the color of the paper in any instance. In fact, I have seen many newspapers printed on paper made entirely from spruce wood which did not look nearly so well as the poorest of the samples submitted by you.

All of these samples on the last run seemed to show up very well indeed, and any one of them ought to serve for newspaper purposes.

PROBLEMS IN CONNECTION WITH THE EXPERIMENTAL WOODS.

Some of the woods tested are resinous, which makes them unsuitable for the manufacture of paper on a high-speed machine. There should be some inexpensive way of treating the resinous woods which would not darken them. It is possible that such treatment would have to be given in the beater. At the same time tests should be made on resinous woods at different times of the year, since it is likely that the time of cutting has a material influence on the operation of the pulp on the paper machine.

The color of many of the woods could probably be bettered by a suitable bleaching treatment while the pulp was being manufactured into laps or while the latter were being stored. Experiments might also be made to ascertain whether the sheets which are only slightly off color could not be brought up to the standard of white required for news-print purposes by the addition of dyes.

A problem not directly connected with pulp and paper production, but of importance to it, is that brought about by the decay of the wood when piled at the mill and of the pulp during storage. Some of the experimental woods decay rapidly and are subject to attacks of insects and fungi. Some reasonably cheap method of insuring these woods against decay and insects will have to be found if they are to be used in any quantity.

METHODS OF INCREASING THE EFFICIENCY OF GRINDING.

There are in the United States approximately 1,500 wood-pulp grinders of different sizes, each of which utilizes on the average 350 horsepower continuously. The amount of power applied to grinders has been increasing steadily from year to year. Where in the beginning of the mechanical pulp industry 125 horsepower was used on the grinder, in many cases now 600 to 750 horsepower is employed, and in the case of the automatic magazine grinder from 1,000 to 1,200 horsepower is utilized. Of the total number of grinders in the United States upon which information is available 36 per cent

are driven by turbines and motors of less than 300 horsepower capacity and 8 per cent of the grinders are driven by less than 200 horsepower. The work which has been described in this publication indicates that a large amount of power to the grinder is desirable. In order to utilize a large amount of power, the stones must be operated under conditions of high speed and high pressure, or they must be of a larger size than those used at the present time. Efficiency of grinding wood can be greatly increased over present average commercial practice by the use of higher pressure, since this results in the reduction of the horsepower consumption per ton of product. There are cases, of course, where such practice would not be desirable. If sulphite is available at low cost and power is expensive, this condition would surely obtain; but if sulphite is expensive and power can be secured at a low figure it is undoubtedly more economical to use a large amount of power per ton of product and make economies in sulphite by virtue of the fact that with the large amount of power better and stronger ground-wood fiber can be obtained.

Economies in grinding, particularly as related to power, depend largely on the character of the material into which the ground wood is to be incorporated. For the manufacturing of such materials as wood-pulp board, as used in the wall-board industry, a long, coarse fiber is required, and this is most desirable, since fibers of this nature do not form as dense a sheet. There are, as a result, a large number of air spaces present which retard the passage of cold and sound. For the production of pulp of this nature pulp stones of coarse grit are required which are softer than those usually employed for the manufacturing of pulps for other purposes. When using a coarse stone, a longer fiber can be obtained at higher pressure than when a finer stone is utilized. Consequently, it is desirable in the production of this character of stock to choose the pulp stone carefully to secure the best results. The matter of efficiency as applied to the manufacturing of stock for any desired purpose hinges, to a large measure, on a careful selection of the pulp stone to be used.

It is common practice in ground-wood mills to use all of the pockets on the grinder in the production of the mechanical pulp. In other words, the total amount of power available for use on the grinder is used on all of the pockets and at the same time. Power can be saved and the efficiency of production increased to a marked extent by the utilization of a fewer than the total number of pockets of the grinder. If four-pocket grinders are used, it is more desirable to use three of the pockets continuously and keep the fourth for surplus to be employed at times when one of the other pockets is being filled or when binding or other troubles are being corrected. When all of the power available on a three-pocket grinder is used

on three pockets, due to the need of filling and frequent binding of the wood in the cells, the total power is used about 88 per cent of the time. In other words, only 88 per cent of the power is being used continuously. When two pockets on the same three-pocket grinder are used to consume the total power and the third is kept for surplus, as previously outlined, all of the power is in use approximately 93 to 95 per cent of the time. Here a saving can be made and the efficiency increased without the installation or use of any additional apparatus, simply by means of increasing the pressure on the grinder cylinders, since this would be necessary if all of the power were applied to two instead of the three pockets on that piece of apparatus. Of course, this does not have as great bearing on the increasing of efficiency when grinders are motor driven; but in case of the direct connection to turbines it will be seen that it is of great consequence.

When grinders are motor driven, the most efficient utilization of the power can be accomplished by the installation of a grinder-cylinder pressure-regulating valve controlled electrically from the bus bars, the idea being to increase the pressure when for any reason the power consumption falls off.

Not only does the increasing of pressure on the cylinders result in the lowering of the horsepower consumption per ton, but there is at higher pressures an increase in the quantity of pulp which can be secured from a cord of wood, and this is another vital factor in the study of the efficiency of production of mechanical pulp. In any case it seems desirable to study carefully the grinding conditions, the speed of the pulp stone, the pressure employed, and the character and grit of the stone in use, since it is to these factors that practically all losses and gains can be traced. The manipulation of the grinder and its feeding and operation by the grinderman are also of prime importance, since without careful watching the binding of the wood in the pockets or some like difficulty may result in reduction of the production from the grinder and also in the lowering on quality of the resultant product. Even with careful watching there are times while the grinder is apparently running satisfactorily when hardly three-fourths of the total power available for its use is being consumed, due to the binding of the wood in the pockets.

FUTURE SUPPLIES FOR THE GROUND-WOOD INDUSTRY.

Of the woods tested, Alpine fir, Engelmann spruce, lowland fir, lodgepole pine, balsam fir, white fir, amabilis fir, noble fir, Sitka spruce, western hemlock, and eastern hemlock all give promise of being suitable for the production of news-print papers. Color is here the chief consideration. An acceptable news-print paper can not be made from such a dark-colored pulp as that of tamarack. Yet this does not bar tamarack as a raw material for the ground-wood industry; it will give a thoroughly satisfactory grade of yellow manila.

Similarly, jack pine, which is also unsatisfactory for news-print purposes, can be used very effectively in the manufacture of box boards. When combined with a large proportion of sulphite any of the woods tested, except the hardwoods, should produce a satisfactory manila of a color other than white. For the manufacture of wood-pulp boards, jack pine, tamarack, loblolly pine, and larch, in addition to the woods mentioned as suitable for news print, should furnish acceptable material. When high color is desired, and a somewhat poorer one in the center of the board is not objectionable, black gum or poplar could be used as a liner, if combined with a small percentage of sulphite. In the manufacture of box boards from steamed wood all of the conifers tested could be utilized, except where the product was to be a strong container board. The spruces, however, will yield a steamed pulp suitable for almost every kind of container.

It will be noted that the great majority of the substitute woods are confined to the West, while the ground-wood industry at present obtains the bulk of its supply of raw material from the East. The industry, however, is really a frontier one. It must have a plentiful supply of wood and an abundance of cheap power, two things not readily obtainable in settled communities. As the regions in which the industry is now centered develop it will have to move on to other and less-settled ones. On the National Forests are immense quantities of many of the woods tested and abundant opportunities for power development.

APPENDIX A.

List of tables contained in Appendix A.

Species.	Grinding data.	Page.	Quality test data.	Page.
White spruce:	<i>Table No.</i>		<i>Table No.</i>	
Untreated.....	5	68	7	78
Cooked.....	6	74		
Balsam fir.....	8	86	33	124
Red fir.....	9	88	34	125
White fir.....	10	90	35	126
Alpine fir.....	11	92	36	127
Amabilis fir.....	12	93	37	128
Lowland fir.....	13	94	38	129
Noble fir.....	14	95	39	130
Hemlock.....	15	96	40	131
Western hemlock.....	16	98	41	131
Tamarack.....	17	99	42	132
Western larch.....	18	103	43	134
Lodgepole pine:				
Montana.....	19	104	44	135
California.....	20	106	45	136
Western yellow pine.....	21	108	46	137
Jack pine.....	22	110	47	138
Loblolly pine.....	23	112	48	139
White pine.....	24	114	49	140
Engelmann spruce:				
Montana.....	25	115	50	141
Colorado.....	26	116	51	142
Sitka spruce.....	27	117	52	143
White birch.....	28	118	53	144
Aspen.....	29	119	54	144
Black gum.....	30	120	55	145
Mixtures of wood.....	31	121	56	146
Woods for "commercial pulps".....	57	148	58	150

114	do.	3	60	24.65	225	3,140	508.0	7,840	64.9	654.0	28.11	29.04	2,400	85.4	30.95	135.7	.00656	
9-1	do.	3	20	8.2	173	2,442	178.5	516	93.5	166.4	27.52	29.29	2,295	85.1	12.60	144.2	.00891	
15	Diamond point, cut 8 to inch.	3	20	8.2	173	2,442	181.0	210	127.6	120.3	27.52	29.29	2,390	81.9	11.05	163.0	.00913	
16	do.	3	40	16.4	175	2,442	327.0	388	88.2	326.0	27.58	27.81	2,272	82.4	13.20	147.0	.00815	
17	do.	3	60	24.65	225	3,140	508.0	489	79.8	465.0	27.59	27.81	2,345	83.0	9.84	141.0	.00707	
18	do.	3	20	8.2	173	2,442	178.5	287	112.0	181.0	27.59	27.81	2,307	83.0	7.75	158.2	.00909	
19	do.	3	40	16.4	175	2,442	327.0	441	89.8	399.0	27.59	27.81	2,350	85.1	12.60	151.8	.00735	
20	do.	3	60	24.65	225	3,140	521.0	592	82.0	534.5	29.12	27.81	2,380	81.8	11.50	148.6	.006735	
120	do.	3	40	16.4	175	2,442	312.0	378	144.8	200.0	27.80	27.42	2,155	77.5	7.45	170.8	.00778	
121	Straight, cut 3 to inch.	3	40	16.4	175	2,442	321.0	365	142.0	197.5	28.34	83.3	2,290	80.8	7.75	171.5	.00800	
122	do.	3	40	16.4	175	2,442	324.0	372	2,260	287.5	21.08	14	37.74	1,820	86.3	7.34	163.1	.00808
123	do.	3	40	16.4	175	2,442	324.0	372	2,260	287.5	21.08	14	37.74	1,820	86.3	7.34	163.1	.00808
124	do.	3	40	16.4	175	2,442	324.0	372	2,260	287.5	21.08	14	37.74	1,820	86.3	7.34	163.1	.00808
125	do.	3	50	24.65	100	1,398	299.0	359	3,005	99.5	255.0	5	31.70	2,360	84.5	12.90	140.2	.00807
126	do.	3	50	24.65	150	2,093	416.0	478	4,655	89.4	382.0	5	27.90	2,440	85.0	10.00	149.5	.00807
127	do.	3	60	24.65	200	2,792	529.0	605	5,960	88.7	481.6	5	27.90	2,476	85.1	20.06	149.3	.00768
128	do.	3	60	24.65	250	3,496	640.0	731	7,850	81.5	675.0	5	28.40	2,826	86.6	11.00	138.6	.00743
129	do.	3	30	12.36	250	3,490	350.0	397	2,938	119.2	251.5	5	30.40	2,340	81.5	8.54	163.2	.00811
130	do.	3	40	16.4	188	2,624	355.0	428	2,980	120.3	247.0	5	30.40	2,390	83.3	11.20	171.3	.00824
131	do.	3	50	20.5	150	2,093	358.0	391	3,850	92.5	318.0	5	31.00	2,420	90.0	9.94	146.3	.00830
132	do.	3	60	24.65	125	1,745	358.0	398	3,580	100.0	306.0	5	31.00	2,340	87.0	13.00	151.0	.008315
133	do.	3	40	16.4	188	2,624	343.0	407	2,685	127.7	236.2	5	28.30	2,272	83.5	10.27	172.8	.00796
134	do.	3	30	12.3	250	3,470	314.0	385	3,200	60.4	441.5	5	28.30	2,355	86.0	13.5	121.4	.00736
135	do.	3	35	13.36	214	2,970	344.0	404	6,040	57.0	505.0	5	28.30	2,390	87.8	12.05	131.5	.00800
136	do.	3	40	16.4	188	2,609	320.5	389	5,290	60.6	452.0	5	28.30	2,338	85.8	14.18	123.2	.00749
137	do.	3	45	18.46	167	2,318	341.0	392	5,255	64.9	444.0	5	29.98	2,370	86.6	10.48	128.0	.007975
138	do.	3	50	20.5	150	2,081	339.0	399	5,230	63.8	445.0	5	29.98	2,355	86.1	13.22	127.4	.00795
139	do.	3	55	22.6	136	1,887	328.0	381	5,200	63.1	432.0	5	29.98	2,410	88.1	13.96	129.5	.00770
140	do.	3	60	24.65	125	1,734	327.0	380	4,870	67.1	428.0	5	29.98	2,280	84.4	13.10	131.7	.00765
141	do.	3	50	20.5	200	2,775	429.0	495	5,875	73.0	502.0	5	31.40	2,340	83.8	21.80	86.0	.00754
142	do.	3	50	20.5	200	2,775	400.5	481	5,240	76.5	434.0	5	31.40	2,418	87.2	13.16	86.0	.00704
143	do.	3	50	20.5	200	2,775	453.0	515	6,210	72.9	529.0	5	31.40	2,350	85.6	17.92	159.3	.00797
144	do.	3	20	8.2	175	2,428	161.0	183	1,640	101.2	132.0	5	33.25	2,455	86.3	85.0	.00824	
145	do.	3	40	16.4	175	2,428	315.5	366	3,110	101.3	252.0	5	33.25	2,470	87.0	7.98	87.8	.00792
146	do.	3	60	24.65	175	2,428	412.0	526	5,145	86.0	392.0	5	33.25	2,620	92.4	13.12	86.7	.00739
147	do.	3	20	8.2	175	2,428	177.7	209	1,105	160.7	89.1	5	33.25	2,480	87.5	11.90	176.3	.00892
148	do.	3	40	16.4	175	2,428	329.0	360	3,410	94.7	350.0	6	41.00	1,950	87.0	9.50	152.7	.00778
149	do.	3	60	24.65	175	2,428	449.0	531	5,610	79.9	582.0	6	41.00	1,930	86.1	15.83	145.0	.00888
150	do.	3	20	8.2	175	2,428	176.8	222	1,350	131.0	134.6	6	41.00	1,870	83.5	3.48	86.4	.00803
151	do.	3	40	16.4	175	2,428	320.0	406	2,820	113.5	283.0	6	41.00	1,952	87.2	8.55	86.0	.00726
152	do.	3	60	24.65	175	2,428	435.0	487	4,680	93.0	461.0	6	41.00	2,030	97.6	9.22	86.3	.00726
153	do.	3	20	8.2	225	3,107	148.0	160	816	181.2	249.0	6	24.14	2,040	76.6	6.65	171.3	.00581
154	do.	2	40	16.4	225	3,107	282.0	334	2,695	104.7	80.0	6	24.14	2,160	81.1	9.70	159.3	.00583
155	do.	2	60	24.65	225	3,107	394.0	447	5,770	68.3	519.0	4	25.12	2,225	84.5	11.40	137.8	.00514
156	do.	2	80	32.8	225	3,107	497.0	551	8,340	59.5	738.0	4	25.12	2,258	85.7	15.85	136.3	.00487
157	do.	2	100	41.0	225	3,107	556.0	621	9,770	57.0	800.0	6	25.12	2,272	86.2	20.24	133.7	.00436
158	do.	2	40	16.4	250	3,452	285.0	325	4,600	62.0	403.0	6	25.12	2,280	86.6	7.35	139.1	.00504
159	do.	2	60	24.64	250	3,452	426.0	460	Stone too sharp and pulp too short for test to be of any practical value; data discarded.									.00500

tone too sharp and pul-
value; data discarded.

1 Seasoned wood used.

TABLE 5.—Grinder runs on white spruce—Continued.

Run No.	Kind of burr	Surface.	Number of pockets used.	Pressure on 14-inch cylinder.		Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid rosed wood ground in 24 hours.	Cu. ft.	Lbs.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.		Bone-dry pulp per 100 cubic feet solid rosed wood.	Efficiency of conversion.	Screens per 100 cubic feet solid rosed wood, bone-dry.	Average temperature of grinding.	Horsepower divided by pressure X speed.
				Lbs.	sq. in.												Per cent.	In.						Per cent.	Lbs.
160	Straight, cut 3 to inch; spiral, cut 12 to inch.	Stone dressed.....	3	40	16.4	100	2,071	275.0	242	2.110	92.0	190.0	27.11	5	25.31	2.220	81.9	9.43	141.5	0.00656			
161	do.....	Same surface.....	3	40	16.4	150	2,762	354.0	318	3.005	91.5	271.0	25.03	43	30.54	2,218	88.5	11.16	146.8	.00810			
162	do.....	do.....	3	40	16.4	200	3,452	407.0	427	4.080	86.7	358.0	25.03	51	30.54	2,280	91.0	8.50	143.9	.00781			
163	do.....	do.....	3	40	16.4	250	4,143	478.0	460	4.980	81.8	439.0	25.03	51	30.54	2,270	90.6	7.91	144.1	.00720			
164	do.....	do.....	3	60	24.65	100	1,351	275.0	322	3.500	78.6	303.0	25.72	51	28.83	2,310	89.9	18.27	141.1	.00806			
165	do.....	do.....	3	60	24.65	150	2,071	362.0	419	4.500	80.5	398.0	25.72	51	28.83	2,262	88.0	11.82	137.7	.00769			
166	do.....	do.....	3	60	24.65	200	2,762	481.0	560	5.800	83.0	505.0	25.72	51	28.83	2,298	89.3	12.32	143.0	.00766			
167	do.....	do.....	3	60	24.65	250	3,452	546.0	620	7.335	74.5	675.0	25.08	51	27.64	2,170	86.5	13.53	140.0	.00641			
168	do.....	do.....	2	40	16.4	250	3,452	394.0	350	3.715	81.8	336.0	25.88	61	27.34	2,210	85.4	7.22	144.8	.00536			
169	do.....	do.....	2	60	24.65	250	3,452	401.0	431	3.590	71.8	489.0	25.88	51	27.34	2,280	88.1	10.22	138.8	.00471			
170	do.....	do.....	2	80	32.8	250	3,452	510.0	564	8.090	60.8	700.0	25.94	51	28.40	2,285	87.5	11.26	129.2	.00450			
171	do.....	do.....	2	100	41.0	250	3,452	543.0	661	8.930	60.8	790.0	26.15	61	32.38	2,288	87.5	9.90	145.4	.00384			
274	do.....	Same as No. 73.....	3	60	8.2	175	2,417	330.0	367	5.025	86.9	492.0	27.09	61	39.70	2,110	75.5	7.60	149.2	.00760			
275	do.....	Same surface.....	3	40	16.4	175	2,417	185.7	239	987	188.0	98.5	27.09	61	39.70	2,004	74.1	5.67	174.1	.00938			
276	do.....	do.....	3	20	24.05	175	2,417	183.0	302	987	188.0	98.5	27.09	61	39.70	2,004	74.1	5.67	174.1	.00938			
180	do.....	Same as No. 79.....	4	20	8.2	175	2,417	334.0	392	5.025	86.9	492.0	27.09	61	39.70	2,110	77.9	7.60	149.2	.00833			
181	do.....	Same surface.....	4	20	16.4	175	2,417	183.0	302	987	188.0	98.5	27.09	61	39.70	2,004	74.1	5.67	174.1	.00925			
283	do.....	do.....	3	60	24.65	175	2,417	449.0	527	6.400	86.6	590.0	27.47	51	28.33	2,225	77.4	10.40	181.8	.00843			
284	do.....	do.....	3	60	24.65	175	2,417	449.0	527	6.400	86.6	590.0	27.47	51	28.33	2,225	77.4	10.40	181.8	.00843			
285	do.....	do.....	3	60	24.65	175	2,417	449.0	527	6.400	86.6	590.0	27.47	51	28.33	2,225	77.4	10.40	181.8	.00843			
286	do.....	do.....	3	60	24.65	175	2,417	449.0	527	6.400	86.6	590.0	27.47	51	28.33	2,225	77.4	10.40	181.8	.00843			
287	do.....	do.....	2	40	16.4	250	3,452	315.0	358	2.600	121.1	260.0	26.38	7	40.15	2,004	76.1	10.40	143.6	.00556			
288	do.....	do.....	2	40	16.4	250	3,452	315.0	358	2.600	121.1	260.0	26.38	7	40.15	2,004	76.1	10.40	143.6	.00556			
289	do.....	do.....	2	60	32.8	250	3,452	439.0	485	3.840	114.2	405.0	25.15	7	41.24	1,893	75.4	10.46	169.0	.00515			
290	do.....	do.....	2	60	32.8	250	3,452	439.0	485	3.840	114.2	405.0	25.15	7	41.24	1,893	75.4	10.46	169.0	.00515			
291	do.....	do.....	3	54	22.15	250	3,452	560.0	609	6.520	85.9	823.0	25.15	61	41.24	1,978	78.7	9.25	150.3	.00452			
291	do.....	do.....	3	54	22.15	250	3,452	554.0	610	4.755	116.4	482.0	25.15	61	41.24	1,978	78.7	9.25	150.3	.00452			

	1 92	Diamond point, cut 6 to inch.	2 100	41.0	250	3, 452 650.0	723	Qualitative run; no production data.	27.51	63	27.47	.....	126.5	.00460
1 93		do.	2 20	8.2	250	3, 452 256.5	286	.....	27.51	63	27.47	.....	136.0	.00906
1 94		Spiral, cut 6 to inch.	2 100	41.0	250	3, 435 572.5	633	.....	27.51	55	27.47	.....	107.6	.00407
1 95		do.	2 20	8.2	250	3, 435 232.5	278	.....	27.51	55	27.47	.....	110.6	.00826
1 96		Straight, cut 3 to inch; spiral, cut 12 to inch.	2 40	16.4	200	2, 748 310.0	390	.....	27.51	55	27.47	.....	113.6	.00687
1 112		do.	3 40	16.4	200	2, 748 326.0	392	.....	27.00	55	27.47	.....	141.8	.00723
2 114		Same as No. 111.	3 40	16.4	200	2, 748 342.0	378	.....	27.19	6	39.66	84.3	7.96	110.9
2 114		Same as No. 113.	3 40	16.4	225	3, 092 307.0	370	.....	25.05	6	39.66	84.1	13.42	124.5
2 121		Same as No. 119.	3 40	16.4	225	3, 092 347.0	392	.....	25.05	6	40.34	2, 130	8.5	142.1
2 122		do.	3 36.5	14.98	225	3, 092 335.0	411	.....	25.05	6	40.34	2, 093	8.5	149.5
2 123		do.	3 60	24.65	225	3, 092 493.0	556	.....	24.84	6	43.02	1, 805	72.6	133.7
2 124		Stone dressed.	3 60	24.65	225	3, 085 595.0	665	.....	24.84	6	43.02	1, 898	76.3	137.8
2 125		Same surface.	3 40	16.4	225	3, 085 419.0	475	.....	24.84	6	43.02	2, 058	82.7	141.3
2 126		do.	3 20	8.2	225	3, 085 232.0	290	.....	24.84	5	29.09	2, 402	85.8	145.0
3 127		do.	3 60	24.65	225	3, 085 597.0	629	.....	28.01	5	29.09	2, 402	85.8	145.0
3 128		do.	3 40	16.4	225	3, 085 417.0	464	.....	28.01	5	29.09	2, 402	85.8	145.0
3 129		do.	3 20	8.2	225	3, 085 231.0	284	.....	28.01	5	29.09	2, 402	85.8	145.0
3 133		Same as No. 132.	3 40	16.4	225	3, 085 413.0	496	.....	27.66	4	28.08	3, 360	83.9	167.0
3 134		do.	3 40	16.4	225	3, 085 411.0	470	.....	27.66	4	28.08	3, 360	83.9	167.0
3 135		Same surface.	3 60	24.65	225	3, 085 403.0	470	.....	27.66	4	28.08	3, 360	83.9	167.0
3 136		do.	3 60	24.65	225	3, 085 416.0	472	.....	27.66	4	28.08	3, 360	83.9	167.0
3 137		do.	3 20	8.2	175	2, 400 188.0	215	.....	27.96	5	27.75	2, 430	87.4	103.3
3 138		do.	3 40	16.4	175	2, 400 338.0	384	.....	27.96	5	27.75	2, 430	87.4	103.3
3 139		do.	3 60	24.65	175	2, 400 462.0	515	.....	28.04	5	27.75	2, 430	87.4	103.3
3 140		do.	3 20	8.2	175	2, 400 180.0	225	.....	28.04	5	27.75	2, 430	87.4	103.3
3 141		do.	3 40	16.4	175	2, 400 323.0	346	.....	28.04	5	27.75	2, 430	87.4	103.3
3 142		do.	3 60	24.65	175	2, 400 465.0	515	.....	28.04	5	27.75	2, 430	87.4	103.3
3 143		Same as No. 142.	3 60	24.65	225	3, 083 572.0	651	.....	26.97	5	27.75	2, 435	86.7	14.51
3 144		Same surface.	3 60	24.65	225	3, 083 553.0	634	.....	26.97	5	27.75	2, 435	86.7	14.51
3 145		do.	3 60	24.65	225	3, 083 586.0	665	.....	26.97	5	27.75	2, 435	86.7	14.51
3 146		do.	3 30	20.5	100	1, 371 247.5	283	.....	26.97	5	27.75	2, 435	86.7	14.51
3 147		do.	3 50	20.5	130	2, 056 254.0	295	.....	26.97	5	27.75	2, 435	86.7	14.51
3 148		do.	3 60	20.5	250	3, 427 222.0	254	.....	26.97	5	27.75	2, 435	86.7	14.51
3 149		do.	3 50	20.5	100	1, 371 266.0	284	.....	26.97	5	27.75	2, 435	86.7	14.51
3 150		do.	3 60	20.5	250	3, 056 263.0	284	.....	26.97	5	27.75	2, 435	86.7	14.51
3 151		do.	3 30	20.5	250	3, 427 226.0	265	.....	26.97	5	27.75	2, 435	86.7	14.51
3 152		do.	3 40	12.3	225	3, 085 324.0	362	.....	27.13	9	32.00	1, 983	82.3	11.30
3 153		Same as white birch No. 2.	3 30	12.3	225	3, 085 298.0	340	.....	26.91	5	22.93	2, 120	78.9	17.57
3 154		Same as tamarack, No. 26.	3 30	12.3	225	3, 085 298.0	340	.....	26.91	5	22.93	2, 120	78.9	17.57
1 154		Same surface.	2 100	41.0	225	3, 085 652.0	706	.....	26.91	5	22.93	2, 035	75.6	25.78
1 155		Straight, cut 3 to inch; spiral, cut 10 to inch.	3 40	16.4	225	3, 085 444.0	489	.....	26.91	5	22.10	2, 270	80.5	5.05
1 156		do.	3 40	16.4	225	3, 085 382.0	446	.....	26.91	5	22.10	2, 240	79.5	12.31
1 157		do.	2 80	32.8	225	3, 085 511.0	509	.....	26.91	5	22.10	2, 270	80.5	9.39
1 158		do.	2 80	32.8	225	3, 085 474.0	571	.....	26.91	5	22.10	2, 270	80.5	9.39
1 159		Straight, cut 3 to inch; spiral, cut 12 to inch.	3 30	12.3	250	3, 427 316.0	368	.....	25.14	6	34.14	2, 110	84.0	6.90

1 Seasoned wood used.

2 Green wood used.

TABLE 5.—Grinder runs on white spruce—Continued.

Run No.	Kind of burr.	Surface.	Number of pockets used.		Pressure on 14-inch cylinder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid rossed wood ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.	Bone-dry pulp per 100 cubic feet solid rossed wood.	Efficiency of conversion.	Screens per 100 cubic feet solid rossed wood, bone-dry.	Average temperature of grinding.	Horsepower divided by pressure X speed.
			Lbs. per sq. in.	Lbs.	Feet per minute.	Tons.	Cu. ft.	Lbs.	In.	Per cent.	Lbs.	Per cent.	Lbs.	Per cent.	Lbs.	Per cent.	Lbs.	Per cent.	Lbs.	° F.	0.00730
1160	Straight, cut 3 to inch; spiral, cut 10 to inch.	Same surface.....	3	12.3	3,427	2.250	136.8	26.48	51	31.12	2,365	87.1	190.3	26.48	51	31.12	2,365	87.1	11.37	158.30	0.00730
1161	do.....	do.....	3	14.35	2,936	2.210	148.2	26.48	368	32.0	2,420	87.1	191.6	26.48	4	31.12	2,310	87.1	9.10	178.2	0.00779
1162	do.....	do.....	3	16.4	2,590	2.425	130.8	26.48	350	31.7	2,425	87.1	206.0	26.48	5	31.12	2,350	87.1	9.81	169.3	0.00779
1163	do.....	do.....	3	18.45	2,290	2.825	120.0	26.48	380	33.0	2,825	87.1	230.0	26.48	5	31.12	2,455	87.1	13.26	166.6	0.00802
1164	do.....	do.....	3	20.5	2,056	2.445	132.1	26.48	361	32.3	2,445	87.1	204.5	26.48	5	31.12	2,385	87.1	11.62	158.2	0.00767
1165	do.....	do.....	3	22.55	1,897	2.265	136.7	26.48	347	31.0	2,265	87.1	196.0	26.48	5	31.12	2,310	87.1	11.70	165.1	0.00736
1166	do.....	do.....	3	24.65	1,714	2.775	116.5	26.48	386	32.3	2,775	87.1	236.0	26.48	5	31.12	2,350	87.1	16.45	155.7	0.00764
1177	Diamond point, cut 8 to inch.	Same as No. 176.....	2	8.2	3,085	1.760	207.0	27.54	194	157.5	1,760	207.0	68.7	27.54	4	27.98	2,210	80.3	10.75	161.2	0.00622
1178	do.....	Same surface.....	40	16.4	3,085	2.290	125.0	27.54	314	314	2,290	125.0	193.0	27.54	4	27.98	2,315	84.0	9.02	160.0	0.00553
1179	do.....	do.....	60	24.65	3,085	3.870	94.5	27.54	455	455	3,870	94.5	342.0	27.54	4	27.98	2,300	86.9	10.27	137.5	0.00508
1180	do.....	do.....	2	32.8	3,085	4.850	73.5	27.54	530	530	4,850	73.5	408.0	27.54	5	27.98	2,370	86.0	10.90	126.4	0.00479
1181	do.....	do.....	2	40.0	3,085	5.630	60.0	27.54	600	600	5,630	60.0	483.0	27.54	5	27.98	2,310	83.9	16.57	126.7	0.00445
1210	Spiral, cut 8 to inch.	Stone dressed.....	3	20.5	2,728	410.0	325.0	Axis of wood stone.	469	1,260	410.0	325.0	643.0	27.54	5	27.98	2,310	83.9	16.57	126.7	0.00445
1222	Straight, cut 3 to inch; spiral, cut 12 to inch.	do.....	2	32.8	3,089	474.0	71.6	25.37	566	6,610	474.0	71.6	551.0	25.37	6	32.24	2,400	94.6	14.65	146.0	0.00470
1243	Spiral, cut 8 to inch; straight, cut 10 to inch.	Same as lowland fir No. 17.	2	16.4	2,348	219.0	125.0	25.63	263	1,750	219.0	125.0	148.0	25.63	4	34.83	2,365	92.2	7.10	158.0	0.00569
1244	do.....	Same surface.....	2	24.65	2,348	306.0	97.3	25.63	346	3,145	306.0	97.3	261.0	25.63	4	34.83	2,412	94.0	12.10	142.0	0.00528
1245	do.....	do.....	80	32.8	2,348	370.0	84.5	25.63	450	4,375	370.0	84.5	360.0	25.63	5	34.83	2,430	94.8	13.10	142.0	0.00480
1246	do.....	do.....	2	24.65	1,342	212.0	97.4	25.63	238	2,175	212.0	97.4	181.0	25.63	4	34.83	2,410	94.0	10.60	145.0	0.00640
1247	do.....	do.....	2	24.65	3,355	411.0	106.0	25.63	465	3,870	411.0	106.0	315.0	25.63	4	34.83	2,460	96.0	9.10	150.0	0.00497
1248	do.....	do.....	2	24.65	2,348	316.0	66.5	25.63	372	4,740	316.0	66.5	430.0	25.63	4	34.83	2,460	96.0	8.10	96.0	0.00545
1249	do.....	Stone dressed.....	2	24.65	2,348	321.0	189.0	25.63	380	1,700	321.0	189.0	189.0	25.63	4	34.83	1,803	70.4	4.9	75.0	0.00554
1250	do.....	do.....	2	24.65	2,348	312.0	400.0	25.63	400	2,080	312.0	400.0	153.7	25.63	5	34.83	1,803	70.4	7.6	151.0	0.00538
1251	do.....	Same surface.....	2	24.65	2,348	304.0	369.0	25.63	369	2,080	304.0	369.0	193.0	25.63	4	34.83	2,150	83.9	10.4	176.0	0.00524
1252	do.....	do.....	3	20.50	3,020	436.0	215.0	25.50	531	2,025	436.0	215.0	191.0	25.50	5	33.1	2,120	82.6	8.2	170.0	0.00705
1253	do.....	do.....	3	20.50	3,020	437.0	178.5	25.50	550	2,560	437.0	178.5	226.0	25.50	5	33.1	2,260	88.1	6.4	154.0	0.00739
1254	do.....	do.....	3	20.50	3,020	527.0	205.0	25.50	641	2,570	527.0	205.0	242.0	25.50	5	33.1	2,120	82.6	8.2	170.0	0.00832

2 255	do.....	3	40	16.40	175	2,348	258.0	314	2,845	90.6	391.0	18.60	12 $\frac{1}{2}$	30.80	1,455	78.3	12.3	130.0	.00670
2 256	do.....	3	40	16.40	175	2,348	290.0	342	2,250	129.0	194.0	23.83	4 $\frac{1}{2}$	29.66	2,320	89.9	14.2	147.0	.00753
1 257	Straight, cut 3 to inch; spiral, cut 12 to inch.	3	20	8.20	175	2,425	176.0	204	1,190	148.0	111.0	24.36	4 $\frac{1}{2}$	28.73	2,140	88.0	22.5	170.0	.00885
1 258	do.....	3	40	16.40	175	2,425	331.0	415	3,450	96.0	318.0	24.36	4 $\frac{1}{2}$	28.73	2,170	89.1	35.9	156.0	.00832
1 259	do.....	3	60	24.65	175	2,425	514.0	565	7,460	68.8	670.0	24.36	4 $\frac{1}{2}$	28.73	2,230	91.6	74.0	152.0	.00839
1 260	do.....	3	40	16.40	100	1,387	235.0	277	2,410	97.5	220.0	24.36	4 $\frac{1}{2}$	28.73	2,185	88.9	32.6	157.0	.01032
1 261	do.....	3	40	16.40	150	2,080	358.0	392	4,270	83.6	395.0	24.36	4 $\frac{1}{2}$	28.73	2,160	88.8	56.6	150.0	.01049
1 262	do.....	3	40	16.40	200	2,774	426.0	478	4,820	88.3	433.0	24.36	4 $\frac{1}{2}$	28.73	2,220	91.2	30.0	145.0	.00936
1 263	do.....	3	40	16.40	250	3,468	490.0	522	6,355	76.7	573.0	24.36	4 $\frac{1}{2}$	28.73	2,222	91.3	31.9	140.0	.00861
1 264	Stone dressed.....	2	60	24.65	225	3,120	418.0	459	7,870	53.2	814.0	24.36	4 $\frac{1}{2}$	28.73	1,680	78.3	43.9	131.0	.00543
1 276	do.....	2	20	8.20	225	3,120	151.0	198	1,750	86.0	117.0	25.11	4 $\frac{1}{2}$	28.88	2,380	94.8	11.5	133.0	.00590
1 277	do.....	2	40	16.40	225	3,120	310.0	353	4,295	72.2	448.0	25.11	4 $\frac{1}{2}$	28.88	1,920	76.5	27.3	128.0	.00606
1 278	do.....	2	60	24.65	225	3,120	469.0	530	9,040	52.0	769.0	25.11	4 $\frac{1}{2}$	28.88	2,354	95.8	32.4	127.0	.00609
1 279	do.....	2	80	32.80	225	3,120	592.0	696	11,800	46.0	982.0	25.11	4 $\frac{1}{2}$	28.88	2,400	95.6	31.0	122.0	.00530
1 280	do.....	3	30	12.32	200	2,774	296.0	361	3,580	82.7	304.0	25.11	4 $\frac{1}{2}$	28.88	2,360	94.0	9.1	72.0	.00867
1 281	do.....	3	30	12.32	200	2,774	312.0	370	3,675	85.0	310.0	25.11	4 $\frac{1}{2}$	28.88	2,360	94.0	11.4	133.0	.00913
1 282	do.....	3	30	12.32	200	2,774	308.0	364	3,000	103.0	260.0	25.11	4 $\frac{1}{2}$	28.88	2,300	91.6	19.8	168.0	.00902

¹ Seasoned wood used.² Partially decayed wood used.

Runs 257-282 were run on a coarse-grit stone.

TABLE 6.—Grinder runs on spruce wood—cooked prior to grinding.

Grinder run No.	Cooking treatment.		Kind of burr.	Surface of stone.	Number of pockets used.		Pressure on 14-inch cylinder.	Revolutions per minute.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid-rosed wood ground in 24 hours.	Weight per cubic foot of wood (bone-dry).	Average diameter of wood.	Moisture in wood.	Pulp bone-dry per 100 cubic foot of solid-rosed wood.	Efficiency of conversion.	Screenings bone-dry per 100 cubic feet solid-rosed wood.	Average temperature of grinding.	Horsepower divided by pressure $\times$ speed.
	Kind of cook.	Duration of cook.			Lbs. per sq. in.	40															
151	Steamed.	8	Straight, cut 3 to in.; spiral cut, 12 to in.	Same as for tamarack No. 23.	3	40	200	326	372	3.130	Tons.	104.0	340.0	22.96	58	39.08	1,840	80.2	18.47	156.6	.00719
157	Boiled.	4	do.	Same as for spruce No. 56.	3	40	200	335	394	3.380		99.2	296.0	27.11	54	25.31	2,283	84.4	23.60	156.0	.00739
172	Steamed.	8	do.	Same as for western yellow pine No. 3.	3	40	200	301	358	2.250		133.9	250.0	25.06	62	30.36	1,800	71.9	16.15	166.4	.00664
173	do.	2	do.	Same as for white birch No. 1.	3	40	200	353	415	2.800		126.0	264.0	26.84	58	30.73	2,122	79.0	19.25	164.1	.00777
177	do.	4	do.	Same as for spruce No. 76.	3	40	175	172	212	2.784		99.2	296.0	27.11	54	25.31	2,283	84.4	23.60	156.0	.00739
178	do.	4	do.	Same surface.	3	40	175	299	349	2.155		138.8	208.5	27.48	6	28.61	2,066	75.2	18.19	158.2	.00755
179	do.	4	do.	do.	3	60	175	373	449	2.935		127.1	292.0	27.14	62	28.83	2,013	74.2	23.90	149.4	.00626
397	do.	6	do.	Stone dressed.	3	20	225	153	180	1.803		84.9	197.8	26.66	62	36.51	1,823	68.4	10.08	131.5	.00605
398	do.	6	do.	Same surface.	3	20	225	230	272	3.365		68.1	352.0	27.19	6	39.66	1,910	70.3	18.32	121.1	.00452
399	do.	6	do.	do.	3	60	225	308	360	4.020		76.7	426.0	27.19	7	39.66	1,883	69.4	27.37	120.2	.00404
3100	do.	6	do.	do.	3	60	225	369	401	4.655		79.1	496.0	27.19	61	39.66	1,876	69.0	34.00	125.1	.00364
3101	do.	6	do.	do.	3	100	225	420	510	4.615		90.9	487.0	27.19	61	39.66	1,896	69.7	45.85	128.4	.00332
3102	do.	6	do.	Stone dressed.	3	40	200	320	320	3.075		91.1	376.0	25.06	61	44.00	1,636	65.3	18.57	125.0	.00621
3103	do.	2	do.	Same surface.	3	40	200	332	382	4.195		79.1	378.0	27.81	61	26.22	2,219	79.7	12.28	128.7	.00736
3104	do.	4	do.	do.	3	40	200	323	393	4.210		76.7	390.0	27.81	61	26.22	2,160	77.6	16.86	137.0	.00716
3105	do.	6	do.	do.	3	40	200	327	364	3.995		81.8	422.0	27.81	55	26.22	1,892	68.0	10.36	126.1	.00725
3106	do.	8	do.	do.	3	40	200	320	382	3.595		89.1	345.0	27.30	55	27.50	2,081	75.8	17.81	137.8	.00710
3107	do.	12	do.	do.	3	40	200	333	398	3.965		90.6	344.0	27.30	55	27.50	2,263	83.5	16.53	144.9	.00752
3108	do.	2	do.	do.	3	40	200	329	393	3.810		89.0	337.0	26.50	55	23.88	2,170	79.5	15.80	134.0	.00681
3109	do.	4	do.	do.	3	40	200	307	363	3.705		82.9	342.0	26.50	55	23.88	2,105	82.0	21.80	142.2	.00652
3110	do.	6	do.	do.	3	40	200	285	342	2.927		97.4	278.0	26.50	55	23.88	2,000	75.5	12.98	139.5	.00610
3111	do.	8	do.	do.	3	40	200	275	323	3.037		90.6	304.0	26.50	55	23.88	1,998	75.4	10.40	143.7	.00639
3112	do.	12	do.	Same as for spruce No. 112.	3	40	200	288	342	2.985		96.5	299.0	26.50	55	23.88	2,080	76.5	10.96	137.9	.00652
3113	do.	2	do.	Same as for spruce No. 114.	3	40	200	294	368	3.260		90.1	314.0	27.19	55	39.66	2,080	73.2	19.30	140.8	.00659
3116	do.	4	do.	Same surface.	3	40	200	252	303	2.475		101.9	270.0	25.05	61	40.34	1,830	68.3	11.13	138.1	.00601
3117	do.	6	do.	do.	3	40	200	271	328	2.540		106.7	285.0	25.05	6	40.34	1,722	68.3	14.76	138.6	.00627
3118	do.	8	do.	do.	3	40	200	283	329	2.775		102.0	325.0	25.05	6	40.34	1,710	68.3	14.76	138.6	.00627

[illegible]

Green wood was ground with bark on.

Green wood used.

3 per cent soda-ash solution.

¹ Seasoned wood used.

TABLE 6.—Grinder runs on spruce wood—cooked prior to grinding—Continued.

Grinder run No.	Cooking treatment.		Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Revolutions per minute.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid rosed wood ground in 24 hours.	Weight per cubic foot of wood (bone-dry).	Average diameter of wood.	Moisture in wood.	Pulp bone-dry per 100 cubic feet of solid rosed wood.	Efficiency of conversion.	Screenings bone-dry per 100 cubic feet solid rosed wood.	Average grinding temperature of	Horsepower divided by pressure $\times$ speed.
	Kind of cook.	Duration of cook.	Kind of burr.	Surface of stone.																
1215	Steamed.	2	25	Spiral, cut 8 to in.; straight, cut 10 to in.	Same surface.	2	60	174.2743	327	3.118	88.1	270.0	26.50	62	30.90	2,310	87.1	14.16	136.10	0.0069
1216	do.	0	0	do.	do.	2	60	171.275	332	3.300	83.4	278.0	26.50	77	30.90	2,372	89.5	10.82	144.0	.00477
1217	do.	12	75	do.	do.	2	60	225.320	361	3.300	97.0	357.0	26.50	77	30.90	1,848	69.6	12.96	136.4	.00422
1218	do.	8	75	do.	do.	2	60	219.280	318	2.703	100.2	298.0	26.50	62	30.90	1,872	70.6	14.40	133.1	.00380
1219	do.	6	75	do.	do.	2	60	214.274	327	2.192	125.0	234.0	26.50	88	30.90	1,875	70.7	11.43	140.7	.00381
1220	do.	4	75	do.	do.	2	60	210.280	312	2.590	108.5	262.0	26.50	88	30.90	1,978	74.5	16.45	136.0	.00396
1221	do.	2	75	do.	do.	2	60	187.280	367	2.385	117.0	220.0	26.50	7	30.90	2,170	81.9	12.10	140.0	.00445
1222	do.	6	75	do.	Stone dressed	2	60	225.277	348	3.130	88.5	321.0	26.50	51	34.69	1,952	77.5	18.90	131.0	.00368
1223	do.	6	60	do.	Same surface.	2	60	207.281	315	3.150	89.6	312.0	25.20	5	34.69	2,205	87.5	27.00	131.0	.00406
1224	do.	6	60	do.	do.	2	60	200.276	327	3.195	86.6	312.0	25.20	5	34.69	2,040	87.5	14.10	125.0	.00413
1225	do.	6	20	do.	do.	2	60	179.277	338	3.845	72.0	318.0	25.20	5	34.69	2,315	91.8	17.50	137.0	.00461
1226	do.	0	0	do.	do.	2	60	156.280	331	3.895	72.0	318.0	25.20	5	34.69	2,450	97.2	4.80	136.0	.00537
1228	do.	3	75	do.	do.	2	60	216.277	332	3.055	90.7	284.0	25.20	4	34.69	2,150	85.4	19.30	133.0	.00383
1229	do.	3	60	do.	do.	2	60	204.280	333	3.225	86.8	308.0	25.20	5	34.69	2,092	83.0	22.60	135.0	.00410
1230	do.	3	30	do.	do.	2	60	179.278	328	3.355	82.9	300.0	25.20	5	34.69	2,238	88.7	15.10	136.0	.00463
1231	do.	3	20	do.	do.	2	60	164.277	335	3.480	79.5	300.0	25.20	5	34.69	2,320	92.0	11.10	141.0	.00504
1232	do.	0	0	do.	do.	2	60	157.278	328	3.980	69.9	328.0	25.20	5	34.69	2,425	96.4	9.90	133.0	.00529
1233	do.	6	75	Diamond point, cut 6 to in.	Stone dressed.	2	60	225.345	404	3.710	93.0	356.0	25.66	5	31.12	2,085	91.4	27.6	166.0	.00458
1234	do.	6	60	do.	Same surface.	2	60	210.348	415	3.540	98.3	334.0	25.66	5	31.12	2,120	82.6	20.4	138.0	.00465
1235	do.	6	60	do.	do.	2	60	206.344	390	3.510	98.0	323.0	25.66	5	31.12	2,176	84.7	17.5	140.0	.00500
1236	do.	6	20	do.	do.	2	60	187.344	409	4.150	82.9	364.0	25.66	5	31.12	2,280	88.9	25.2	141.0	.00550
1237	do.	0	0	do.	do.	2	60	178.339	385	4.090	83.0	343.0	25.66	5	31.12	2,385	93.0	12.0	142.0	.00570
1238	do.	3	75	do.	do.	2	60	205.347	398	3.710	93.5	362.0	25.66	5	31.12	2,018	79.9	20.6	112.0	.00506
1239	do.	3	60	do.	do.	2	60	192.344	408	4.090	85.0	376.0	25.66	5	31.12	2,155	83.9	27.3	137.0	.00535
1240	do.	3	60	do.	do.	2	60	191.342	388	4.150	82.5	363.0	25.66	4	31.12	2,278	88.6	21.9	134.0	.00552
1241	do.	3	20	do.	do.	2	60	188.347	390	4.300	80.7	360.0	25.66	6	31.12	2,395	93.2	23.0	138.0	.00581
1242	do.	0	0	do.	do.	2	60	176.354	398	4.360	81.2	378.0	25.66	4	31.12	2,310	90.0	15.0	129.0	.00601

TABLE 7.—*Quality tests—white spruce.*

Grinder run No.	Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Mullen test.			Schopper tests.						Tintometer indications.						
				Total.	Per 0.001 inch of thickness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.			Stretch.		Breaking weight per square millimeter, sectional area.	Breaking length per horsepower per ton.	Red.	Green.	Blue.	Black.	
								Points.	Points.	Points.	Meters.	Meters.							Per ct.
1	110	80	32.0	12.15	3.14	0.380	256.0	2,600	4,000	3,300	3.00	1.40	2.20	1,506	33.9	95	86	78	41
2	62	80	32.0	16.4	4.55	0.513	306.0	3,075	5,300	4,188	2.04	1.22	1.63	2,050	26.7	89	80	73	58
3	75	80	37.0	19.35	4.72	0.523	210.0	3,585	6,040	4,821	1.98	1.04	1.51	2,440	43.8	87	76	66	71
4	42	80	29.0	0.038	2.97	0.300	221.0	2,420	4,640	3,530	1.74	0.98	1.36	1,462	40.8	89	78	68	65
5	77	80	40.0	0.047	4.55	0.535	351.0	2,500	5,440	3,970	1.78	1.10	1.10	1,936	21.2	90	80	70	60
6	22	79	33.0	0.038	4.13	0.476	229.0	2,500	5,410	4,665	1.76	1.06	1.14	2,130	42.8	88	79	69	64
7	56	80	34.0	0.043	4.13	0.476	221.0	2,674	4,780	3,727	1.66	1.10	1.38	1,590	40.9	87	77	64	72
8	31	80	33.0	14.05	3.27	0.413	323.0	3,344	5,600	4,517	2.86	1.58	2.22	2,350	25.7	92	71	61	86
9	16	80	35.0	17.95	4.72	0.544	189.0	2,673	5,410	4,166	1.58	0.98	1.28	1,272	45.2	96	75	73	50
10	72	80	33.0	14.15	3.60	0.429	174.0	2,973	5,358	4,166	1.40	1.04	1.22	1,975	55.9	91	79	68	80
11	45	80	34.0	12.35	2.94	0.363	180.0	2,123	4,335	3,229	2.92	1.30	2.11	1,360	49.3	91	78	70	61
12	92	80	34.0	15.65	3.75	0.460	163.0	2,180	5,320	4,250	1.78	1.22	1.50	1,895	56.6	97	85	76	62
13	13	80	34.0	13.00	3.25	0.382	176.0	2,655	5,030	3,843	1.98	1.10	1.54	1,680	57.3	90	79	66	65
14	28	80	34.0	13.00	2.77	0.358	170.0	2,065	4,325	3,195	1.94	1.12	1.54	1,330	49.2	90	79	69	62
15	61	80	32.0	11.45	2.77	0.358	181.0	2,228	4,320	3,124	1.74	1.02	1.38	1,240	48.2	90	80	74	56
16	15	80	30.0	16.55	4.83	0.552	231.0	3,865	5,750	4,808	2.22	1.10	1.66	2,140	51.3	85	75	64	76
17	19	80	38.0	17.45	4.06	0.459	192.0	3,098	5,960	4,529	2.16	1.26	1.71	2,114	51.3	85	75	64	76
18	48	80	33.0	13.40	4.47	0.406	196.0	2,395	3,795	3,095	2.40	0.98	1.64	1,940	38.8	88	73	65	74
19	73	80	29.0	14.50	4.40	0.500	224.0	3,085	5,850	4,408	1.76	1.16	1.46	2,119	39.9	86	77	70	67
20	91	80	35.0	16.35	4.12	0.467	192.0	3,350	5,360	4,355	2.00	1.20	1.60	2,085	48.5	95	82	75	67
21	43	80	31.0	13.90	3.56	0.448	183.0	2,865	4,855	3,860	1.94	1.00	1.47	1,613	47.1	92	82	71	55
22	25	80	44.0	25.6	5.69	0.582	249.0	3,384	6,680	5,032	2.02	1.48	2.02	2,700	34.8	87	78	67	68
23	77	80	33.0	17.15	4.85	0.520	273.0	3,400	5,850	4,625	2.02	1.24	1.63	2,350	32.6	82	69	61	88
24	59	80	33.0	18.70	5.27	0.567	236.0	3,570	5,910	4,740	2.22	1.32	1.85	2,420	35.3	84	75	70	71
25	67	80	33.0	16.75	4.53	0.508	196.0	3,165	5,430	4,298	2.22	1.32	1.77	2,010	43.1	86	74	67	73
26	50	80	31.0	13.0	4.30	0.513	174.0	3,045	4,840	3,943	2.18	1.18	1.68	1,850	44.1	78	66	58	98
27	59	80	36.0	13.9	4.36	0.497	178.0	3,000	5,610	4,325	2.60	1.00	2.10	2,150	48.7	88	75	64	73
28	93	80	33.0	13.85	3.30	0.420	194.0	2,445	5,018	3,733	1.24	1.05	1.15	1,656	45.8	85	71	66	78
29	96	80	35.0	18.2	4.67	0.520	229.0	2,965	5,200	3,832	2.00	1.08	1.54	2,185	32.1	95	79	71	55
30	96	80	32.0	16.1	4.41	0.503	203.0	3,195	5,020	4,108	2.22	1.12	1.58	2,170	37.6	88	79	71	62
31	64	80	31.0	15.15	4.21	0.489	201.0	3,195	5,020	4,108	2.22	1.14	1.68	1,975	32.2	85	76	68	71

30	58	15.00	4.17	.484	191.0	3,295	5,400	4,348	2.12	1.14	1.63	1,914	47.0	87	78	67	68
31	26	13.25	3.79	.427	234.0	3,050	5,450	4,255	1.72	1.08	1.40	1,928	42.5	91	80	72	57
32	66	8.5	2.07	.274	220.0	3,065	5,450	4,255	1.12	.94	1.03	1,220	48.2	87	78	71	64
33	24	10.0	2.22	.306	188.0	2,180	4,230	3,205	1.36	.88	1.12	1,254	56.2	87	77	69	67
34	17	10.75	2.29	.326	186.0	2,140	4,000	3,070	1.20	.88	1.04	1,260	50.6	90	76	68	68
35	23	11.7	2.66	.354	183.5	2,282	4,600	3,441	1.48	.96	1.22	1,365	53.1	83	72	61	84
36	18	11.45	2.73	.358	181.0	2,294	4,935	3,615	1.48	1.00	1.24	1,500	55.8	90	79	70	61
37	52	12.35	2.87	.363	174.0	2,560	4,060	3,380	2.04	1.12	1.52	1,340	53.5	86	74	66	74
38	55	12.35	2.83	.363	174.0	2,560	3,970	3,265	1.96	1.08	1.52	1,340	51.7	88	76	64	72
39	54	11.60	2.64	.341	197.0	2,300	4,725	3,613	1.78	1.08	1.43	1,226	44.0	83	70	61	86
40	14	9.95	2.74	.331	221.0	2,500	4,635	3,693	1.44	.98	1.01	1,570	49.5	81	70	62	87
41	19	13.80	3.14	.380	232.0	2,750	4,635	3,693	1.44	.98	1.21	1,615	48.22	80	74	65	82
42	74	12.00	3.10	.402	181.0	2,805	4,960	3,878	1.46	1.08	1.27	1,610	53.1	84	71	63	82
43	39	13.70	3.91	.442	229.0	2,773	5,280	4,026	2.14	1.12	1.63	2,014	39.8	84	76	72	65
44	25	13.8	3.73	.431	235.0	2,810	5,010	4,010	2.14	1.32	1.73	1,910	39.6	88	80	70	62
45	44	11.9	3.30	.384	224.0	2,630	5,170	3,910	2.40	1.00	1.20	1,695	45.5	84	72	61	83
46	52	15.95	4.31	.455	353.0	3,055	4,950	4,003	2.72	1.36	2.04	2,010	25.0	79	69	59	93
47	40	14.45	4.30	.452	197.0	5,280	5,135	3,858	2.54	1.22	1.88	1,710	40.7	87	79	70	64
48	60	13.6	3.40	.425	188.0	2,714	4,620	3,517	2.54	1.54	2.04	1,545	44.0	80	75	66	72
49	49	14.8	4.05	.456	288.0	3,455	5,415	4,435	2.02	1.00	1.51	2,200	33.8	80	70	61	89
50	85	14.7	4.11	.462	246.0	3,014	5,280	4,147	2.14	1.28	1.71	1,940	36.5	84	73	68	75
51	51	20.5	5.55	.569	366.0	3,460	5,400	4,430	2.68	1.16	1.92	1,840	44.0	86	79	69	66
52	97	17.35	5.88	.495	183.0	3,525	4,805	4,165	1.92	.84	1.38	2,880	23.0	83	76	68	73
53	63	11.25	3.35	.388	270.0	2,925	5,155	4,040	1.84	1.14	1.49	1,810	38.6	89	79	69	63
54	82	13.30	3.14	.380	180.0	2,985	4,580	3,783	1.84	1.16	1.50	1,728	55.5	83	73	69	75
55	68	8.9	2.28	.306	195.0	2,445	4,260	3,353	1.50	1.02	1.26	1,395	56.2	88	78	71	63
56	71	10.5	2.48	.326	175.0	2,305	4,060	3,180	1.18	.92	1.05	1,394	55.8	86	74	66	74
57	58	16.45	4.01	.470	211.0	3,245	5,350	4,298	2.26	1.18	1.72	1,934	43.3	82	68	63	87
58	83	11.45	2.74	.358	173.0	2,715	4,385	3,550	1.44	1.00	1.22	1,517	57.2	87	75	68	70
59	86	13.85	3.85	.461	199.5	3,110	5,190	4,150	1.82	1.20	1.51	2,000	45.1	91	81	72	56
60	87	15.95	4.25	.483	189.0	3,110	5,000	4,055	2.04	1.36	1.78	1,975	44.3	91	79	74	56
61	81	14.05	3.38	.413	210.0	3,040	4,865	3,953	2.04	1.18	1.61	1,753	45.5	91	78	73	62
62	80	12.15	3.04	.380	215.0	2,910	5,040	3,975	1.52	1.10	1.31	1,712	48.6	85	76	67	72
63	76	11.95	3.28	.412	191.0	2,760	4,635	3,697	1.60	1.02	1.31	1,640	47.0	88	76	67	69
64	6	11.40	2.85	.345	233.0	2,445	4,892	3,677	1.63	1.01	1.32	1,569	45.1	87	75	66	72
65	57	11.60	3.31	.426	194.5	2,910	4,635	3,773	2.00	1.10	1.55	1,640	45.5	84	72	62	82
66	4	12.35	2.38	.353	211.0	2,155	4,281	3,187	1.55	1.02	1.19	1,395	42.8	86	76	66	73
67	13	14.75	3.14	.434	188.5	2,730	4,440	3,467	1.72	1.06	1.39	1,610	46.4	89	79	70	62
68	12	8.8	2.98	.400	171.5	2,485	4,450	3,476	1.58	.96	1.27	1,510	48.3	92	83	73	52
69	3	9.2	2.18	.288	189.0	2,603	4,065	3,074	1.26	.98	1.11	1,203	48.8	84	76	76	84
70	10	11.15	2.42	.328	185.5	2,045	4,150	3,088	1.64	.98	1.31	1,310	50.8	84	74	74	66
71	166	18.30	4.69	.4946	271.0	3,050	5,206	4,128	2.08	1.18	1.63	2,308	30.8	46	31	24	199
72	72	19.00	4.150	.576	218.0	3,780	3,890	3,890	2.42	1.26	1.84	1,940	30.9	57	39	199	80
73	170	10.15	2.750	.3170	283.0	1,985	3,705	2,845	2.00	1.10	1.55	1,421	31.7	68	61	54	117
74	175	15.00	4.01	.4415	258.0	2,898	4,852	3,875	2.30	1.30	1.80	1,982	34.1	68	66	56	117
75	176	17.25	4.83	.507	371.0	2,965	5,635	4,300	2.56	1.36	1.75	2,255	22.8	67	66	56	117
76	177	17.50	4.83	.507	371.0	2,965	5,635	4,300	2.56	1.36	1.75	2,255	22.8	67	66	56	117
77	171	17.50	5.030	.507	440.0	3,100	5,430	4,265	2.14	1.54	2.05	2,340	19.4	47	32	27	196
78	167	19.90	5.350	.5532	251.0	3,408	5,424	4,416	2.34	1.20	1.77	2,425	31.8	63	44	38	155

TABLE 7.—*Quality tests—white spruce—Continued.*

Grinder run No.	Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Thickness.	Mullen test.				Schopper tests.						Tintometer indications.							
					Total.	Per 0.001 inch of thickness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.			Stretch.			Breaking length per horsepower	Red.	Green.	Blue.	Black.			
									Meters.	Lengthwise.	Average.	Crosswise.	Lengthwise.	Average.						Per ct.	Per ct.	Per ct.
79.	192	80	33.0	0.00349	17.70	Points.	5.070	Point.	0.5364	237.0	Meters.	6.744	5.132	1.84	1.08	1.46	2.801	40.3	53	34	27	186
80.	190	80	31.0	0.00326	15.85	Points.	4.86	Point.	0.5112	539.0	Meters.	5.574	5.045	1.80	1.18	1.49	3.002	19.5	76	70	64	90
81.	191	80	31.0	0.00321	13.90	Points.	3.96	Point.	0.4484	295.0	Meters.	6.631	5.015	1.94	1.06	1.50	2.439	38.1	97	85	70	48
82.	172	80	35.0	0.00408	14.00	Points.	3.43	Point.	0.405	242.0	Meters.	5.100	3.288	2.24	1.32	1.83	1.580	33.6	67	55	48	130
83.	184	80	31.0	0.00367	11.70	Points.	3.19	Point.	0.3775	261.0	Meters.	5.100	4.047	1.72	1.04	1.38	1.891	41.0	75	67	61	97
84.	183	80	34.0	0.00414	15.54	Points.	3.73	Point.	0.4545	258.0	Meters.	5.200	4.055	1.70	1.04	1.42	1.893	34.6	87	75	62	95
85.	169	80	35.0	0.00429	14.20	Points.	3.312	Point.	0.4060	228.0	Meters.	4.826	4.001	1.94	1.04	1.47	1.958	43.1	78	66	69	68
86.	178	80	34.0	0.00418	14.10	Points.	3.37	Point.	0.4100	216.0	Meters.	4.826	3.870	1.72	0.98	1.35	1.725	43.7	75	65	60	100
87.	179	80	34.0	0.00399	15.50	Points.	3.89	Point.	0.4565	265.0	Meters.	5.685	4.390	1.78	1.16	1.43	2.140	36.2	70	78	71	65
88.	163	80	30.0	0.00367	11.80	Points.	3.217	Point.	0.3935	280.0	Meters.	4.610	3.759	2.06	1.22	1.64	1.748	32.9	84	74	71	71
89.	180	80	35.0	0.00400	14.25	Points.	3.56	Point.	0.4070	281.0	Meters.	4.610	3.746	1.82	1.18	1.50	1.803	32.8	92	81	73	54
90.	181	80	32.0	0.00394	10.65	Points.	2.70	Point.	0.3200	268.0	Meters.	4.460	3.519	1.44	0.82	1.18	1.637	41.0	85	75	73	68
91.	182	80	32.0	0.00417	11.25	Points.	2.70	Point.	0.3517	224.0	Meters.	4.460	3.464	1.54	0.82	1.18	1.508	44.1	87	78	69	66
92.	198	80	30.0	0.00361	12.35	Points.	3.42	Point.	0.4117	283.0	Meters.	5.722	4.292	1.53	1.04	1.31	1.743	36.9	80	71	68	81
97.	145	80	34.0	0.00363	19.20	Points.	5.292	Point.	0.5650	150.0	Meters.	6.012	4.451	2.42	1.06	1.91	2.293	52.5	61	41	32	168
98.	146	80	34.0	0.00349	17.30	Points.	4.957	Point.	0.5088	131.0	Meters.	5.694	4.263	2.42	1.34	1.95	2.228	82.6	54	35	29	182
99.	193	80	30.0	0.00318	13.15	Points.	4.355	Point.	0.3885	173.0	Meters.	6.287	4.584	2.86	1.88	1.95	2.491	89.7	65	43	35	157
100.	195	80	33.0	0.00347	16.25	Points.	4.954	Point.	0.4926	161.0	Meters.	5.348	4.030	2.80	1.32	1.91	2.117	51.0	54	37	30	179
101.	196	80	31.0	0.00337	15.20	Points.	4.51	Point.	0.4905	183.0	Meters.	5.338	4.084	1.98	1.14	1.56	2.072	43.0	55	38	31	176
102.	198	80	33.0	0.00335	16.15	Points.	4.780	Point.	0.4895	186.0	Meters.	5.732	4.423	1.80	0.96	1.38	2.350	48.3	43	30	22	205
103.	198	80	33.0	0.00417	12.40	Points.	2.974	Point.	0.3757	211.0	Meters.	5.107	3.955	1.94	1.20	1.57	1.801	50.3	78	64	57	101
104.	199	80	34.0	0.00350	16.50	Points.	4.715	Point.	0.4851	158.0	Meters.	5.732	4.376	2.20	1.28	1.74	2.137	53.7	76	64	57	101
105.	187	80	32.0	0.00386	16.50	Points.	4.280	Point.	0.5160	158.0	Meters.	5.945	4.760	1.76	0.92	1.34	2.339	58.3	74	59	50	117
106.	195	80	30.0	0.00353	14.85	Points.	4.21	Point.	0.495	180.0	Meters.	5.891	4.396	2.16	1.00	1.59	2.090	49.4	72	58	44	121
107.	187	80	33.2	0.00386	17.35	Points.	4.68	Point.	0.529	171.0	Meters.	5.328	4.890	2.20	0.98	1.59	2.455	53.4	68	53	44	135
108.	136	80	31.0	0.00386	13.95	Points.	3.616	Point.	0.4536	196.0	Meters.	5.900	4.528	2.32	1.18	1.75	1.942	47.8	78	62	53	107
109.	136	80	33.0	0.00375	17.35	Points.	5.323	Point.	0.5253	157.5	Meters.	5.900	4.254	2.20	1.18	1.75	1.942	47.8	78	62	53	107
110.	139	80	34.0	0.00375	21.30	Points.	5.703	Point.	0.6266	155.0	Meters.	6.176	4.088	2.48	1.24	1.86	2.203	54.6	65	48	41	146
111.	138	80	34.0	0.00394	20.45	Points.	5.612	Point.	0.6015	150.8	Meters.	6.176	4.970	2.38	1.32	1.81	2.473	48.1	59	42	36	173
112.	144	80	32.0	0.0032	18.50	Points.	5.78	Point.	0.5781	157.0	Meters.	6.100	4.685	2.18	1.22	1.70	2.490	51.6	57	40	30	173
113.	142	80	30.0	0.00393	11.50	Points.	2.928	Point.	0.3834	197.0	Meters.	4.711	3.721	1.62	0.98	1.30	1.550	49.3	88	71	67	71

113.....	148	80	32.0	.00328	18.15	5.536	.5674	170.0	2.860	4.870	3.865	2.42	1.36	1.89	2.130	40.0	54	34	27	185
114.....	149	80	31.0	.00398	10.25	2.578	.3307	223.0	2.362	4.066	3.214	1.74	1.08	1.41	1.430	43.5	85	76	65	74
115.....	151	80	33.0	.00398	14.00	3.518	.4241	213.0	3.074	5.510	4.292	2.12	1.04	1.58	1.950	47.5	81	53	47	129
116.....	150	80	31.0	.00341	17.15	5.030	.5500	185.0	2.774	5.874	4.324	2.54	1.12	1.83	2.236	42.5	63	48	41	148
117.....	185	80	31.0	.00337	16.95	5.030	.5470	185.0	2.902	5.995	4.448	1.86	1.00	1.43	2.379	41.7	33	25	27	191
118.....	155	80	32.0	.00337	14.30	4.245	.4470	228.0	2.826	5.010	3.918	2.84	1.04	1.94	2.158	38.4	51	33	25	190
119.....	156	80	32.0	.00323	14.15	4.380	.4430	223.0	2.768	4.748	3.758	3.12	1.02	2.07	2.122	38.0	42	26	20	212
120.....	153	80	31.0	.00422	8.35	1.979	.2694	216.0	2.572	3.910	3.241	1.74	.92	1.33	1.315	55.6	80	70	61	89
121.....	152	80	33.0	.00429	12.20	2.843	.3698	178.0	2.870	4.722	3.796	1.44	1.00	1.22	1.731	57.7	85	74	74	74
122.....	173	80	34.0	.00416	12.65	3.50	.419	212.0	2.580	4.565	3.568	2.44	1.20	1.82	1.590	40.1	65	56	52	127
123.....	157	80	34.0	.00416	12.65	3.040	.3720	234.0	3.064	4.442	3.753	1.88	1.06	1.47	1.748	43.1	80	78	74	59
124.....	134	80	32.0	.00386	12.45	3.225	.3890	204.0	2.716	4.765	3.740	1.74	1.20	1.70	2.080	45.8	93	82	72	58
125.....	141	80	31.0	.00365	14.35	3.932	.4630	207.0*	3.288	5.460	4.374	2.22	1.36	1.70	2.078	47.0	91	81	73	53
126.....	131	80	32.0	.003315	15.35	4.369	.4706	284.0	3.172	5.185	4.178	2.06	1.38	2.17	2.078	30.7	89	75	69	67
127.....	133	80	32.0	.0041	13.775	3.204	.4175	196.0	2.574	4.212	3.393	2.68	1.38	2.03	1.672	41.5	89	75	69	72
128.....	188	80	32.4	.00373	13.10	4.05	.4660	196.0	3.257	3.385	3.421	1.84	.96	1.40	2.101	47.5	88	72	68	95
129.....	154	80	31.0	.00354	16.40	4.910	.5290	288.0	3.810	6.348	5.079	2.58	1.14	1.76	2.448	33.3	79	69	37	109
130.....	137	80	34.0	.00352	19.40	5.514	.5709	193.5	3.152	6.072	4.612	2.38	1.14	1.76	2.334	47.6	61	49	49	132
131.....	124	80	30.0	.0031	19.90	6.41	.663	180.0	2.684	5.350	4.017	1.90	1.36	1.63	2.195	40.2	63	46	39	152
132.....	125	80	33.0	.00332	22.3	6.72	.675	173.0	2.876	5.552	4.214	2.36	1.42	1.89	2.224	36.2	63	46	39	152
133.....	126	80	34.0	.00405	15.1	3.73	.444	196.0	2.958	4.662	3.810	2.26	1.38	1.82	1.815	43.8	94	83	74	49
134.....	133	80	31.0	.00379	11.90	3.14	.3889	193.0	3.152	5.712	4.432	1.68	1.06	1.37	2.068	45.3	83	72	66	79
135.....	140	80	30.0	.00375	10.55	2.810	.3518	199.0	2.700	4.591	3.645	1.58	1.00	1.29	1.596	52.3	89	79	69	63
136.....	129	80	34.0	.004555	13.35	2.93	.3928	183.0	2.466	3.958	3.212	2.92	1.18	2.05	1.437	44.5	87	74	68	71
137.....	137	80	32.0	.00378	16.85	4.46	.5267	214.0	3.600	6.004	4.802	1.96	1.12	1.54	2.526	37.4	84	74	65	77
138.....	121	80	31.0	.00359	15.25	4.25	.492	200.0	3.255	4.920	4.088	2.98	1.34	2.16	1.952	41.5	86	73	67	74
139.....	123	80	33.0	.00409	16.95	4.15	.514	155.0	2.962	4.776	3.899	2.74	1.36	2.05	1.830	48.6	87	76	66	71
140.....	143	80	31.0	.00356	15.00	4.212	.4840	263.0	3.810	5.840	4.825	2.40	1.12	1.76	2.253	38.0	80	76	66	71
141.....	130	80	32.0	.004045	15.25	3.77	.4766	194.0	2.740	4.590	3.665	2.98	1.40	2.19	1.756	39.6	80	78	72	81
142.....	132	80	32.0	.0042	11.80	2.809	.3689	218.0	2.452	3.968	3.210	2.44	1.30	1.87	1.495	39.9	89	78	72	61
143.....	122	80	33.0	.00426	14.8	3.47	.448	186.0	2.805	4.380	3.593	2.34	1.32	1.83	1.608	43.1	86	76	72	70
144.....	118	80	31.0	.00414	14.05	3.54	.4725	178.0	2.712	4.350	3.531	2.44	1.40	1.92	1.660	41.9	87	76	72	65
145.....	128	80	33.0	.004185	13.175	3.149	.3993	196.0	2.831	4.981	3.906	1.60	1.10	1.50	1.805	49.4	88	79	70	63
146.....	168	80	31.0	.00375	12.10	3.228	.3902	248.0	3.086	4.716	3.901	1.90	1.04	1.32	1.605	40.5	85	70	64	83
147.....	160	80	35.0	.00407	14.65	3.599	.4187	290.0	3.266	4.680	3.973	2.84	1.22	2.03	1.917	45.0	85	76	68	71
148.....	148	80	32.0	.00405	12.50	3.087	.3906	220.0	2.728	4.860	3.704	2.84	1.26	2.03	1.846	41.2	83	72	65	80
149.....	174	80	33.0	.00350	11.00	3.140	.3375	302.0	2.658	4.628	3.643	2.58	1.36	1.97	1.730	33.8	86	60	50	128
150.....	161	80	32.0	.00398	12.35	3.104	.3859	251.0	2.964	4.554	3.800	2.20	1.10	1.65	1.948	38.9	84	72	64	76
151.....	169	80	31.0	.00418	14.70	3.518	.4266	217.0	3.061	4.818	3.980	2.40	1.16	1.78	1.944	42.5	89	77	73	61
152.....	132	80	34.0	.00355	15.10	4.25	.4365	315.0	3.01	6.259	5.000	2.66	1.04	1.35	2.305	28.2	72	62	56	110
153.....	131	80	30.0	.0044	13.0	3.4	.44	228.0	2.980	4.480	3.580	2.12	1.00	1.56	1.370	33.6	66	58	53	99
154.....	135	80	33.0	.0035	17.9	5.1	.51	333.0	3.280	6.030	4.660	2.06	1.38	2.12	2.340	23.2	77	66	58	108
155.....	374	80	36.0	.0039	15.4	4.0	.43	486.0	3.070	5.960	4.520	2.08	1.44	1.76	2.160	21.6	75	63	54	108
156.....	355	80	31.0	.0038	13.7	3.6	.40	332.0	3.130	5.500	4.320	1.92	1.18	1.55	2.060	32.5	80	68	60	92
157.....	357	80	33.0	.0038	12.9	3.4	.39	282.0	3.100	5.500	4.300	2.10	1.22	1.66	1.880	37.8	71	61	53	115
158.....	358	80	32.0	.0038	14.2	5.1	.44	287.0	2.740	4.570	3.660	2.02	1.34	1.68	2.350	31.1	74	67	62	97
159.....	244	80	31.0	.0032	16.4	5.2	.53	256.0	3.420	5.250	4.340	2.76	1.28	2.02	2.360	31.8	72	64	60	104
160.....	213	80	31.0	.0032	16.4	5.4	.56	265.0	3.360	5.720	4.540	2.72	1.52	2.12	2.240	30.6	69	63	60	91

192 to 96, inclusive, qualitative grinder runs; no production data.

TABLE 7.—*Quality tests—white spruce—Continued.*

Grinder run No.	Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Mullen test.				Schopper tests.						Tintometer indications.			
				Total.	Per 0.001 inch of thickness.	Per pound.	Horsepower per ton strength factor.	Breaking length.		Stretch.		Breaking weight per square millimeter, sectional area.	Breaking length per ton.	Red.	Green.	Blue.	Black.
				Points.	Points.	Points.	Points.	Crosswise.	Lengthwise.	Per ct.	Per ct.	Average.	Per ct.	Parts.	Parts.	Parts.	Parts.
162	247	80	30.0	16.2	5.3	0.55	238.0	3,270	5,340	2.46	1.40	1.93	32.9	75	66	61	98
163	248	80	37.0	20.4	5.5	.55	218.0	3,520	5,640	2.54	1.24	1.89	38.2	78	71	64	87
164	256	80	41.0	18.4	4.8	.45	204.0	2,980	5,740	1.92	1.26	1.59	33.0	77	67	60	96
165	259	80	31.0	16.8	4.8	.54	233.0	3,360	5,690	1.98	1.26	1.62	31.2	72	62	55	111
166	216	80	28.0	14.8	7.8	.53	226.0	3,130	5,700	2.46	1.38	1.50	38.5	72	65	59	104
167	199	100	36.6	21.15	7.24	.578	266.0	3,375	7,199	1.98	1.02	1.50	36.5	44	26	20	210
168	200	100	38.4	22.7	6.90	.591	269.0	3,340	5,730	1.78	.84	1.31	28.6	42	26	18	214
169	201	100	36.4	23.4	7.73	.643	264.0	3,679	6,209	1.58	1.00	1.39	41.1	39	22	17	223
170	202	100	37.0	17.25	5.44	.4665	250.0	3,666	6,495	1.40	.86	1.13	42.2	38	23	18	220
171	203	100	35.0	13.7	4.80	.3915	321.0	3,623	4,930	1.42	.90	1.16	39.2	33	22	17	221
172	204	100	41.0	20.5	6.53	.500	332.0	3,600	7,140	1.82	1.02	1.42	26.0	33	19	13	235
173	205	100	43.0	22.8	6.56	.530	229.0	3,624	6,972	1.46	.98	1.22	46.7	35	19	14	232
174	206	100	33.6	18.15	6.45	.5401	204.0	3,546	6,495	1.80	.90	1.35	45.6	41	23	17	219
175	207	100	35.0	21.3	7.35	.609	181.0	3,620	6,255	2.98	1.08	2.03	43.3	46	30	23	201
176	209	100	39.4	26.65	8.25	.6765	168.0	3,390	6,560	2.00	1.24	1.62	24.0	75	65	60	100
177	226	80	31.0	17.9	5.6	.57	303.0	3,980	5,440	2.12	1.26	1.69	34.1	81	74	68	77
178	229	80	34.0	17.3	4.6	.51	215.0	3,980	5,440	2.00	1.26	1.69	34.1	81	74	68	77
179	228	80	32.0	15.9	4.4	.50	180.0	3,680	5,600	2.18	1.26	1.63	45.9	78	68	62	92
180	227	80	32.0	15.3	4.2	.48	182.0	3,280	5,800	2.18	1.30	1.74	51.9	74	66	60	100
181	230	80	37.0	12.2	3.1	.38	199.0	2,630	4,370	1.72	1.08	1.40	46.4	81	73	68	78
182	210	100	43.0	27.0	7.95	.63	226.0	3,480	6,310	3.04	1.08	2.06	37.3	41	25	18	216
183	208	100	35.0	25.25	8.12	.7215	140.0	3,105	6,523	2.68	1.22	1.57	47.2	47	29	20	204
184	291	100	38.0	27.8	8.0	.72	142.0	3,150	6,620	2.68	1.42	2.05	45.2	46	29	21	204
85	292	100	42.0	32.4	6.9	.68	130.0	3,290	6,130	3.08	1.08	2.53	55.5	48	29	21	204
186	259	100	48.0	32.8	7.45	.68	119.0	3,290	6,190	3.38	1.38	2.38	57.9	46	29	21	204
187	256	100	44.0	24.8	7.3	.64	134.0	2,940	5,120	2.64	1.34	1.99	46.8	43	26	19	213
188	258	100	47.0	33.2	8.3	.70	146.0	2,980	6,670	3.32	1.42	2.27	47.1	46	29	21	204
189	281	100	49.0	37.4	8.7	.76	123.0	3,660	7,030	2.66	1.10	1.88	60.3	43	27	20	209
190	384	100	53.0	36.6	8.0	.69	123.0	3,940	6,680	2.94	1.06	2.00	67.4	43	26	17	214
191	382	100	44.0	28.0	7.8	.64	115.0	3,510	6,370	2.94	1.34	1.98	88.0	41	24	17	218
192	280	100	49.0	26.8	6.5	.55	254.0	3,100	5,280	2.62	1.34	1.98	32.4	41	24	17	218
193	268	100	37.0	20.0	6.6	.54	231.0	3,020	6,760	2.44	1.54	1.99	36.0	41	24	17	218

104	293	100	44.0	.0036	27.6	7.7	.63	266.0	3,150	6,270	4,720	3.50	1.92	2.71	3,250	28.2	42	25	18	215
105	266	100	41.0	.0031	23.8	7.2	.58	290.0	3,580	6,630	5,100	2.04	1.32	1.68	3,370	30.3	50	33	25	195
106	267	100	39.0	.0031	21.0	6.8	.54	319.0	3,360	6,550	4,960	2.14	1.32	1.73	3,350	28.8	44	27	21	210
107	385	100	40.0	.0034	26.6	7.8	.66	280.0	4,410	7,130	5,770	2.02	1.06	1.55	3,760	31.3	59	41	34	166
108	375	100	35.0	.0036	17.3	4.8	.40	372.0	3,260	6,080	4,670	1.98	1.62	2.07	2,990	25.6	75	66	57	102
109	318	100	38.0	.0035	20.8	5.9	.54	185.0	2,880	6,790	4,810	1.81	1.62	1.65	2,860	48.3	55	38	27	180
110	311	100	38.0	.0035	17.3	5.3	.58	181.0	3,210	6,730	4,970	1.98	1.38	1.81	3,160	47.4	69	50	33	138
111	201	100	42.0	.0043	21.6	5.0	.61	202.0	3,690	6,610	5,000	1.88	1.32	1.66	2,900	39.4	72	61	45	131
112	317	100	40.0	.0042	19.7	4.7	.50	197.0	3,340	6,120	4,230	1.98	1.32	1.66	2,900	39.4	72	61	52	115
113	315	100	40.0	.0042	19.7	4.7	.50	197.0	3,340	6,120	4,230	1.98	1.32	1.66	2,900	39.4	72	61	52	148
114	316	100	36.0	.0039	16.8	4.3	.47	197.0	3,030	6,480	4,780	1.76	1.42	1.78	2,850	42.1	82	71	64	83
115	303	100	38.0	.0043	15.7	3.6	.41	226.0	3,030	6,480	4,780	1.76	1.42	1.78	2,850	42.1	82	71	64	151
116	336	80	38.0	.0043	15.7	3.6	.41	226.0	3,030	6,480	4,780	1.76	1.42	1.78	2,850	42.1	82	71	64	207
117	309	100	38.0	.0035	19.8	5.6	.52	190.0	3,010	6,380	4,700	1.76	1.42	1.59	2,780	47.6	66	46	37	151
118	307	100	38.0	.0033	19.0	5.8	.50	190.0	2,230	6,140	4,180	1.10	1.36	1.23	2,730	44.1	46	27	20	207
119	306	100	34.0	.0038	27.8	7.4	.63	161.0	3,100	6,160	4,360	3.04	1.44	2.24	3,120	45.6	34	19	11	233
120	304	100	44.0	.0038	27.8	7.4	.63	161.0	3,100	6,160	4,360	3.04	1.44	2.24	3,120	45.6	34	19	11	233
121	303	100	45.0	.0035	30.2	7.7	.67	145.0	2,700	5,460	4,080	2.28	1.52	2.05	2,660	42.0	34	18	12	236
122	308	100	35.0	.0040	23.1	5.8	.66	135.0	2,080	4,790	3,440	2.28	1.56	1.92	2,130	38.6	32	16	9	243
123	308	100	35.0	.0040	23.1	5.8	.66	135.0	2,080	4,790	3,440	2.28	1.56	1.92	2,130	38.6	32	16	9	243
124	337	80	41.0	.0038	17.7	4.7	.43	159.0	3,180	5,920	4,550	2.12	1.46	1.79	2,580	14.0	72	62	54	112
125	305	100	52.0	.0050	26.6	5.4	.51	159.0	3,180	5,920	4,550	2.12	1.46	1.79	2,580	14.0	72	62	54	112
126	311	100	50.0	.0045	24.6	5.5	.50	165.0	3,020	6,070	4,540	2.28	1.42	1.85	2,750	55.0	63	42	31	167
127	306	100	50.0	.0045	24.6	5.5	.50	165.0	3,020	6,070	4,540	2.28	1.42	1.85	2,750	55.0	63	42	31	167
128	332	79	30.0	.0034	13.6	4.0	.45	192.0	3,300	5,690	4,490	2.20	1.38	1.79	2,200	52.0	71	58	48	123
129	313	80	33.0	.0036	18.4	5.1	.56	145.0	3,330	6,170	4,750	2.20	1.38	1.79	2,200	52.0	71	58	48	123
130	333	80	31.0	.0034	12.9	3.8	.42	210.0	2,890	5,020	3,960	2.18	1.56	1.87	2,110	50.7	77	67	59	107
131	334	80	31.0	.0034	12.9	3.8	.42	210.0	2,890	5,020	3,960	2.18	1.56	1.87	2,110	50.7	77	67	59	107
132	335	80	32.0	.0034	16.6	4.1	.44	190.0	3,040	5,410	4,230	2.90	1.54	2.22	2,960	50.1	29	15	10	246
133	316	100	42.0	.0034	22.8	6.7	.54	180.0	3,240	5,480	4,860	2.90	1.54	2.22	2,960	50.1	29	15	10	246
134	317	100	49.0	.0040	26.2	6.6	.53	189.0	2,720	5,920	4,320	2.96	1.72	2.34	2,910	43.1	30	15	9	246
135	318	100	38.0	.0032	20.0	6.3	.53	236.0	2,870	5,710	4,290	2.08	1.46	1.77	2,910	43.1	30	15	9	246
136	297	100	39.0	.0036	23.1	6.4	.59	278.0	2,300	5,560	3,930	2.92	1.40	2.16	2,660	36.2	54	37	22	15
137	294	100	41.0	.0037	23.8	6.4	.58	202.0	3,400	6,060	4,730	2.06	1.34	2.16	2,660	36.2	54	37	22	15
138	290	100	41.0	.0037	23.8	6.4	.58	202.0	3,400	6,060	4,730	2.06	1.34	2.16	2,660	36.2	54	37	22	15
139	221	75	32.0	.0039	8.8	3.0	.28	256.0	1,880	3,740	2,810	1.26	.82	1.04	1,760	39.2	65	59	58	118
140	444	80	32.0	.0040	11.9	2.0	.37	194.0	2,730	4,700	3,720	1.68	.88	1.28	1,610	51.9	72	62	52	200
141	222	100	29.0	.0025	13.4	5.4	.66	192.0	2,910	5,130	3,670	2.51	1.18	1.86	2,540	41.5	44	31	25	200
142	476	100	35.0	.0031	20.6	6.9	.59	151.0	2,620	5,880	4,250	3.28	1.30	2.29	2,810	47.6	50	36	29	185
143	224	100	35.0	.0026	20.2	7.7	.63	137.0	3,120	6,270	4,700	3.16	1.48	2.32	3,200	54.3	54	41	34	171
144	477	100	32.0	.0033	14.0	4.2	.44	164.0	2,740	4,600	3,600	2.26	1.24	1.90	2,210	50.8	66	56	47	131
145	226	100	32.0	.0033	14.0	4.2	.44	164.0	2,740	4,600	3,600	2.26	1.24	1.90	2,210	50.8	66	56	47	131
146	478	100	33.0	.0038	10.6	2.8	.32	225.0	2,430	4,610	3,020	2.24	1.12	1.68	1,320	42.0	78	68	63	91
147	227	100	35.0	.0028	21.4	7.6	.61	149.0	3,050	6,190	4,920	3.94	1.44	2.69	3,540	54.2	50	38	31	181
148	479	100	34.0	.0031	21.6	6.9	.63	138.0	3,120	6,180	4,650	3.38	1.42	2.0	2,960	55.1	65	52	46	137
149	229	100	37.0	.0033	21.0	6.4	.57	145.0	3,330	5,800	4,560	2.42	1.52	1.59	2,960	55.1	65	52	46	137
150	482	100	36.0	.0040	12.8	3.2	.36	221.0	2,600	4,200	3,400	2.06	1.14	1.57	1,830	42.7	71	60	64	105
151	231	100	35.0	.0043	10.8	2.5	.31	225.0	2,300	3,850	3,080	2.24	1.14	1.57	1,830	42.7	71	60	64	105
152	474	100	46.0	.0036	28.6	8.0	.62	150.0	2,770	6,420	4,590	2.74	1.28	2.01	3,350	49.5	46	32	28	194
153	542	100	35.0	.0036	21.6	7.3	.58	170.0	3,100	6,080	4,590	2.26	.92	1.59	3,230	46.6	49	36	30	185
154	234	100	37.0	.0030	20.6	6.9	.63	163.0	3,090	3,120	3,100	1.92	2.02	1.97	2,050	31.6	57	44	36	163
155	543	100	34.0	.0030	20.6	6.9	.63	163.0	3,090	3,120	3,100	1.92	2.02	1.97	2,050	31.6	57	44	36	163
156	235	100	46.0	.0042	27.2	6.5	.59	140.0	3,020	6,280	4,650	2.02	1.16	1.89	2,960	56.2	69	57	49	125
157	544	100	60.0	.0061	25.8	4.2	.43	193.0	2,740	4,810	3,780	3.04	1.44	2.24	2,200	45.5	76	68	61	95
158	236	100	46.0	.0042	27.2	6.5	.59	140.0	3,020	6,280	4,650	2.02	1.16	1.89	2,960	56.2	69	57	49	125
159	521	100	40.0	.0034	23.9	7.1	.63	135.0	3,080	6,360	4,720	2.16	1.20	1.97	3,290	55.5	58	47	38	157
160	546	100	42.0	.0034	23.9	7.1	.63	135.0	3,080	6,360	4,720	2.16	1.20	1.97	3,290	55.5	58	47	38	157
161	240	100	39.0	.0039	15.0	3.8	.38	212.0	2,630	3,720	3,180	1.84	.92	1.38	1,860	30.4	70	61	54	115

1 Commercial.

TABLE 7.—*Quality tests—white spruce—Continued.*

Grinder run No.	Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Thickness.	Mullen test.				Schopper tests.						Tintometer indications.				
					Total.	Per 0.001 inch of thickness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.			Stretch.		Breaking weight per square millimeter, sectional area.	Breaking length per horsepower.	Red.	Green.	Blue.	Black.
									Crosswise.	Lengthwise.	Average.	Per ct.	Lengthwise.							Average.
			Lbs.	Inch.	Points.	Points.	Point.		Meters.	Meters.	Meters.	Per ct.	Per ct.	Grams.	Meters.	Parts.	Parts.	Parts.	Parts.
242	522	100	44.0	0.0046	17.6	3.8	0.40	203.0	2,550	4,230	3,390	2.22	1.04	1,920	41.7	77	69	61	93
243	623	80	34.0	0.0036	15.5	4.3	.46	272.0	3,110	5,640	3,380	3.10	1.38	2,370	35.0	80	72	65	83
244	622	80	38.0	0.0040	16.4	4.0	.43	226.0	2,530	4,950	3,740	2.08	1.36	2,040	38.4	80	71	65	84
245	672	80	36.0	0.0037	16.1	4.4	.45	188.0	3,140	6,140	4,640	1.96	1.16	1.96	55.0	78	68	64	90
246	652	80	37.0	0.0040	16.4	4.0	.44	221.0	3,060	5,390	4,220	2.86	1.06	2,180	43.3	74	67	62	87
247	624	80	36.0	0.0040	14.8	3.7	.41	259.0	2,610	4,960	2,780	2.96	1.40	2,180	26.2	78	71	63	88
248	625	80	41.0	0.0045	13.4	3.0	.33	202.0	2,350	4,250	3,300	2.22	1.22	1,760	49.6	76	70	64	90
249	666	80	44.0	0.0040	21.0	5.3	.48	394.0	3,280	5,580	4,430	2.28	1.14	1,760	23.4	71	63	56	110
250	662	80	34.0	0.0034	16.8	5.5	.53	290.0	3,380	6,660	5,020	2.58	1.24	2,880	32.7	76	67	61	96
251	627	80	33.0	0.0034	17.2	5.1	.52	281.0	2,870	6,110	4,490	2.58	1.24	2,880	30.7	70	61	57	112
252	660	80	37.0	0.0036	19.4	5.4	.52	414.0	3,370	6,730	5,050	1.80	1.30	2,840	23.5	73	64	58	105
253	661	80	37.0	0.0035	20.0	5.7	.54	330.0	3,580	6,600	5,120	2.30	1.30	3,000	28.7	76	68	60	96
254	626	80	40.0	0.0036	20.6	5.7	.52	394.0	3,180	6,270	4,720	2.72	1.30	2,960	23.0	77	66	62	95
255	657	84	35.0	0.0038	10.3	2.7	.29	312.0	2,650	4,690	3,670	1.54	1.02	1,780	40.5	59	49	43	149
256	633	80	40.0	0.0042	18.7	4.4	.47	274.0	3,030	5,140	4,080	1.98	.84	2,140	31.6	77	68	60	95
257	648	80	36.0	0.0040	15.8	4.0	.44	336.0	3,230	6,380	4,800	2.22	1.10	2,270	32.4	75	70	63	92
258	644	80	36.0	0.0041	13.6	3.4	.38	253.0	3,000	5,270	4,140	2.16	.98	1,970	43.1	76	70	63	91
259	671	80	27.0	0.0041	10.5	2.4	.28	246.0	2,460	4,500	3,480	1.38	.88	1,450	50.6	81	71	63	85
260	639	80	35.0	0.0039	13.9	3.5	.39	244.0	2,870	5,800	4,340	1.84	1.04	2,070	44.5	77	69	62	82
261	679	80	33.0	0.0046	14.8	3.2	.37	239.0	2,980	5,800	4,390	1.84	.94	2,020	52.5	79	69	63	89
262	608	80	40.0	0.0046	14.6	3.2	.37	207.0	2,810	5,210	4,010	1.82	.92	1,960	45.4	73	65	60	102
263	680	80	39.0	0.0046	14.8	3.0	.45	130.0	3,060	5,350	4,200	1.76	1.29	2,560	54.7	80	70	64	86
265	705	100	40.0	0.0036	18.0	5.0	.45	130.0	2,420	5,680	4,050	1.48	1.06	1,960	69.5	47	32	27	194
266	704	100	38.0	0.0035	18.4	5.3	.48	119.0	2,160	5,710	3,940	1.10	1.04	2,470	68.8	50	35	30	185
267	703	100	38.0	0.0034	19.8	5.9	.52	111.0	2,350	6,180	4,260	1.28	1.14	2,650	74.0	55	39	32	174
268	697	100	45.0	0.0049	17.4	3.6	.36	127.0	2,280	4,910	3,600	1.28	1.00	1,880	72.6	65	52	45	138
269	733	80	33.0	0.0046	8.6	1.9	.26	188.0	3,620	7,540	5,580	1.42	1.06	1,130	63.7	77	69	61	93
270	697	100	39.0	0.0033	24.0	7.3	.62	104.0	3,020	6,580	4,900	1.42	1.10	3,680	86.5	52	37	30	181
271	698	100	34.0	0.0031	18.6	6.0	.55	103.0	2,630	6,580	4,600	1.54	1.06	2,910	81.0	52	37	30	182
272	696	100	43.0	0.0041	22.5	5.5	.52	112.0	2,890	5,800	4,340	1.38	2.22	2,700	74.4	50	37	31	182
273	702	100	46.0	0.0041	27.0	6.6	.58	99.0	3,190	6,170	4,680	1.38	2.30	3,000	81.5	59	42	36	163

274.....	699	100	41.0	.0044	17.8	4.1	.43	128.0	2,850	5,250	4,040	1.42	.88	1.15	2,140	73.3	64	53	46	137
275.....	664	100	46.0	.0057	9.2	1.6	.20	265.0	2,320	3,060	2,700	1.20	.82	1.01	1,220	51.0	76	68	61	95
276.....	710	80	33.0	.0042	9.6	2.3	.29	296.0	2,340	4,860	3,600	1.52	.94	1.23	1,540	41.9	84	74	67	75
277.....	665	80	37.0	.0048	9.3	2.0	.30	241.0	2,320	3,930	3,120	1.52	1.02	1.27	1,320	43.2	73	70	62	95
278.....	678	80	44.0	.0054	12.2	2.2	.28	186.0	2,460	4,680	3,570	1.38	.82	1.10	1,510	68.7	81	70	64	85
279.....	676	80	37.0	.0051	7.2	1.4	.19	242.0	1,820	3,360	2,590	1.20	.70	.95	950	56.3	81	71	64	84
280.....	714	80	38.0	.0046	12.7	2.7	.33	251.0	1,260	4,860	3,560	1.96	1.00	1.48	1,640	43.0	81	72	66	81
281.....	635	80	38.0	.0045	13.8	3.1	.36	236.0	2,960	4,950	3,960	2.36	.98	1.67	1,800	46.6	78	72	67	83
282.....	670	80	38.0	.0044	12.7	2.9	.33	312.0	2,810	5,410	4,110	2.00	1.02	1.51	1,900	39.9	75	66	62	97

1 Pulps for runs 257 to 282, inclusive, were made on a coarse-grit stone.

TABLE 8.—Grinder runs on balsam fir.¹

Run No.	Preliminary treatment of wood.	Stone.		No. of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid rossed wood ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.	Bone-dry pulp per 100 cubic feet solid rossed wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid rossed per wood bone-dry.	Average temperature of grinding.	Horsepower divided by pressure $\times$ speed.
		Kind of burr.	Surface.		Lbs. per sq. in.	Lbs.	Feet per minute.				Tons.					P. ct.	Lbs.	P. ct.	Lbs.		
1		Straight, cut 3 to 12 to inch.	Same as No. 7 tararack.	3	20	8.2	2,428	189.0	228	3,225	140.5	157.0	23.80	58	6	27.83	1,710	71.9	9.35	162.1	0.00949
2		do.	Same surface.	3	40	16.4	2,428	323.0	372	3,225	100.2	300.0	23.80	58	5	27.83	1,792	75.4	19.88	155.0	.00811
3		do.	do.	3	60	24.65	2,428	470.0	541	5,695	82.6	601.0	23.80	5	5	27.83	1,720	72.3	41.25	150.0	.00785
4		Diamond point, cut 10 to inch.	Stone dressed.	3	20	8.2	2,428	161.6	178				23.08			34.76		76.6		137.8	
5		do.	do.	3	40	16.4	2,428	311.0	344	1,749	178.0					34.76	1,770	81.3	8.65	175.3	.00781
6		do.	do.	3	60	24.65	2,428	424.0	495	3,485	121.3	371.5	23.08			34.76	1,877	81.3	13.50	157.5	.00708
7	Steamed.	Straight, cut 3 to 12 to inch.	Same as poplar No. 1.	3	40	16.4	2,762	336.0	399	2,710	123.9	354.5	21.07	61	6	59.45	1,530	72.5	23.20	146.7	.00741
8		do.	Same as for No. 925 spruce.	3	20	8.2	2,417	187.0	210	835	224.0	86.8	21.44	43	4	58.45	1,923	89.6	10.79	178.8	.00945
9		do.	Same surface.	3	40	16.4	2,417	336.0	378	2,525	133.0	200.0	21.44	43	4	58.45	1,943	90.1	11.24	158.1	.00849
10		do.	do.	3	60	24.65	2,417	440.0	517	4,130	108.0	422.5	21.44	43	4	58.45	1,956	91.1	19.12	146.9	.00750
11		do.	do.	3	20	8.2	3,107	230.0	278	2,940	243.5	96.2	21.44	5	5	58.45	1,968	91.6	10.73	182.8	.00904
12		do.	do.	3	40	16.4	3,107	396.0	451	2,960	165.7	240.4	21.44	51	5	58.45	1,988	92.6	9.65	171.8	.00777
13		do.	do.	3	60	24.65	3,107	595.0	660	5,400	110.1	540.0	21.44	44	4	58.45	2,000	93.2	18.17	145.8	.00776
14		do.	Same as for poplar No. 2.	3	30	12.3	3,085	322.0	358	2,080	154.8	216.0	22.01	44	4	49.88	1,922	87.4	6.88	178.5	.00848
15	Boiled.	Straight, cut 8 to 12 to inch.	Same as No. 15 Montana lodge-pole.	2	40	16.4	3,080	240.0	292	1,155	208.0	140.9	21.66	51	5	51.23	1,040	75.6	21.45	143.9	.00475
16	do.	do.	Same surface.	2	60	24.65	3,080	317.0	383	1,830	173.2	212.0	21.66	51	5	51.23	1,728	79.6	25.40	138.0	.00417
17	do.	do.	do.	2	80	32.8	3,080	374.0	440	2,227	167.8	264.0	21.66	51	5	48.75	1,690	78.0	22.70	129.6	.00370
18		Straight, cut 3 to 12 to inch.	Same as for No. 15 western yellow pine.	3	60	24.65	1,366	275.0	306	2,242	122.8	264.0	21.20	51	5	48.75	1,698	80.0	15.43	97.0	.00816
19		do.	Same surface.	3	60	24.65	2,049	400.0	449	3,320	120.4	354.0	21.20	43	4	48.75	1,876	88.5	19.06	129.5	.00790
20		do.	do.	3	60	24.65	2,732	496.0	553	3,880	128.0	428.0	21.20	51	5	48.75	1,814	85.5	15.80	139.6	.00736

21	.....	Straight, cut 2 to inch; spiral, cut 12 to inch.	3	60	24.65	250	3,415	551.0	630	4.325	127.6	463.0	21.20	5 $\frac{1}{2}$	48.75	1,870	88.1	19.20	147.6	.00654
22	.....	Spiral, cut 8 to inch; straight, cut 10 to inch.	3	40	16.4	225	3,069	481.0	543	5.330	90.4	546.0	20.75	4 $\frac{1}{2}$	60.40	1,950	94.1	8.45	150.4	.00955
23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
24	.....	Spiral, cut 8 to inch; straight, cut 10 to inch.	2	60	16.4	175	2,387	333.0	372	3.225	103.1	338.0	20.20	5 $\frac{1}{2}$	61.66	1,910	94.5	18.60	148.0	.00850
25	Steamed.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
26	do.	.....	.....	.....	.....	.....	3,048	137.0	171	.953	144.0	113.0	19.92	5 $\frac{1}{2}$	61.08	1,680	84.4	13.40	150.0	.00548
27	do.	.....	.....	.....	.....	.....	3,048	246.0	286	2.302	106.8	270.0	19.92	5 $\frac{1}{2}$	61.08	1,710	85.9	17.30	133.0	.00491
28	do.	.....	.....	.....	.....	.....	3,048	311.0	355	3.105	100.0	374.0	19.92	5 $\frac{1}{2}$	61.08	1,660	83.3	20.30	136.0	.00414
29	do.	.....	.....	.....	.....	.....	3,048	371.0	414	3.755	98.9	441.0	19.92	5 $\frac{1}{2}$	61.08	1,700	83.3	30.60	134.0	.00371
29	do.	.....	.....	.....	.....	.....	3,048	413.0	491	4.050	102.0	479.0	19.92	5 $\frac{1}{2}$	61.08	1,695	85.0	27.30	136.0	.00350

¹ For conditions of cooking see Table 32.² See Runs on mixed woods (commercial).

TABLE 9.—Grinder runs on red fir.¹

Run No.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.	Bone-dry pulp per 100 cubic feet solid wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid rossed wood bone-dry.	Average temperature of grinding.	Horsepower divided by pressure $\times$ speed.
	Preliminary treatment of wood.	Kind of burr.		Lbs. per sq. in.	Lbs.		Ft. per minute.													
1		Straight, cut 3 to 12 to inch.	3	50	20.5	200	2,775	420.0	489	6,450	65.2	672.0	21.93	(²)	16.98	1,920	87.6	10.94	133.0	0.00739
2	Steamed	do.....	3	40	16.4	200	2,762	288.5	370	2,299	125.7	297.0	23.76	(²)	15.63	1,547	65.1	17.76	166.3	.00036
3		do.....	3	30	12.3	225	3,085	325.0	374	Qualitative run.				(²)	.....	.....	.....	.....	165.1	.00856
4		do.....	3	30	12.3	225	3,085	304.0	370	1,680	181.0	169.0	24.35	(²)	11.17	1,988	81.6	12.31	178.0	.00800
5		do.....	3	60	24.65	225	3,085	521.0	574	2,565	203.5	302.0	24.47	(²)	22.40	1,700	69.5	9.83	176.2	.00685
6		do.....	3	60	24.65	100	1,366	244.0	282	1,161	210.0	128.0	21.85	(²)	20.13	1,815	83.0	19.10	157.2	.00725
7		do.....	3	60	24.65	150	2,049	366.0	434	1,088	337.0	136.6	21.85	(²)	20.13	1,590	72.7	12.38	175.3	.00724
8		do.....	3	60	24.65	200	2,732	425.0	485	1,379	308.0	162.0	21.85	(²)	20.13	1,698	77.6	11.10	178.2	.00630
9		do.....	3	60	24.65	250	3,415	566.0	647	2,188	238.5	312.0	21.85	(²)	20.13	1,400	64.0	9.60	181.0	.00673
10		do.....	2	20	8.2	225	3,073	153.4	177	.492	312.0	52.5	21.02	(²)	22.72	1,872	89.0	6.40	154.1	.00609
11		do.....	2	40	16.4	225	3,073	246.0	303	1,165	211.0	130.0	21.02	(²)	22.72	1,790	85.1	7.98	166.3	.00489
12		do.....	2	60	24.65	225	3,073	376.0	450	1,737	216.5	212.0	21.02	(²)	22.72	1,638	77.8	9.90	166.2	.00496
13		do.....	2	80	32.8	225	3,073	459.0	543	2,500	183.4	265.0	21.02	(²)	22.72	1,890	89.9	8.51	156.5	.00455
14		do.....	2	100	41.0	225	3,073	475.0	576	3,275	145.0	362.0	21.02	(²)	22.72	1,810	86.0	16.72	155.7	.00377
15		Spiral, cut 8 to 10 to inch; straight, cut 10 to inch.	2	40	16.4	225	3,069	238.0	286	1,627	146.3	165.0	21.60	(²)	28.87	1,970	91.2	7.76	158.0	.00472

16	do.	Same surface.	2	60	24.65	225	3,069	352.0	428	2,806	125.2	282.0	21.60	(2)	28.87	1,998	92.4	9.70	157.7	.00465
17	do.	do.	2	80	32.8	225	3,069	462.0	527	4,570	101.1	446.0	21.60	(2)	28.87	2,043	94.6	11.26	149.0	.00459
18	do.	do.	2	100	41.0	225	3,069	500.0	632	5,540	101.0	540.0	21.60	(2)	28.87	2,050	94.9	10.37	151.7	.00445
19	do.	Same as for No. 26 California lodgepole.	2	80	32.8	225	3,069	483.0	580	5,710	84.6	571.0	21.59	(2)	26.50	2,000	92.7	12.60	158.0	.00479

² Split wood.¹ For conditions of cooking see Table 32.

TABLE 10.—Grinder runs on white fir.¹

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.	Bone-dry pulp per 100 cubic feet solid tressed wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid tressed wood bone-dry.	Average temperature of grinding.	Horsepower divided by pressure $\times$ speed.
		Kind of burr.	Surface.		Lbs. per sq. in.	Lbs.	ft. per minute.				Tons.										
1		Spiral, cut 8 to 10 inch; straight, cut 10 to 10 inch.	Same as No. 3, Engelmann spruce, Colo.	2	40	16.4	225	3,069	306	342	132.0	370	245	19.47	(2)	64.80	1,892	97.2	17.3	155	0.00607
2		do.	Same surface.	2	60	24.65	225	3,069	355	442	107.7	370	245	19.47	(2)	64.80	1,930	99.1	21.3	150	.00509
3		do.	do.	2	80	32.8	225	3,069	409	559	88.5	529	296	22.17	(2)	64.80	2,000	102.8	22.6	142	.00465
4		do.	do.	2	60	24.65	100	1,355	276	318	3.150	86.8	8	22.17	(2)	48.76	2,150	97.0	10.7	146	.00825
5		do.	do.	3	60	24.65	150	2,033	302	427	3.990	90.7	394	22.17	(2)	48.76	2,025	91.5	12.6	150	.03722
6		do.	do.	3	60	24.65	200	2,710	503	609	5.885	83.5	602	22.17	(2)	48.76	1,775	80.1	9.4	135	.00732
7		do.	do.	3	60	24.65	250	3,388	556	661	6.630	83.7	582	22.17	(2)	48.76	2,280	102.9	11.5	136	.00665
8		do.	do.	2	40	16.4	175	2,372	223	268	1.921	115.9	189	21.42	(2)	45.50	2,630	94.7	13.6	151	.00574
9		do.	do.	2	60	24.65	175	2,372	201	345	2.880	101.0	302	21.42	(2)	45.50	1,910	89.1	15.2	155	.00497
10		do.	do.	2	80	32.8	175	2,372	374	440	4.020	93.1	383	21.42	(2)	45.50	2,100	98.0	17.2	148	.00480
11		do.	do.	2	100	41.0	175	2,372	407	492	4.775	85.2	477	21.42	(2)	45.50	2,000	93.2	20.2	143	.00419
12		do.	do.	2	40	16.4	175	2,372	214	260	2.055	109.0	194	22.76	(2)	50.88	2,120	93.2	8.5	150	.00627
13		do.	do.	2	60	24.65	175	2,372	313	350	2.897	108.0	274	22.76	(2)	50.88	2,110	92.9	16.2	154	.00535
14		do.	do.	2	80	32.8	175	2,372	390	449	4.470	87.2	438	22.76	(2)	50.88	2,040	89.7	9.6	145	.00501
15		do.	do.	2	100	41.0	175	2,372	413	516	5.250	84.4	500	22.76	(2)	50.88	2,100	92.4	14.6	142	.00455
16		Spiral cut 8 to 10 inch	Stone dressed	3	40	16.4	175	2,372	218	274	(2)	(2)	(2)	(2)	(2)	49.97	(2)	(2)	(2)	133	.00560
17		Diamond point, 6 to 10 inch.	do.	2	40	16.4	175	2,372	232	280	2.100	107.2	229	20.82	(2)	49.97	1,888	90.5	5.3	147	.00596
18		do.	do.	2	60	24.65	175	2,372	325	365	3.255	100.0	364	20.82	(2)	49.97	1,790	85.9	12.6	151	.00555
19		do.	do.	2	80	32.8	175	2,372	365	465	4.630	85.4	476	20.82	(2)	49.97	1,945	93.4	14.6	151	.00508
20		do.	do.	2	100	41.0	175	2,372	407	558	6.210	75.2	681	20.82	(2)	49.97	1,825	87.5	15.5	143	.00480
21	Steamed	do.	do.	2	40	16.4	200	2,710	231	271	1.925	126.0	238	20.82	(2)	49.97	1,620	77.7	30.0	141	.00520
22	do.	do.	do.	2	60	24.65	206	2,794	320	364	2.800	114.0	375	20.82	(2)	49.97	1,490	71.5	21.5	144	.00465
23	do.	do.	do.	2	80	32.8	209	2,835	368	449	4.005	98.6	488	20.82	(2)	49.97	1,645	79.1	27.6	139	.00425
24	do.	do.	do.	2	100	41.0	210	2,845	405	555	4.815	97.1	617	20.82	(2)	49.97	1,500	74.9	28.8	134	.00401
25	do.	do.	do.	2	60	24.65	198	2,682	322	371	3.370	95.5	388	20.82	(2)	49.97	1,740	83.5	25.0	134	.00486
26	do.	do.	do.	3	60	24.65	189	2,561	320	372	3.585	89.2	395	20.82	(2)	49.97	1,813	87.0	27.2	137	.00506

27	do.	do.	2	60	24.65	100	1,355	195	226	1,725	113.0	179	21.85	(*)	38.90	1,930	88.3	10.0	.00584
28	do.	do.	2	60	24.65	150	2,033	280	326	2,605	107.3	249	21.85	(*)	38.90	2,093	95.6	13.3	.00559
29	do.	do.	2	60	24.65	200	2,710	381	425	3,930	97.0	387	21.85	(*)	38.90	2,030	92.8	13.4	.00570
30	do.	do.	2	60	24.65	250	3,388	449	500	4,755	94.5	445	21.85	(*)	38.90	2,140	97.9	6.5	.00536
31	do.	do.	2	60	24.65	100	1,355	196	231	1,750	112.0	171	22.18	(*)	34.15	2,040	92.0	15.7	.00586
32	do.	do.	2	60	24.65	150	2,033	280	329	2,938	122.0	225	22.18	(*)	34.15	2,040	92.0	14.0	.00559
33	do.	do.	2	60	24.65	200	2,710	400	459	3,500	114.2	338	22.18	(*)	34.15	2,075	93.5	27.0	.00599
34	do.	do.	2	60	24.65	250	3,388	455	509	3,945	115.0	393	22.18	(*)	34.15	2,005	90.5	12.9	.00544
35	Spiral, cut 8 to inch; straight, cut 10 to inch.	Stone dressed	3	45	18.5	225	3,020	384	477	4,775	80.4	498	20.80	(*)	20.58	1,920	92.2	16.4	.00387

* No production data.

Split wood.

1 For conditions of cooking see Table 32.

TABLE 11.—Grinder runs on Alpine fir.¹

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch.	Revolutions per minute.	Peripheral speed.		Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.		Bone-dry pulp per 100 cubic feet solid ground wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid ground wood.	Average temperature of grinding.	Horsepower divided by pressure $\times$ speed.
		Kind of burr.	Surface.					<i>Lbs. per sq. in.</i>	<i>Lbs.</i>								<i>Ft. per minute.</i>	<i>Tons.</i>						Cu. ft.	Lbs.	Inches.	P. ct.	Lbs.
1		Diamond point, 6 to inch; spiral, cut 12 to inch.	Same as No. 14 anablis fir.	2	40	16.40	225	3,049	312	371	2,647	117.7	252	22.30	6 $\frac{3}{8}$	47.25	2,095	93.9	92.6	14.10	137	0.00624	
2		do.	Same surface.	2	60	24.65	225	3,049	412	469	4,430	93.0	429	22.30	7 $\frac{1}{8}$	47.25	2,065	92.6	92.6	14.10	137	.00548	
3		do.	do.	2	80	32.80	225	3,049	513	591	6,510	78.7	627	22.30	7 $\frac{1}{8}$	47.25	2,078	93.0	90.7	21.80	131	.00513	
4		do.	do.	2	100	41.00	225	3,049	611	660	8,050	75.9	795	22.30	7 $\frac{1}{8}$	47.25	2,022	90.7	90.7	21.80	127	.00490	
5		Spiral, cut 12 to inch; straight, cut 3 to inch.	Stone dressed.	2	60	24.65	100	1,355	204	253	2,045	99.7	207	22.30	6 $\frac{3}{8}$	47.25	1,977	88.6	88.6	16.90	140	.00611	
6		do.	Same surface.	2	60	24.65	150	2,033	320	361	3,280	97.5	319	22.30	6 $\frac{3}{8}$	47.25	2,056	92.1	92.1	16.10	147	.00638	
7		do.	do.	2	60	24.65	200	2,710	365	420	3,940	92.6	369	22.30	6 $\frac{3}{8}$	47.25	2,135	95.6	95.6	14.30	139	.00546	
8		do.	do.	2	60	24.65	250	3,388	465	509	5,435	85.6	533	22.30	7 $\frac{1}{8}$	47.25	2,038	91.4	91.4	14.30	133	.00556	
9	Steamed.	do.	do.	2	40	16.40	225	3,049	264	317	2,125	124.0	242	22.30	7 $\frac{1}{8}$	47.25	1,757	78.8	78.8	34.40	134	.00528	
10	do.	do.	do.	2	60	24.65	225	3,049	357	410	3,775	94.7	413	22.30	7 $\frac{1}{8}$	47.25	1,830	82.1	82.1	70.50	120	.00475	
11	do.	do.	do.	2	80	32.80	225	3,049	420	497	4,715	88.0	526	22.30	7 $\frac{1}{8}$	47.25	1,788	80.1	80.1	91.90	120	.00420	
12	do.	do.	do.	2	100	41.00	225	3,049	475	537	5,375	88.4	629	22.30	6 $\frac{3}{8}$	47.25	1,710	76.7	76.7	101.00	117	.00380	
13	do.	do.	Stone dressed.	3	50	20.50	225	3,020	430	579	5,110	84.0	479	21.60	7 $\frac{1}{8}$	43.00	2,135	98.9	98.9	16.2	136	.00695	

¹ For conditions of cooking see Table 32.

TABLE 12.—Grinder runs on *ambilis* fir.¹

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horse-dry pulp in 24 hours.	Solid ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.		Bone-dry pulp per 100 cubic feet solid tressed wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid tressed wood bone-dry.	Average temperature of grinding.	Horsepower divided by pressure $\times$ speed.
		Kind of burr.	Surface.													P. ct.	Lbs.						P. ct.	Lbs.
1		Diamond point, 6 to 12 to inch, spiral, cut 12 to inch.	Stone dressed....	2	40	16.40	225	3,049	296	349	3.200	92.5	339	20.96	(2)	47.56	1,888	90.1	5.60	145	0.00591	
2		do.	Same surface....	2	60	24.65	225	3,049	308	455	4.930	80.8	518	20.96	(2)	47.56	1,905	91.0	8.43	142	.00529	
3		do.	do.	2	80	32.80	225	3,049	484	569	6.850	70.6	735	20.96	(2)	47.56	1,863	89.0	10.20	132	.00484	
4		do.	do.	2	100	41.00	225	3,049	581	670	8.700	66.3	975	20.96	(2)	47.56	1,800	86.0	12.40	138	.00465	
5		do.	do.	2	60	24.65	100	1,355	195	228	2.170	90.0	233	20.96	(2)	47.56	1,802	89.0	10.50	140	.00384	
6		do.	do.	2	60	24.65	150	2,033	275	330	2.945	93.5	332	20.96	(2)	47.56	1,773	84.7	8.05	142	.00349	
7		do.	do.	2	60	24.65	200	2,710	376	432	4.125	91.2	461	20.96	(2)	47.56	1,790	85.5	9.00	147	.00563	
8		do.	do.	2	60	24.65	250	3,388	454	509	5.800	78.2	596	20.96	(2)	47.56	1,948	93.0	13.60	137	.00543	
9	Steamed.	do.	do.	2	40	16.40	225	3,049	223	282	1.728	129.0	226	20.96	(2)	47.56	1,530	73.0	20.60	131	.00445	
10		do.	do.	2	60	24.65	225	3,049	320	381	3.225	99.2	421	20.96	(2)	47.56	1,532	73.1	34.60	124	.00425	
11		do.	do.	2	80	32.80	225	3,049	368	447	3.530	104.0	468	20.96	(2)	47.56	1,510	72.1	40.90	123	.00368	
12		do.	do.	2	100	41.00	225	3,049	434	514	4.430	98.0	589	20.96	(2)	47.56	1,505	71.9	38.20	120	.00347	
13		do.	do.	2	60	24.65	211	2,860	324	394	2.920	111.0	352	20.96	(2)	47.56	1,660	79.2	18.90	138	.00459	
14		do.	do.	2	60	24.65	181	2,455	323	390	3.240	99.7	355	20.96	(2)	47.56	1,822	87.0	14.00	138	.00534	
15		Spiral, cut 8 to 10 to inch, straight, cut 10 to inch.	Stone dressed....	2	80	32.80	225	3,029	397	502	4.900	81.0	485	21.10	(2)	25.27	2,020	95.7	10.30	159	.00401	

² Split wood.¹ For conditions of cooking see Table 32.

TABLE 13.—Grinder runs on lowland fir (Montana).¹

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.	Bone-dry pulp per 100 cubic feet solid ground.	Efficiency of conversion.	Screenings per 100 cubic feet solid ground bone-dry.	Average temperature of grinding.	Horsepower divided by pressure X speed.
		Kind of burr.	Surface.																		
1	Steamed...	Spiral, cut 8 to inch; straight, cut 10 to inch.	Stone dressed...	2	Lbs. per sq. in. 40	Lbs. 16.40	175	Ft. per minute. 2,348	157	Tons. 1,855	84.6	Cu. ft. 224	Lbs. 21.40	Inches. 8 1/8	P. ct. 48.00	Lbs. 1,660	P. ct. 77.5	Lbs. 21.6	° F. 122	0.00407	
2	do.	do.	Same surface	2	60	24.65	175	2,348	221	273	2,765	80.0	344	21.40	8 1/8	48.00	1,610	75.2	32.9	119	.00382
3	do.	do.	do.	2	80	32.80	175	2,348	283	342	3,445	82.1	409	21.40	8	48.00	1,653	78.7	25.7	119	.00367
4	do.	do.	do.	2	40	16.40	175	2,348	207	260	2,980	69.5	320	21.40	9	48.00	1,862	87.0	7.6	136	.00538
5	do.	do.	do.	2	60	24.65	175	2,348	280	322	4,465	62.6	475	21.40	8 1/8	48.00	1,880	87.9	8.4	136	.00483
6	do.	do.	do.	2	80	32.80	175	2,348	347	376	5,650	61.4	605	21.40	8 1/8	48.00	1,870	87.4	8.7	127	.00450
7	do.	do.	do.	2	40	16.40	100	1,342	141	176	1,730	81.5	192	21.40	8 1/8	48.00	1,805	84.3	5.7	139	.00640
8	do.	do.	do.	2	40	16.40	150	2,013	185	218	2,290	80.7	240	21.40	8 1/8	48.00	1,910	89.2	8.2	143	.00561
9	do.	do.	do.	2	40	16.40	200	2,684	226	276	2,735	82.8	290	21.40	8 1/8	48.00	1,888	88.1	5.5	139	.00513
10	do.	do.	do.	2	40	16.40	250	3,355	255	317	3,405	74.9	370	21.40	8 1/8	48.00	1,837	85.8	5.5	136	.00464
11	do.	do.	do.	2	40	16.40	175	2,348	213	258	2,345	90.3	234	21.65	6 1/8	46.40	2,000	92.4	4.9	142	.00553
12	do.	do.	Same surface.	2	60	24.65	175	2,348	294	339	3,750	78.4	366	21.65	6 1/8	46.40	2,045	94.5	6.3	138	.00507
13	do.	do.	do.	2	80	32.80	175	2,348	358	413	5,100	70.3	488	21.65	7	46.40	2,090	96.5	6.9	139	.00465
14	do.	do.	do.	2	60	24.65	100	1,342	192	226	2,315	83.0	224	21.65	6 1/8	46.40	2,060	95.1	4.8	132	.00580
15	do.	do.	do.	2	60	24.65	150	2,013	273	311	3,245	84.2	329	21.65	7 1/8	46.40	1,970	91.0	4.8	140	.00551
16	do.	do.	do.	2	60	24.65	200	2,684	353	403	4,265	82.6	409	21.65	6 1/8	46.40	2,090	96.5	5.2	138	.00533
17	do.	do.	do.	2	60	24.65	250	3,355	384	436	4,790	80.3	492	21.65	6 1/8	46.40	1,941	89.7	4.4	142	.00465

¹ For conditions of cooking see Table 32.

TABLE 14.—Grinder runs on noble fir.¹

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.		Bone-dry pulp per 100 cubic feet solid ground wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid ground wood bone-dry.	Average temperature of grinding.	Horsepower divided by pressure $\times$ speed.
		Kind of burr.	Surface.													P. ct.	Lbs.					
1		Spiral, cut 8 to inch; straight, cut 10 to inch.	Stone dressed...	2	Lbs. per sq. in. 40	Lbs. 16.40	225	Ft. per minute. 3,020	222	Tons. 307	1,980	112.0	Cu. ft. 216	Lbs. 21.05	Inches.	P. ct. 34.80	Lbs. 1,835	P. ct. 87.1	Lbs. 17.4	° F. 143	0.00449	
2		do.	Same surface.	2	60	24.65	225	3,020	290	413	3,410	85.0	345	21.05	....	34.80	1,980	94.0	20.1	131	.00389	
3		do.	do.	2	80	32.80	225	3,020	406	487	5,100	79.6	487	21.05	....	34.80	2,000	99.2	18.9	131	.00410	
4		do.	do.	2	100	41.00	225	3,020	470	581	6,750	69.5	695	21.05	....	34.80	1,950	92.6	22.6	118	.00380	
5		do.	do.	2	60	24.65	100	1,342	190	218	2,275	83.5	232	21.05	....	34.80	1,805	85.7	22.0	125	.00574	
6		do.	do.	2	60	24.65	150	2,013	233	284	2,920	79.8	311	21.05	....	34.80	1,875	89.0	16.5	123	.00470	
7		do.	do.	2	60	24.65	200	2,684	290	370	3,340	86.8	336	21.05	....	34.80	1,990	94.5	15.7	132	.00437	
8	Steamed	do.	do.	2	60	24.65	250	3,355	336	392	3,990	84.2	386	21.05	....	34.80	2,060	97.9	11.2	128	.00406	
9	do.	do.	do.	2	40	16.40	225	3,020	189	256	1,990	95.5	272	21.05	....	34.80	1,465	69.6	33.6	121	.00382	
10	do.	do.	do.	2	60	24.65	225	3,020	271	326	2,965	91.3	441	21.05	....	34.80	1,312	63.8	82.1	116	.00364	
11	do.	do.	do.	2	80	32.80	225	3,020	314	407	3,290	95.5	437	21.05	....	34.80	1,502	71.4	89.5	112	.00317	
12	do.	do.	do.	2	60	24.65	225	3,020	296	382	3,930	101.0	437	21.05	....	34.80	1,860	88.4	44.4	123	.00398	
13	do.	do.	do.	2	80	32.80	225	3,020	313	356	4,070	76.9	414	21.05	....	34.80	1,969	93.5	16.4	123	.00421	
14	do.	do.	Same as No. 256 spruce.	2	80	32.80	225	3,020	438	492	5,390	81.4	564	20.96	....	36.60	1,916	91.5	21.0	130	.00443	
15	do.	do.	Same surface.	2	80	32.80	225	3,020	415	462	4,450	93.2	456	21.20	....	33.25	1,950	92.0	21.2	132	.00419	
16	do.	do.	Stone dressed.	3	50	20.50	225	3,020	393	504	4,275	92.0	442	21.05	....	34.80	1,933	91.9	14.8	151	.00636	
17	do.	Straight, cut 3 to inch; spiral, cut 12 to inch.	Same as No. 275 spruce.	2	40	16.40	200	2,774	277	319	4,560	60.7	571	21.05	....	34.80	1,595	75.7	332.0	117	.00609	
18	do.	do.	Same as No. 17.	2	20	8.20	200	2,774	155	195	2,150	72.0	220	21.05	....	34.80	1,950	92.6	35.9	130	.00682	

¹ For conditions of cooking see Table 34.

Nos. 17 and 18 were run on a coarse-grit stone.

[illegible]

² See Commercial runs on mixed woods.

For conditions of cooking see Table 32.

NOTE.—For runs 46 (*a*, *b*, and *c*) and 49 (*a* and *b*) see for runs on mixed woods.

TABLE 16.—Grinder runs on western hemlock.¹

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.		Bone-dry pulp per 100 cubic feet solid ground wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid ground wood.	Average temperature of grinding.	Horsepower divided by pressure $\times$ speed.
		Kind of burr.	Surface.		Lbs. per sq. in.	Lbs.										P. ct.	Lbs.		P. ct.	Lbs.		$^{\circ}$ F.
1		Straight, cut 3 to inch; spiral, cut 12 to inch.	Same as for Sitka spruce No. 1.	3	20	12.30	225	3,085	305	354	2,270	134.5	218.0	24.40	(2)	27.73	2,080	85.2	85.2	10.91	178.9	0.00803
2		do.	Same as for Sitka spruce No. 4.	3	20	8.20	250	3,427	218	258	1,715	127.0	144.0	28.35	(2)	24.15	2,380	84.0	84.0	8.85	161.1	.00775
3		do.	Same surface.	3	40	16.40	250	3,427	376	391	3,480	93.7	288.0	28.35	(2)	24.15	2,420	85.4	85.4	13.50	154.3	.00580
4		do.	do.	3	60	24.65	250	3,427	552	625	5,850	94.4	524.0	28.35	(2)	24.15	2,235	78.8	78.8	13.46	150.3	.00654
5		do.	Same as No. 11	3	60	24.65	100	1,366	252	309	1,935	130.0	189.0	23.42	(2)	25.20	2,042	87.2	87.2	14.10	149.9	.00749
6		do.	Sitka spruce.	3	60	24.65	150	2,049	339	388	2,390	142.0	241.5	23.42	(2)	25.20	1,980	84.5	84.5	12.92	157.3	.00670
7		do.	do.	3	60	24.65	200	2,732	447	512	2,715	165.0	258.0	23.42	(2)	25.20	2,106	89.9	89.9	11.90	164.8	.00664
8		do.	do.	3	60	24.65	250	3,415	539	617	2,800	192.2	270.0	23.42	(2)	25.20	2,072	88.4	88.4	12.60	168.4	.00640
9	Steamed.	do.	Same as No. 6	3	60	24.65	200	2,732	348	406	1,892	183.7	237.0	23.58	(2)	26.62	1,595	67.6	67.6	14.63	123.8	.00516
10		do.	larch.	3	60	24.65	172	2,350	340	415	1,291	203.0	151.0	23.58	(2)	26.62	1,715	72.8	72.8	7.78	164.9	.00586
11		do.	Same surface.	2	40	16.40	225	3,073	267	314	3,130	85.3	277.0	24.77	(2)	24.20	2,260	91.3	91.3	8.56	116.0	.00530
12		do.	tamarack.	2	60	24.65	225	3,073	336	389	4,550	73.9	403.0	24.77	(2)	24.20	2,260	91.3	91.3	17.80	103.6	.00444
13		do.	Same surface.	2	80	32.80	225	3,073	430	490	6,130	70.2	571.0	24.77	(2)	24.20	2,145	86.6	86.6	16.30	117.5	.00426
14		do.	do.	2	100	41.00	225	3,073	480	549	7,690	62.5	675.0	24.77	(2)	24.20	2,278	92.0	92.0	19.96	110.7	.00381
15		do.	do.	2	100	41.00	225	3,073	480	549	7,690	62.5	675.0	24.77	(2)	24.20	2,278	92.0	92.0	19.96	110.7	.00381
16		do.	do.	2	100	41.00	225	3,073	480	549	7,690	62.5	675.0	24.77	(2)	24.20	2,278	92.0	92.0	19.96	110.7	.00381
17		do.	do.	2	100	41.00	225	3,073	480	549	7,690	62.5	675.0	24.77	(2)	24.20	2,278	92.0	92.0	19.96	110.7	.00381
18		Straight, cut 3 to inch; spiral, cut 12 to inch.	Stone dressed	3	50	20.50	225	3,069	479	565	3,800	126.0	338.0	24.77	(2)	24.20	2,250	91.0	91.0	10.80	169.0	.00760

¹ For conditions of cooking see Table 32.² Split wood.³ For runs 15 to 17, inclusive, see runs on "Mixtures of woods."

TABLE 17.—Grinder runs on tamarack.¹

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.	Bone-dry pulp per 100 cubic feet solid ground.	Efficiency of conversion.	Screenings per 100 cubic feet solid ground.	Average temperature of grinding.	Horsepower divided by pressure × speed.
		Kind of burr.	Surface.																	
21		{ Straight, cut 3 to 12 to inch. do. do. do.	Same surface.	3 { 40 50 20.5	16.4 20.5	175	2,445	368	470	4,380	96.8								161.0	° F.
21																				
21																				
21																				
21		{ do. do. do. do.	Same surface.	3 { 50 50 20.5	20.5	175	2,445	400	451	4,332	92.3								167.4	
21																				
21																				
21																				
21		{ do. do. do. do.	Same surface.	3 { 50 50 20.5	20.5	175	2,445	406	457	4,563	88.5								179.3	
21																				
21																				
21																				
		{ do. do. do. do.	Same surface.	3 { 50 50 20.5	20.5	175	2,445	400		4,500	90.0		32.38		24.41	2,648	81.9		174.6	
2																				
2																				
2																				
3		{ do. do. do. do.	Same surface.	3 { 40 60 24.65	16.4 24.65	175	2,428	332	377	3,725	89.1	286.0	32.22	54	26.22	2,606	80.9	11.09	161.2	.00834
4																				
4																				
4																				
5		{ do. do. do. do.	Same surface.	3 { 20 20 8.2	16.4	225	3,122	229	261	1,680	138.0	125.9	33.52	54	26.22	2,570	79.7	14.20	161.2	.00761
6																				
6																				
6																				
7		{ do. do. do. do.	Same surface.	3 { 40 60 24.65	16.4	225	3,122	410	484	4,930	83.2	335.0	33.52	54	29.18	2,640	78.8	10.94	171.0	.00894
8																				
8																				
8																				
8		{ do. do. do. do.	Stone dressed.	3 { 20 20 8.4	16.4	175	2,428	145	171		70.1	608.0	33.52	54	29.18	2,720	81.1	12.47	147.6	.00753
9																				
9																				
9																				
9		{ do. do. do. do.	Same surface.	3 { 60 60 24.65	24.65	175	2,428	422	485	1,542	273.0		32.25	54	27.20				142.7	.00728
10																				
10																				
10																				
10		{ do. do. do. do.	Same as for No. 2 western yellow pine.	3 { 60 60 24.65	24.65	250	3,470	592	621	1,880	315.0	200.0	32.25	6	27.20	1,880	58.3	12.5	123.4	.00691
11																				
11																				
11																				
11		{ do. do. do. do.	Same surface.	3 { 40 40 16.4	16.4	200	2,762	334	384	6,215	53.7	505.0	32.25	5	27.20	2,460	76.2	12.5	123.4	.00736
12																				
12																				
12																				
12	Steamed.	{ do. do. do. do.	Same surface.	3 { 40 40 16.4	16.4	200	2,762	306	356	4,470	68.5	339.0	32.25	54	27.20	2,490	77.1	11.8	133.4	.00675
13																				
13																				
13																				
14		{ do. do. do. do.	Same surface.	3 { 40 40 16.4	16.4	200	2,762	347	387	5,510	63.0	404.0	32.78	61	28.88	2,730	83.4	9.51	136.1	.00750
15																				
15																				
15																				
15		{ do. do. do. do.	Same surface.	3 { 40 40 16.4	16.4	200	2,762	330	393	4,455	71.0	340.0	32.78	61	28.88	2,620	80.0	14.46	149.8	.00727

¹ For conditions of cooking see Table 32.² Commercial.

TABLE 17.—Grinder run on tamarack—Continued.

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.		Bone-dry pulp per 100 cubic feet solid wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid wood bone-dry.	Average temperature of grinding.	Horsepower divided by pressure $\times$ speed.
		Kind of burr.	Surface.		Lbs. per sq. in.	Lbs.		Ft per minute.			Tons.		Cu. ft.		Inches.	P. ct.	Lbs.	P. ct.		P. ct.	Lbs.	° F.
16	Steamed..	Straight, cut 3 to inch; spiral, cut 12 to inch.	Same surface....	3	40	16.4	200	2,762	314	382	3,510	89.5	266.0	32.78	5½	28.88	2,638	80.5	16.70	150.2	0.00692	
17	do.	do.	do.	3	40	16.4	200	2,762	330	397	3,475	95.0	277.0	29.70	5½	33.01	2,515	84.6	11.88	163.0	.00728	
18	do.	do.	do.	3	40	16.4	200	2,762	338	389	3,240	104.3	261.0	29.70	6	33.01	2,483	83.6	10.99	156.3	.00745	
19	do.	do.	do.	3	40	16.4	200	2,762	338	356	2,950	97.6	233.5	33.70	5½	27.93	2,524	71.9	16.90	143.4	.00635	
20	do.	do.	Stone dressed	3	40	16.4	200	2,762	326	378	5,195	62.8	380.0	33.70	5½	27.93	2,730	81.0	12.86	125.4	.00719	
21	do.	do.	Same surface.	3	40	16.4	200	2,762	314	370	3,850	81.5	308.0	32.36	6½	28.04	2,500	77.3	16.40	141.8	.00692	
22	do.	do.	do.	3	40	16.4	200	2,762	295	349	3,035	97.2	274.0	32.36	6	28.04	2,218	68.5	11.60	143.6	.00650	
23	do.	do.	do.	3	40	16.4	200	2,762	291	361	3,480	83.7	309.0	32.36	5½	28.04	2,250	69.5	16.90	132.0	.00647	
24	do.	do.	do.	3	40	16.4	200	2,762	348	435	5,030	68.9	378.0	32.36	5½	28.04	2,670	82.5	8.35	139.1	.00766	
25	do.	do.	Same as No. 55 hemlock.	3	40	16.4	200	2,762	302	354	3,000	100.6	250.0	34.25	5½	25.32	2,398	70.0	16.88	141.5	.00661	
26	do.	do.	Same as No. 56 hemlock.	3	30	12.3	225	3,085	302	343	1,898	159.2	144.8	33.29	5½	22.51	2,620	78.7	8.14	187.2	.00795	
27	Steamed..	Spiral, cut 6 to inch.	Same as No. 6 California lodgepole.	2	40	16.4	250	3,427	288	326	4,780	60.3	384.0	31.47	5½	25.58	2,490	79.0	16.10	103.6	.00512	
28	do.	do.	Same surface.	2	55	22.55	201	2,760	283	311	4,420	64.0	366.0	31.47	5½	25.58	2,412	76.5	18.42	113.0	.00455	
29	do.	do.	do.	2	70	28.7	179	2,458	280	310	4,350	64.4	368.0	31.47	5½	25.58	2,360	75.0	22.30	117.8	.00397	
30	do.	do.	do.	2	85	34.8	158	2,165	289	322	3,912	73.9	330.0	31.47	5½	25.58	2,365	75.1	28.65	108.3	.00383	
31	do.	do.	do.	2	100	41.0	136	1,868	278	311	3,840	72.4	314.0	31.47	6	25.58	2,442	77.6	30.35	113.0	.00364	
32	do.	Straight, cut 3 to inch; diamond point, 10 to inch.	Same as for No. 9 California lodgepole.	2	40	16.4	225	3,081	258	288	2,865	90.0	252	31.68	5½	24.54	2,275	71.7	9.70	127.1	.00510	
33	do.	do.	Same surface.	2	60	24.65	225	3,081	360	408	4,270	84.3	363.0	31.68	5½	24.54	2,350	74.1	22.20	136.5	.00473	
34	do.	do.	do.	2	80	32.8	225	3,081	421	482	4,790	80.0	410.0	31.68	5½	24.54	2,338	73.6	36.70	128.5	.00417	
35	Bolled..	do.	do.	2	40	16.4	225	3,081	272	300	2,630	107.6	206.5	31.68	6	24.54	2,450	77.3	15.47	134.7	.00538	
36	do.	do.	do.	2	60	24.65	225	3,081	382	420	4,670	81.9	381.0	31.68	6	24.54	2,450	77.3	18.30	142.5	.00502	
37	do.	do.	Same as No. 41 tamarack.	2	80	32.8	225	3,081	438	499	4,565	95.8	385.0	31.47	6½	23.58	2,370	75.3	28.70	130.6	.00433	

38	Steamed...	do.	3	40	16.4	200	2,740	360	390	2,950	122.0	222.0	31.68	6 $\frac{1}{2}$	24.54	2,660	83.9	9.66	141.2	.00801
39	do.	do.	3	40	16.4	225	3,031	262	281	2,050	127.9	185.8	31.68	4 $\frac{1}{2}$	24.54	2,208	69.6	17.60	142.3	.00518
40	do.	do.	3	60	24.65	225	3,081	351	395	2,795	92.5	330.0	31.68	4 $\frac{1}{2}$	24.54	2,300	72.5	15.50	135.7	.00461
41	do.	do.	3	80	32.8	225	3,081	429	465	4,455	96.1	390.0	31.68	5 $\frac{1}{2}$	24.54	2,290	72.3	18.50	129.8	.00424
42	Boiled...	Straight, cut 8 to inch.	3	40	16.4	225	3,080	224	260	1,675	133.8	164.0	30.72	5 $\frac{1}{2}$	24.47	2,042	66.6	13.25	148.3	.00444
43	do.	do.	3	60	24.65	225	3,080	299	336	2,745	109.0	240.0	30.72	5 $\frac{1}{2}$	24.47	2,285	74.5	15.07	133.4	.00394
44	do.	do.	3	80	32.8	225	3,080	360	410	3,495	103.0	316.0	30.72	5 $\frac{1}{2}$	24.47	2,210	72.0	21.00	127.6	.00356
45	do.	do.	3	60	24.65	225	3,080	308	346	2,975	103.7	274.0	30.40	5 $\frac{1}{2}$	25.75	2,168	71.4	20.27	125.9	.00405
46	Boiled in s a l t brine.	do.	3	60	24.65	225	3,080	312	337	3,265	95.5	264.5	33.14	5 $\frac{1}{2}$	24.34	2,465	74.5	14.36	136.9	.00410
47	Steamed...	Straight, cut 3 to inch; spiral, cut 12 to inch.	3	60	24.65	200	2,732	422	471	1,459	290.0	138.0	32.75	6	23.62	2,280	69.6	10.79	177.3	.00626
48	do.	do.	3	60	24.65	200	2,732	366	440	4,610	79.4	394.0	32.75	5 $\frac{1}{2}$	23.62	2,338	71.4	24.9	108.3	.00543
49	do.	do.	3	60	24.65	150	2,049	352	406	5,400	65.2	426.0	32.75	5 $\frac{1}{2}$	23.62	2,535	77.4	11.09	109.0	.00696
50	do.	do.	3	60	24.65	150	2,049	352	406	5,400	65.2	426.0	32.75	5 $\frac{1}{2}$	23.62	2,535	77.4	11.09	109.0	.00696
51	do.	do.	3	60	24.65	150	2,049	352	406	5,400	65.2	426.0	32.75	5 $\frac{1}{2}$	23.62	2,535	77.4	11.09	109.0	.00696
52	do.	do.	3	60	24.65	150	2,049	352	406	5,400	65.2	426.0	32.75	5 $\frac{1}{2}$	23.62	2,535	77.4	11.09	109.0	.00696
53	do.	do.	3	60	24.65	150	2,049	352	406	5,400	65.2	426.0	32.75	5 $\frac{1}{2}$	23.62	2,535	77.4	11.09	109.0	.00696
54	do.	do.	3	40	16.4	225	3,069	430	505	4,510	95.4	324.0	32.44	5 $\frac{1}{2}$	25.25	2,780	85.6	10.10	170.0	.00854
55	Steamed...	Spiral, cut 8 to inch; straight, cut 10 to inch.	3	30	12.3	250	3,387	286	325	2,615	109.5	233.0	31.21	5 $\frac{1}{2}$	25.20	2,245	72.0	13.50	144.0	.00656
56	do.	do.	3	35	14.3	221	2,990	288	352	2,755	104.5	234.0	31.21	5 $\frac{1}{2}$	25.20	2,350	75.2	13.65	134.0	.00674
57	do.	do.	3	40	16.4	196	2,658	290	348	2,725	106.3	240.0	31.21	5 $\frac{1}{2}$	25.20	2,275	72.8	14.40	150.0	.00685
58	do.	do.	3	45	18.4	167	2,262	285	339	2,533	112.5	220.0	31.21	5 $\frac{1}{2}$	25.20	2,505	73.9	12.60	149.0	.00684
59	do.	do.	3	50	20.5	154	2,086	290	329	2,320	120.0	210.0	31.21	5 $\frac{1}{2}$	25.20	2,300	73.6	9.50	155.0	.00677
60	do.	do.	3	55	22.5	153	2,076	286	323	2,500	114.3	220.0	31.21	5 $\frac{1}{2}$	25.20	2,270	72.7	16.20	146.0	.00612
61	do.	do.	3	60	24.65	140	1,898	286	323	2,165	132.0	198.0	31.21	5 $\frac{1}{2}$	25.20	2,186	70.1	11.50	156.0	.00611
62	do.	do.	3	40	16.4	250	3,387	269	312	3,615	81.2	298.0	31.21	5 $\frac{1}{2}$	25.20	2,222	71.2	12.95	139.0	.00484
63	do.	do.	3	45	18.4	232	3,143	267	316	3,390	78.8	294.0	31.21	5 $\frac{1}{2}$	25.20	2,305	73.9	9.65	145.0	.00461
64	do.	do.	3	50	20.5	225	3,049	273	324	3,385	80.6	288.0	31.21	5 $\frac{1}{2}$	25.20	2,340	75.0	11.25	139.0	.00436
65	do.	do.	3	55	22.5	220	2,980	272	330	3,080	88.3	266.0	31.21	5 $\frac{1}{2}$	25.20	2,320	74.3	10.50	146.0	.00405
66	do.	do.	3	60	24.65	201	2,722	272	335	2,880	94.5	247.0	31.21	5 $\frac{1}{2}$	25.20	2,330	74.6	14.15	142.0	.00405
67	do.	do.	3	65	26.6	213	2,852	274	342	2,670	102.8	232.0	31.21	5 $\frac{1}{2}$	25.20	2,302	73.8	12.30	141.0	.00357
68	do.	do.	3	70	28.7	190	2,575	272	351	2,745	99.1	233.0	31.21	5 $\frac{1}{2}$	25.20	2,350	75.3	11.95	147.0	.00368
69	do.	do.	3	60	24.65	225	3,049	334	380	5,010	66.6	458.0	32.46	5 $\frac{1}{2}$	28.64	2,190	67.5	19.70	136.0	.00444
70	do.	do.	3	60	24.65	222	3,008	333	352	4,710	70.7	434.0	32.46	5 $\frac{1}{2}$	28.64	2,175	67.0	21.90	135.0	.00448
71	do.	do.	3	60	24.65	218	2,938	335	384	4,605	72.7	460.0	32.46	5 $\frac{1}{2}$	28.64	2,000	61.6	19.40	137.0	.00460

1 See runs on mixed woods.

TABLE 17.—Grinder runs on tamarack—Continued.

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid tressed wood ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.	Bone-dry pulp per 100 cubic feet solid tressed wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid tressed wood bone-dry.	Average temperature of grinding.	Horsepower divided by pressure $\times$ speed.
		Kind of burr.	Surface.																		
72	Steamed..	Diamond point, 6 to 10 in.	Same surface....	2	60	21.65	220	2,981	335	399	4.370	76.7	386.0	32.46	5½	28.64	2,260	69.6	27.20	133.0	0.00456
73	do.....	do.....	do.....	2	60	24.65	217	2,941	336	398	4.050	73.9	374.0	32.46	5½	28.64	2,435	75.0	27.30	137.0	.00463
74	do.....	do.....	do.....	2	60	24.65	205	2,780	333	391	4.490	74.2	360.0	32.46	5½	28.64	2,490	76.7	23.30	137.0	.00486
75	do.....	do.....	do.....	2	60	24.65	197	2,673	335	388	4.775	70.1	372.0	32.46	4½	28.64	2,560	78.9	18.30	131.0	.00508
76	do.....	do.....	do.....	2	60	24.65	185	2,505	335	394	5.075	66.0	378.0	32.46	5	28.64	2,680	82.5	19.30	140.0	.00511
77	do.....	do.....	do.....	2	60	24.65	170	2,302	334	404	5.780	57.9	380.0	32.46	5½	28.64	3,040	93.6	11.10	138.0	.00587
78	do.....	Spiral, cut 8 to 10 in.; straight, cut 10 to 10 in.	Same as No. 12 black gum.	2	40	16.40	175	2,348	216	276	1.320	163.6	119.0	30.88	6	33.60	2,215	71.7	11.4	164.0	.00561
179	do.....	do.....	Same surface....	2	40	16.40	175	2,348	195	258	1.020	191.0	102.0	23.37	10½	32.80	2,000	68.1	12.7	170.0	.00506
80	do.....	do.....	Stone dressed....	2	40	16.40	175	2,348	207	251	.560	370.0	63.0	30.88	7	33.60	1,770	57.4	8.8	174.0	.00538
181	do.....	do.....	Same surface....	2	40	16.40	175	2,348	202	245	.541	373.0	65.0	29.37	8½	32.80	1,672	57.0	15.9	175.0	.00524

1 Wood for these runs partially decayed.

TABLE 18.—Grinder runs on western larch.

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.	Bone-dry pulp per 100 cubic feet solid pressed wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid pressed wood.	Average temperature of grinding.	Horsepower divided by pressure $\times$ speed.
		Kind of burr.	Surface.																		
1	Steamed.	Straight, cut 3 to 12 to inch.	Same as No. 8 Montana lodgepole.	3	40	16.4	200	2,762	321	374	2,730	117.6	282.0	30.12	7	37.64	1,937	64.3	14.40	157.7	0.00709
2		do.	Same as for No. 9 Montana lodgepole.	3	30	12.3	225	3,085	334	378	3,220	103.6	338.0	27.94	7½	34.87	1,902	68.1	6.70	168.7	.00880
3		do.	Stone dressed.	3	60	24.65	100	1,366	267	298	1,830	146.0	212.0	26.55	7	36.38	1,728	65.1	6.20	138.2	.00793
4		do.	Same surface.	3	30	12.3	225	3,073	304	323	1,340	227.0	130.8	26.55	7	36.38	1,778	67.0	6.54	154.3	.00805
5		do.	Same as No. 15 Sitka spruce.	3	60	24.65	225	3,073	508	595	2,725	186.3	329.0	26.55	7	36.38	1,657	62.4	7.27	166.5	.00670
6		do.	Same surface.	3	40	16.4	175	2,390	303	344	1,086	279.0	115.0	26.55	7	36.38	1,887	71.1	5.80	177.9	.00772
7		Spiral, cut 8 to 10 to inch.	Same as 24 green balsam.	2	60	24.65	175	2,387	309	357	3,570	86.5	314.0	27.62	9½	40.28	2,270	82.1	12.85	149.0	.00525
8		do.	Same surface.	2	40	16.4	225	3,069	304	342	2,525	120.1	227.0	27.62	8½	40.28	2,223	80.5	10.40	157.0	.00605
9		do.	do.	2	60	24.65	225	3,069	401	442	4,155	96.6	376.0	27.62	9½	40.28	2,213	80.0	4.70	155.0	.00530
10		do.	do.	2	80	32.8	225	3,069	473	567	5,490	86.3	515.0	27.62	9½	40.28	2,125	77.0	12.35	142.0	.00470
11		do.	do.	2	80	32.8	175	2,387	382	456	4,355	87.6	406.0	27.62	7½	40.28	2,142	77.5	9.90	146.0	.00487
12		do.	do.	2	80	32.8	125	1,705	307	348	3,445	89.1	312.0	27.62	7½	40.28	2,206	79.9	10.90	154.0	.00549

1 For conditions of cooking see Table 32.

TABLE 19.—Grinder runs on *Montana lodgepole pine*.¹

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cyl-inder.	Tlbs. per sq. in.	TPressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton of bone-dry pulp in 24 hours.	Solid ground in 24 hours.	Weight per cubic foot of bone-dry wood.	Average diameter of wood.	Moisture in wood.		Bone-dry pulp per 100 cubic feet solid ground wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid ground wood.	Average temperature of grinding.	Horsepower divided by pressure $\times$ speed.
		Kind of burr.	Surface.														P. ct.	Lbs.					
1		Straight, cut 3 to 12 to inch.	Same as for run No. 23 spruce.	3	40	16.4	175	2,442	337.0	383	2.710	124.3	247.8	27.20	6 $\frac{1}{2}$	16.90	2,190	80.5	8.68	170.8	0.00840		
2		do.	Stone dressed.	3	20	8.2	225	3,122	233.0	263	2.210	105.3	216.0	25.00	7	32.60	2,040	81.6	13.70	137.4	.00910		
3		do.	Same surface.	3	40	16.4	225	3,122	412.0	453	5.940	69.4	553.0	25.00	6 $\frac{1}{2}$	32.60	2,145	85.9	17.76	137.9	.00804		
4		do.	do.	3	60	24.65	225	3,122	574.0	660	8.965	64.0	930.0	25.00	7 $\frac{1}{2}$	32.60	1,970	77.1	25.80	148.0	.00745		
5		do.	do.	3	20	8.2	175	2,428	183.6	208	1.700	108.0	159.6	26.10	6 $\frac{1}{2}$	18.80	2,130	81.6	8.96	86.0	.00921		
6		do.	do.	3	40	16.4	175	2,428	341.5	382	3.530	96.7	343.0	26.10	6 $\frac{1}{2}$	18.80	2,060	78.9	7.69	89.6	.00856		
7		do.	do.	3	60	24.65	175	2,428	482.5	545	5.465	88.2	511.0	26.10	6 $\frac{1}{2}$	18.80	2,140	82.0	17.75	87.8	.00805		
8	Steamed	do.	Same as yellow pine No. 3.	3	40	16.4	200	2,762	289.0	339	2.795	103.3	288.0	26.48	6 $\frac{1}{2}$	19.52	1,942	73.4	22.73	148.3	.00638		
9		do.	Same as for western yellow pine No. 4.	3	30	12.3	225	3,085	318.0	356	2.795	113.7	223.0	26.57	6 $\frac{1}{2}$	13.67	2,500	94.2	13.40	171.0	.00837		
10		Straight, cut 3 to 10 to inch.	Same as for western yellow pine No. 7.	3	60	24.65	250	3,435	588.0	650	6.285	93.6	588.0	26.55	6 $\frac{1}{2}$	15.22	2,135	80.4	11.66	150.9	.00695		
11		do.	Same surface.	3	40	16.4	250	3,435	424.0	477	3.375	125.7	303.0	26.55	6 $\frac{1}{2}$	15.22	2,223	83.9	10.12	165.3	.00752		
12		do.	do.	3	20	8.2	225	3,435	228.0	269	964	237.0	92.0	26.55	6 $\frac{1}{2}$	15.22	2,093	78.8	6.84	176.8	.00810		
13	Boiled	Straight, cut 8 to 10 to inch.	Same as No. 46 tamarack.	2	40	16.4	225	3,080	271.0	269	1.635	141.1	187.8	23.95	6 $\frac{1}{2}$	24.90	1,741	72.8	17.06	140.7	.00457		
14	do.	do.	Same surface.	2	60	24.65	225	3,080	320.0	356	2.500	128.0	270.0	23.95	6 $\frac{1}{2}$	24.90	1,850	77.3	24.15	136.0	.00421		
15	do.	do.	do.	2	80	32.8	225	3,080	374.0	419	2.820	132.7	304.0	23.95	6 $\frac{1}{2}$	24.90	1,850	77.3	20.50	129.9	.00370		
16		Straight, cut 3 to 12 to inch.	Same as No. 209 spruce.	3	60	24.65	100	1,367	251.0	295	2.612	96.1	241.0	24.70	7	24.80	2,170	87.9	16.59	127.1	.00745		
17		do.	Same surface.	3	60	24.65	150	2,045	375.0	428	3.670	102.2	334.0	24.70	7	24.80	2,195	88.9	13.59	124.4	.00741		
18		do.	do.	3	60	24.65	200	2,732	486.0	536	4.395	110.7	406.0	24.70	7	24.80	2,160	87.5	16.62	135.0	.00722		
19		do.	do.	3	60	24.65	250	3,415	599.0	676	5.650	106.0	530.0	24.70	6 $\frac{1}{2}$	24.80	2,130	86.3	16.50	136.3	.00711		
20		Spiral, cut 8 to 10 to inch; straight, cut 10 to inch.	Same as No. 18 red fir.	2	40	16.4	225	3,063	263.0	308	2.040	129.0	195.0	23.40	6 $\frac{1}{2}$	24.80	2,085	89.1	7.69	153.0	.00322		

TABLE 20.—Grinder runs on *California lodgepole pine*.¹

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton of bone-dry pulp in 24 hours.	Solid ground in 24 hours.	Weight per cubic foot of bone-dry wood.	Average diameter of wood.	Moisture in wood.		Bone-dry pulp per 100 cubic feet solid tressed wood.	Efficiency of conversion.	Screenings per 100 cubic bone-dry.	Average temperature of grinding.	Horsepower divided by pressure×speed.
		Kind of burr.	Surface.		Lbs. per sq. in.	Lbs.					Tons.					Inches.	P. ct.	Lbs.	P. ct.			
1	Steamed	Straight, cut 3 to 12 to inch.	Same as larch No. 1.	3	40	16.4	200	2,762	312	358	2,515	124.2	329.5	21.74	6½	22.78	1,526	61.7	16.86	155.3		0.00689
2		do.	Same as western hemlock No. 1.	3	30	12.3	225	3,085	326	364	2,370	137.6	227	25.38	(2)	11.00	2,082	82.2	11.30	172.1		.00859
3		do.	Same as spruce No. 154.	2	80	32.8	225	3,085	513	555	4,930	104.0	524	23.58	(2)	28.04	1,882	79.9	23.44	157.7		.00506
4		Spiral, cut 6 to inch	Same as spruce No. 191.	3	20	8.2	175	2,400	193	222	1,661	116.2	161	25.35	(2)	10.93	2,062	81.5	11.57	142.1		.00980
5		do.	Same surface.	3	40	16.4	175	2,400	357	391	4,230	84.4	432	25.35	(2)	10.93	1,960	77.4	15.90	121.6		.00907
6		do.	do.	3	60	24.65	175	2,400	474	505	7,150	66.2	761	25.35	(2)	10.93	1,880	74.2	17.67	108.1		.00800
7		Straight, cut 3 to inch; diamond point, 10 to inch.	Stone dressed.	3	20	8.2	225	3,081	228	264	1,475	154.6	164	25.35	(2)	10.93	1,800	71.0	7.99	144.5		.00902
8		do.	Same surface.	3	40	16.4	225	3,081	392	444	3,245	121.0	344	25.35	(2)	10.93	1,886	74.4	7.95	149.2		.00775
9		do.	do.	3	60	24.65	225	3,081	579	651	6,400	90.5	695	25.35	(2)	10.93	1,842	72.7	21.00	114.4		.00760
10		Straight, cut 3 to inch; spiral, cut 12 to inch.	Stone dressed.	3	60	24.65	100	1,366	264	323	1,140	232.0	124.4	22.29	(2)	22.33	1,832	82.2	12.49	152.7		.00784
11		do.	Same surface.	3	60	24.65	150	2,049	374	430	1,745	214.0	106	22.29	(2)	22.33	1,776	79.5	12.22	161.7		.00740
12		do.	do.	3	60	24.65	200	2,732	512	594	2,055	249.0	223	22.29	(2)	22.33	1,623	72.9	13.17	168.8		.00760
13		do.	do.	3	60	24.65	250	3,415	630	690	2,595	208.0	204	22.29	(2)	22.33	1,763	79.1	13.40	164.8		.00641
14		do.	Stone dressed.	2	20	8.2	225	3,073	126	157	504	250.0	59	22.67	(2)	24.67	1,707	75.1	5.88	139.9		.00500
15		do.	Same surface.	2	40	16.4	225	3,073	270	301	1,675	161.2	178	22.67	(2)	24.67	1,878	82.7	7.30	164.0		.00585
16		do.	do.	2	60	24.65	225	3,073	358	402	2,675	134.0	286	22.67	(2)	24.67	1,810	79.8	6.97	149.7		.00473
17		do.	do.	2	80	32.8	225	3,073	439	508	3,725	117.4	396	22.67	(2)	24.67	1,930	85.0	10.60	139.6		.00455
18		do.	do.	2	100	41.0	225	3,073	577	655	4,975	116.0	531	22.67	(2)	24.67	1,872	82.5	16.71	151.5		.00458
19		Spiral, cut 8 to inch; straight, cut 10 to inch.	Same as No. 23 lodgepole.	2	40	16.4	225	3,069	259	307	1,081	239.5	111	23.05	(2)	26.05	1,952	84.6	7.05	175.6		.00514
20		do.	do.	2	60	24.65	225	3,069	347	410	1,763	196.7	184	23.05	(2)	26.05	1,921	83.4	9.65	168.0		.00459
21		do.	Same surface.	2	80	32.8	225	3,069	409	465	2,925	139.6	303	23.05	(2)	26.05	1,932	83.8	10.15	165.1		.00405

TABLE 21.—Grinder runs on western yellow pine.¹

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.		Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per 100 bone-dry pulp in 24 hours.	Solid ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.		Bone-dry pulp per 100 cubic feet solid ground wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid ground wood bone-dry.	Average temperature of grinding.	Horsepower divided by pressure X speed.
		Kind of burr.	Surface.					Ft. per minute.	Tons.								Cu. ft.	Lbs.					
1	Steamed.	Straight, cut 3 to 12 to inch.	Same as hemlock No. 53.	3	40	16.4	200	2,768	376	422	4,100	91.7	486.0	23.50	2 7	44.27	1,688	71.8	40.30	121.1	0.00828		
2	Boiled.	do.	Same as hemlock No. 54.	3	40	16.4	200	2,762	307	356	4,020	76.4	368.0	23.65	2 8	54.54	2,182	92.3	26.05	124.7	0.00577		
3	Steamed.	do.	Stone dressed.	3	40	16.4	200	2,762	326	394	4,400	74.1	392.0	28.24	10	43.83	2,243	79.2	34.10	129.2	0.00719		
4	do.	do.	Same as spruce No. 151.	3	30	12.3	225	3,085	337	386	3,255	103.7	313.0	25.11	9 1/2	16.53	2,080	82.9	10.78	166.0	0.00888		
5	do.	do.	Stone dressed.	3	60	24.65	250	3,435	580	661	6,620	87.6	610.0	26.55	9 1/2	24.15	2,170	81.8	15.42	137.5	0.00885		
6	do.	do.	Stone surface.	3	40	16.4	250	3,435	466	511	4,850	96.0	436.0	26.55	10	24.15	2,222	83.8	8.54	156.9	0.00829		
7	do.	do.	do.	2	80	32.8	150	2,056	356	393	5,100	69.8	489.0	26.55	9 1/2	24.15	2,085	78.5	27.60	134.1	0.00328		
8	Boiled.	Straight, cut 8 to 12 to inch.	Same as No. 7.	2	40	16.4	225	3,080	244	259	1,620	150.7	219.0	22.50	9 1/2	23.40	1,480	65.8	14.92	129.6	0.00483		
9	do.	do.	Sitka spruce.	2	60	24.65	225	3,080	317	341	2,865	110.7	326.0	22.50	9 1/2	23.40	1,757	78.0	29.20	109.4	0.00417		
10	do.	do.	do.	2	80	32.8	225	3,080	370	401	3,075	120.2	384.0	22.50	8 1/2	23.40	1,603	71.4	39.60	116.5	0.00366		
11	Steamed.	Straight, cut 3 to 12 to inch.	Same as No. 10.	3	40	16.4	200	2,732	320	397	1,011	316.0	114.3	21.25	8 1/2	23.09	1,770	73.0	21.20	165.3	0.00715		
12	do.	do.	Same as No. 19.	3	60	24.65	100	1,366	269	300	2,630	102.3	275.0	23.97	10 1/2	22.31	1,912	79.9	26.64	105.0	0.00799		
13	do.	do.	Montana lodgepole.	3	60	24.65	150	2,049	403	437	2,912	138.2	301.0	23.97	8 1/2	22.31	1,936	80.9	27.65	122.4	0.00796		
14	do.	do.	Same surface.	3	60	24.65	200	2,732	529	580	3,777	140.0	392.0	23.97	9 1/2	22.31	1,930	80.6	24.07	123.9	0.00784		
15	do.	do.	do.	3	60	24.65	250	3,415	654	726	4,800	134.6	501.0	23.97	9 1/2	22.31	1,940	81.0	17.60	117.1	0.00776		
16	do.	do.	Stone dressed.	2	40	16.4	225	3,069	290	338	2,533	114.3	255.0	22.90	9 1/2	28.65	1,990	86.9	8.37	150.8	0.00576		
17	do.	do.	Same surface.	2	60	24.65	225	3,069	410	470	5,950	81.2	473.0	22.90	9 1/2	28.65	2,105	92.0	12.69	143.0	0.00541		
18	do.	do.	do.	2	80	32.8	225	3,069	434	496	6,595	65.9	616.0	22.90	9 1/2	28.65	2,140	93.4	12.69	123.8	0.00431		
19	do.	do.	do.	2	100	41.0	225	3,069	513	577	8,150	62.9	738.0	22.90	9 1/2	28.65	2,065	90.2	22.30	125.6	0.00407		
20	do.	do.	do.	2	100	41.0	225	3,069	513	577	8,150	62.9	738.0	22.90	9 1/2	28.65	2,065	90.2	22.30	125.6	0.00407		
21	do.	do.	do.	2	100	41.0	225	3,069	513	577	8,150	62.9	738.0	22.90	9 1/2	28.65	2,065	90.2	22.30	125.6	0.00407		
22	do.	do.	do.	2	100	41.0	225	3,069	513	577	8,150	62.9	738.0	22.90	9 1/2	28.65	2,065	90.2	22.30	125.6	0.00407		
23	do.	do.	do.	2	100	41.0	225	3,069	513	577	8,150	62.9	738.0	22.90	9 1/2	28.65	2,065	90.2	22.30	125.6	0.00407		
24	do.	do.	do.	2	100	41.0	225	3,069	513	577	8,150	62.9	738.0	22.90	9 1/2	28.65	2,065	90.2	22.30	125.6	0.00407		

25 26 27	Stone dressed...	3	40	16.4	225	3,069	455	541	7.055	64.5	635.0	24.67	104	26.98	2,220	90.0	30.29	137.0	.00904
	Straight, cut 10 to inch; spiral, cut 8 to inch.																		

¹ For conditions of cooking see Table 32.

² Wood was in 1-foot lengths.

³ See runs on mixture of woods.

17	do.	Stone dressed...	3	40.0	16.4	173.0	2,330	239.0	3,834	75.5						143.0
17-1	do.	Same as for No. 18-1.	3	40.0	16.4	174.0	2,350	332.0	4,350	76.3						178.0
18	do.	Stone dressed...	3	50.0	20.5	204.0	2,800	407.5	6,910	59.0						143.0
18-1	do.	do.	3	50.0	20.5	205.0	2,800	414.0	6,360	65.0						143.0
19	do.	do.	3	30.0	12.3	152.5	2,100	201.0	2,045	98.3						149.0
20	do.	do.	3	30.0	12.3	205.0	2,800	313.0	5,320	58.8						178.0
20-1	do.	Same as for No. 22.	3	30.0	12.3	205.0	2,800	304.0	3,620	83.8	305.5	24.90	50.00	2,370	95.1	198.0
21	do.	Same as for No. 20.	3	30.0	12.3	174.0	2,380	269.5	4,810	56.0						172.0
22	do.	Stone dressed...	3	60.0	24.65	205.0	2,800	481.0	7,320	65.8						185.0
23	do.	Same as for No. 18-1.	3	40.0	16.4	205.0	2,800	249.0	4,110	84.9						206.0
24	Straight, cut 3 to inch; spiral, cut 12 to inch.	Same as for commercial No. 51, hemlock.	3 {	40.0	16.4	175.0	2,445	395.0	469	4,305	91.8	388.0	25.60	37.16	2,220	86.7 14.86 176.3 0.00924
25	Steamed.	Stone dressed...	3	40.0	16.4	200.0	2,768	370.0	455	5,100	72.5	479.0	24.96	6½	44.49	2,130 85.5 25.27 130.3 .00815
26	do.	Same as No. 7 balsam.	3	40.0	16.4	200.0	2,762	331.0	376	2,990	110.8	339.0	24.16	5½	43.20	1,762 73.1 12.66 151.8 .00730
27	do.	Same as for spruce No. 152.	3	30.0	12.3	225.0	3,085	337.0	380	2,255	149.7	219.0	25.70	5½	29.30	2,060 80.1 7.31 179.2 .00888
28	Boiled.	Same as No. 43 tamarack.	2	40.0	16.4	225.0	3,080	243.0	272	1,646	147.8	209.3	23.46	5½	37.51	1,572 67.0 11.63 146.2 .00481
29	do.	Same as No. 44 tamarack.	2	60.0	24.65	225.0	3,080	323.0	358	2,650	122.0	334.0	23.46	6½	37.51	1,583 67.5 15.30 141.4 .00425
30	do.	Same surface.	2	80.0	32.8	225.0	3,080	363.0	411	3,095	117.3	402.0	23.46	6½	37.51	1,539 65.5 22.58 125.0 .00360
31	do.	Same as No. 10 western yellow pine.	2	60.0	24.65	225.0	3,080	322.0	352	2,650	121.4	339.0	22.97	6½	39.10	1,565 68.2 14.75 108.1 .00424
32	Steamed.	Same as No. 11 western yellow pine.	3	60.0	24.65	200.0	2,732	449.0	516	1,830	245.0	201.0	22.80	6½	36.60	1,820 79.8 12.26 165.8 .00666
33	do.	Stone dressed...	3	60.0	24.65	200.0	2,732	371.0	430	4,225	87.8	540.0	22.80	7½	36.60	1,567 68.6 28.40 103.3 .00550
34	do.	Same surface.	3	60.0	24.65	155.0	2,118	337.0	462	5,390	66.3	587.0	22.80	5½	36.60	1,832 80.4 11.70 99.2 .00684

1 For conditions of cooking see Table 32.

2 Approximate.

TABLE 23.—Grinder runs on *tobblolly pine*.¹

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton, bone-dry pulp in 24 hours.	Solid ground in 24 hours.	Weight per cubic foot, bone-dry wood.	Average diameter of wood.	Moisture in wood.	Bone-dry pulp per 100 cubic feet, solid ground wood.	Efficiency of conversion.	Screenings per 100 cubic feet, solid ground wood.	Average temperature of grinding.	Horsepower divided by pressure $\times$ speed.
		Kind of burr.	Surface.		Lbs. per sq. in.	Lbs.		Ft. per minute.													
1		Full-cut wood.	Stone dressed	2	40	16.40	175	2,348	225	248	2,430	92.5	204	28.56	.....	20.20	2,380	83.4	15.3	150	0.00584
2		Spiral, cut 8 to inch; straight, cut 10 to inch.	Stone dressed	2	60	24.65	175	2,348	314	367	3,830	81.7	337	28.56	.....	20.20	2,280	79.9	12.5	136	.00541
3		do.	Same surface.	2	80	32.80	175	2,348	368	419	3,195	115.0	290	28.56	.....	20.20	2,500	86.2	14.1	156	.00478
4		do.	Same surface.	2	60	24.65	175	2,348	318	350	2,455	129.5	196	28.56	.....	20.20	2,400	87.6	15.5	156	.00549
5		do.	do.	2	40	16.40	175	2,348	226	264	1,105	104.0	199	28.56	.....	20.20	2,350	82.4	18.7	163	.00587
6		do.	do.	2	60	24.65	100	1,342	209	240	2,225	93.8	179	28.56	.....	20.20	2,490	87.3	12.4	150	.00631
7		do.	Stone dressed	2	60	24.65	150	2,015	296	332	3,140	94.2	247	28.56	.....	20.20	2,540	89.0	13.2	147	.00597
8		do.	Same surface.	2	60	24.65	250	3,355	430	489	4,865	88.3	404	28.56	.....	20.20	2,410	84.5	12.0	146	.00620
9		do.	do.	2	80	32.80	225	3,020	397	465	3,400	116.9	313	28.56	.....	20.20	1,900	69.8	19.4	145	.00401
10		do.	Same as No. 13.	2	40	16.40	175	2,348	198	251	1,772	111.0	145	29.52	.....	16.80	2,445	82.9	22.8	149	.00513
11		do.	Same as No. 13.	2	60	24.65	175	2,348	302	362	3,305	91.2	262	29.52	.....	16.80	2,520	85.4	22.7	149	.00521
12		do.	Same as No. 24.	2	80	32.80	175	2,348	371	413	4,350	85.2	347	29.52	.....	16.80	2,510	85.0	17.4	143	.00481
13		do.	Same as No. 27, spruce.	2	20	8.20	200	2,774	129	150	1,800	71.6	123	29.52	.....	16.80	2,930	.....	17.7	129	.00568
14		Spring-cut wood.	Stone dressed	2	40	16.40	175	2,348	220	278	1,585	138.5	143	27.56	.....	23.62	2,220	80.6	8.8	158	.00571
15		Spiral, cut 3 to inch; straight, cut 10 to inch.	Stone dressed	2	60	24.65	175	2,348	307	367	2,490	123.3	214	27.56	.....	23.62	2,320	84.2	14.9	157	.00530
16		do.	Same as No. 3.	2	80	32.80	175	2,348	366	437	3,375	108.5	280	27.56	.....	23.62	2,415	87.6	14.4	146	.00475
17		do.	Same surface.	2	60	24.65	100	1,342	208	250	1,500	131.0	133	27.56	.....	23.62	2,300	86.8	9.6	160	.00629
18		do.	Same surface.	2	60	24.65	150	2,015	292	313	1,300	144.0	139	27.56	.....	23.62	2,460	89.3	8.5	156	.00569
19		do.	do.	2	60	24.65	200	2,684	352	426	2,225	181.0	190	27.56	.....	23.62	2,300	83.5	9.9	170	.00631
20		do.	do.	2	60	24.65	250	3,355	390	464	2,225	175.2	196	27.56	.....	23.62	2,276	82.6	12.1	168	.00471
21		do.	Same as No. 15.	2	40	16.40	225	3,020	214	318	2,015	121.0	202	27.56	.....	23.62	2,000	72.6	15.4	142	.00494
22		do.	Same surface.	2	60	24.65	225	3,020	333	372	2,800	119.0	276	27.56	.....	23.62	2,025	73.5	13.5	139	.00446
23		do.	do.	2	80	32.80	225	3,020	410	481	3,865	106.0	370	27.56	.....	23.62	2,090	75.9	22.9	139	.00415

20	do.	Same as No. 19.	2	60	24.65	225	3,020	337	438	3,005	122.0	261	27.56	23.62	2,300	83.5	28.9	143	.00493
21	do.	Same surface.	2	60	24.65	225	3,020	419	475	3,690	113.3	310	27.56	23.62	2,380	86.4	11.7	146	.00563
22	do.	Same as No. 13,	2	60	24.65	175	2,348	290	327	4,225	68.8	368	27.89	25.19	2,300	82.5	17.6	129	.00501
		noble fir.																	
25	do.	Same as No. 25.	2	40	16.40	175	2,348	205	267	1,955	104.8	171	27.38	24.07	2,280	83.3	22.3	152	.00532
27	do.	Same as No. 26.	2	60	24.65	175	2,348	296	342	2,900	102.0	254	27.38	24.07	2,280	83.3	18.2	145	.00511
28	do.	Same as No. 27.	2	80	32.80	175	2,348	374	427	3,500	106.8	312	27.38	24.07	2,240	81.9	28.7	155	.00485

1 For conditions of cooking see Table 32.

2 No. 29 was run on a coarse-grit stone.

TABLE 24.—Grinder runs on white pine.¹

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton of bone-dry pulp in 24 hours.	Solid rossi wood ground in 24 hours.	Weight per cubic foot of bone-dry wood.	Average diameter of wood.	Moisture in wood.	Bone-dry pulp per 100 cubic feet solid rossi wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid rossi wood bone-dry.	Average temperature of grinding.	Horsepower divided by pressure $\times$ speed.
		Kind of burr.	Surface.		Lbs. per sq. in.	Lbs.		Ft. per minute.			Tons.				Inches.	P. ct.	Lbs.		P. ct.	Lbs.	$^{\circ}$ F.
1	.....	Diamond point, 6 to 1 inch.	Same as No. 26 white fir.	2	40	16.4	175	2,372	248	305	2,035	122.0	218	20.40	51	61.74	1,870	91.7	4.4	150	0.00638
2	.....	do.	Same surface.	2	60	24.65	175	2,372	347	391	3,427	101.0	373	20.40	51	61.74	1,840	90.2	8.8	139	.00594
3	.....	do.	do.	2	80	32.8	175	2,372	451	489	5,010	90.0	534	20.40	63	61.74	1,880	92.1	11.2	142	.00581
4	.....	do.	do.	2	100	41.0	175	2,372	527	586	6,800	76.9	742	20.40	63	61.74	1,850	90.7	10.0	133	.00543
5	.....	do.	do.	2	60	24.65	100	1,355	226	250	2,035	111.0	211	20.40	51	61.74	1,930	94.6	11.6	144	.00676
6	.....	do.	do.	2	60	24.65	150	2,033	320	362	3,175	103.7	350	20.40	51	61.74	1,812	89.0	7.6	146	.00656
7	.....	do.	do.	2	60	24.65	200	2,710	458	491	4,670	98.1	480	20.40	51	61.74	1,947	95.5	6.7	147	.00585
8	.....	do.	do.	2	60	24.65	250	3,388	496	536	5,200	95.5	532	20.40	51	61.74	1,952	95.8	6.7	145	.00594
9	Steamed.	do.	do.	2	40	16.4	225	3,049	302	354	2,330	123.7	318	20.10	51	57.20	1,470	73.1	9.8	153	.00604
10	do.	do.	Same as No. 34 white fir.	2	60	24.65	225	3,049	400	456	3,600	111.0	489	20.10	51	57.20	1,470	73.1	15.4	153	.00531
11	do.	do.	do.	2	80	32.8	225	3,049	440	531	4,245	108.4	552	20.10	51	57.20	1,535	76.4	22.15	139	.00460
12	do.	do.	do.	2	100	41.0	225	3,049	517	573	4,675	110.7	669	20.10	51	57.20	1,400	69.6	30.6	138	.00414

¹ For conditions of steaming see Table 32.

TABLE 25.—Grinder runs on Engelmann spruce (Montana).¹

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 1-inch cylinder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.	Bone-dry pulp per 100 cubic feet solid ground wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid ground wood.	Average temperature of grinding.	Horsepower divided by pressure × speed.
		Kind of burr.	Surface.		Lbs. per sq. in.	Lbs.	100	Ft. per minute.			Tons.										
1		Spiral, cut 12 to inch, straight, cut 3 to inch.	Same as No. 12 Alpine fir.	2	60	24.65	100	1,355	216	264	2.730	79.1	246	24.90	9 ¹ / ₂	44.00	2,220	89.1	13.4	137	0.00646
2		do.....	Same surface.....	2	60	24.65	150	2,033	283	328	4.260	66.4	368	24.90	9	44.00	2,315	92.9	12.5	132	.00565
3		do.....	do.....	2	60	24.65	200	2,710	381	446	5.640	67.6	486	24.90	8 ¹ / ₂	44.00	2,315	92.9	16.4	129	.00570
4		do.....	do.....	2	60	24.65	250	3,388	455	539	7.050	64.5	611	24.90	9 ¹ / ₂	44.00	2,300	92.4	9.4	130	.00546
5		do.....	do.....	2	40	16.40	225	3,049	281	333	3.695	76.1	328	24.90	9	44.00	2,255	90.5	4.2	135	.00666
6		do.....	do.....	2	60	24.65	225	3,049	422	461	6.140	67.3	554	24.90	9	44.00	2,220	89.1	8.5	134	.00561
7		do.....	do.....	2	80	32.80	225	3,049	484	534	9.280	52.2	770	24.90	8 ¹ / ₂	44.00	2,413	96.8	16.5	124	.00534
8	Steamed.	do.....	Stone dressed.....	2	40	16.40	175	2,371	203	233	2.580	78.7	252	24.90	10 ¹ / ₂	44.00	2,050	82.4	20.2	122	.00322
9		do.....	Same surface.....	2	60	24.65	175	2,371	278	332	3.500	79.5	328	24.90	10	44.00	2,130	85.5	48.2	114	.00475
10		do.....	do.....	2	80	32.80	175	2,371	326	378	4.565	71.3	476	24.90	8 ¹ / ₂	44.00	1,915	76.9	104.0	113	.00420
11		do.....	do.....	2	40	16.40	175	2,371	240	278	3.645	65.9	302	24.90	9 ¹ / ₂	44.00	2,405	96.6	9.7	132	.00618
12		do.....	do.....	2	60	24.65	175	2,371	330	365	5.655	58.5	491	24.90	9 ¹ / ₂	44.00	2,290	92.0	19.1	128	.00565
13		do.....	do.....	2	80	32.80	175	2,371	399	459	6.880	58.0	651	24.90	10	44.00	2,110	84.8	26.5	120	.00514
14		Spiral, cut 8 to inch, straight, cut 10 to inch.	Same as No. 10 lowland fir.	2	40	16.40	175	2,348	204	228	2.370	86.0	222	23.86	8	46.79	2,140	89.7	4.5	137	.00530
15		do.....	Same surface.....	2	60	24.65	175	2,348	294	331	4.000	73.5	360	23.86	8	46.79	2,220	93.1	10.7	130	.00507
16		do.....	do.....	2	80	32.80	175	2,348	313	354	4.840	64.6	402	23.86	8 ¹ / ₂	46.79	2,405	10.08	12.9	131	.00406
17		do.....	do.....	2	60	24.65	100	1,342	187	201	2.525	74.0	223	23.86	10	46.79	2,275	95.4	11.3	136	.00564
18		do.....	do.....	2	60	24.65	150	2,013	259	303	3.380	76.6	306	23.86	7 ¹ / ₂	46.79	2,215	92.9	7.8	136	.00522
19		do.....	do.....	2	60	24.65	200	2,654	333	370	4.880	68.3	437	23.86	7 ¹ / ₂	46.79	2,230	93.5	4.3	131	.00503

¹ For conditions of cooking see Table 32.

TABLE 26.—Grinder runs on Engelmann spruce (Colorado).¹

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid tressed wood ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.	Bone-dry pulp per 100 cubic feet solid tressed wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid tressed wood bone dry.	Average temperature of grinding.	Horsepower divided by pressure × speed.
		Kind of burr.	Surface.																		
1	.....	Spiral, cut 8 to inch; straight, cut 10 to inch.	Same as No. 54 tamarack.	2	Lbs. per sq. in. 40	Lbs. 16.4	225	Ft. per minute. 3,069	299	348	Tons. 2,700	110.8	Cu. ft. 272	Lbs. 20.48	Inches. 57	P. ct. 59.20	Lbs. 1,980	P. ct. 96.5	Lbs. 12.35	F.° 140	0.00594
2	.....	do.	Same surface.	2	60	24.65	225	3,069	411	457	4,535	90.6	465	20.48	57	59.20	1,951	95.2	13.30	136	.00543
3	.....	do.	do.	2	80	32.8	225	3,069	478	538	5,000	85.4	577	20.48	57	59.20	1,940	94.6	16.20	150	.00475
4	.....	do.	Same as No. 3 white fir.	2	60	24.65	175	2,387	323	358	3,230	100.0	343	20.48	57	59.20	1,882	91.9	13.30	144	.00548
5	.....	do.	Same as No. 29 balsam.	3	60	24.65	100	1,355	257	300	3,325	77.3	310	22.22	6	57.30	2,150	96.7	11.10	137	.00739
6	.....	do.	Same surface.	3	60	24.65	150	2,033	383	444	4,735	80.9	457	22.22	6	57.30	2,073	93.2	10.80	133	.00765
7	.....	do.	do.	3	60	24.65	200	2,710	510	589	6,535	78.1	602	22.22	6	57.30	1,972	88.8	6.70	138	.00763
8	.....	do.	do.	3	60	24.65	250	3,388	500	605	7,340	76.1	700	22.22	6	57.30	1,940	87.3	6.60	132	.00670
9	.....	do.	Same as No. 7 white fir.	2	40	16.4	175	2,372	231	263	2,555	90.4	243	21.17	6	58.26	2,105	99.5	6.8	140	.00595
10	.....	do.	Same surface.	2	60	24.65	175	2,372	304	362	4,075	74.6	383	21.17	63	58.26	2,127	.....	8.9	136	.00520
11	.....	do.	do.	2	80	32.8	175	2,372	339	420	4,745	71.5	438	21.17	63	58.26	2,080	.....	11.4	131	.00436
12	.....	do.	do.	2	100	41.0	175	2,372	416	493	6,215	67.0	508	21.17	63	58.26	2,165	98.4	9.7	139	.00428
13	Steamed.	do.	do.	2	40	16.4	212	2,870	235	280	2,117	111.0	264	21.17	63	58.26	1,603	75.9	17.2	132	.00109
14	do.	do.	do.	2	60	24.65	223	3,020	398	377	3,160	97.4	334	21.17	63	58.26	1,890	80.4	19.2	132	.00413
15	do.	do.	do.	2	80	32.8	207	2,805	411	411	3,590	95.0	395	21.17	63	58.26	1,820	86.0	21.2	122	.00370
16	do.	do.	do.	2	100	41.0	222	3,007	414	400	4,125	91.4	525	21.17	63	58.26	1,792	84.8	23.8	129	.00336
17	do.	do.	do.	2	60	24.65	200	2,710	306	350	3,125	97.8	348	21.17	63	58.26	1,702	89.8	15.7	129	.00458
18	do.	do.	do.	2	60	24.65	195	2,642	307	372	3,560	86.3	375	21.17	63	58.26	1,900	89.8	15.3	126	.00470
19	do.	do.	Same as No. 35 white fir.	2	70	28.70	225	3,020	368	479	4,840	76.0	488	21.17	63	58.26	1,950	93.6	12.8	123	.00425

¹ For cooking conditions see Table 32.

TABLE 27.—Grinder runs on *Silka spruce*.¹

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.	Bone-dry pulp per 100 cubic feet solid tressed wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid tressed wood bone-dry.	Average temperature of grinding.	Horsepower divided by pressure $\times$ speed.
		Kind of burr.	Surface.		Lbs. per sq. in.	Lbs.		Ft. per minute.			Tons.				Inches.	P. ct.	Lbs.	P. ct.	Lbs.	° F.	
1	.....	Straight, cut 3 to 12 to inch.	Same as for western larch No. 2.	3	30	12.3	225	2,085	307	358	2,225	137.8	214.5	25.38	(2)	16.66	2,075	81.8	12.88	174.2	0.00809
2	.....	do.	Stone dressed.	3	20	8.2	250	3,427	217	245	1,840	118.0	188.4	24.60	(2)	19.07	1,952	79.4	8.59	154.0	.00772
3	.....	do.	Same surface.	3	40	16.4	250	3,427	308	407	4,550	84.0	435.0	24.60	(2)	19.07	2,065	85.1	13.87	145.3	.00554
4	.....	do.	do.	3	60	24.65	250	3,427	510	586	7,050	72.4	680.0	24.60	(2)	19.07	2,075	84.3	13.48	136.8	.00602
5	Boiled	Straight, cut 8 to 12 to inch.	Same as No. 5	2	40	16.4	225	3,080	197	245	1,500	131.2	164.0	23.60	(2)	24.00	1,830	77.5	20.30	107.0	.00390
6	do.	do.	Same surface.	2	60	24.65	225	3,080	256	329	1,985	129.0	234.0	23.60	(2)	24.00	1,698	71.9	36.00	109.0	.00337
7	do.	Straight, cut 3 to 12 to inch.	do.	2	80	32.8	225	3,080	331	404	2,920	113.3	333.0	23.60	(2)	24.00	1,750	74.1	44.20	103.1	.00328
8	.....	do.	Stone dressed.	3	60	24.65	100	1,306	293	313	2,095	125.7	208.0	23.40	(2)	22.60	2,003	85.7	14.37	134.9	.00780
9	.....	do.	Same surface.	3	60	24.65	150	2,049	346	401	3,107	111.2	236.0	23.40	(2)	22.60	2,100	89.7	13.51	147.2	.00685
10	.....	do.	do.	3	60	24.65	200	2,732	468	505	4,340	108.0	407.0	23.40	(2)	22.60	2,130	91.0	16.70	144.0	.00695
11	.....	do.	do.	3	60	24.65	250	3,415	560	651	5,340	105.0	494.0	23.40	(2)	22.60	2,160	92.3	13.17	142.9	.00665
12	.....	do.	Same as No. 18	2	40	16.4	225	3,073	222	280	1,047	212.0	104.0	23.00	(2)	22.60	2,008	87.4	12.70	155.8	.00440
13	.....	do.	Lodgepole.	2	60	24.65	225	3,073	313	414	2,005	156.0	200.0	23.00	(2)	22.60	2,000	87.0	10.60	155.0	.00413
14	.....	do.	Same surface.	2	80	32.8	225	3,073	409	512	2,917	140.2	292.0	23.00	(2)	22.60	1,992	86.6	20.70	149.3	.00405
15	.....	do.	do.	2	100	41.0	225	3,073	433	515	3,005	144.0	310.0	23.00	(2)	22.60	1,945	84.5	16.29	154.3	.00344
16	Steamed	do.	Same as No. 47	3	60	24.65	200	2,732	414	493	1,107	374.0	126.7	23.00	(2)	22.60	1,750	76.1	28.83	178.4	.00614
17	do.	do.	tamarack.	3	60	24.65	200	2,732	382	454	1,920	240.0	197.0	23.00	(2)	22.60	1,618	70.3	31.27	138.3	.00566
18	.....	do.	Same surface.	3	60	24.65	189	2,580	368	432	2,920	400.0	94.2	23.00	(2)	22.60	1,952	84.9	18.50	176.7	.00578
19	.....	do.	Stone dressed.	2	80	32.8	225	3,069	458	541	4,495	102.0	435.0	23.00	(2)	22.60	2,065	89.9	32.50	166.0	.00455

² Split wood.¹ For cooking conditions see Table 32.

TABLE 28.—Grinder runs on white birch.¹

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cyl-inder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid rossed wood ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.	Bone-dry pulp per 100 cubic feet solid rossed wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid rossed wood.	Average temperature of grinding.	Horsepower divided by pressure X speed.
		Kind of burr.	Surface.																		
1	Steamed	Straight, cut 3 to inch; spiral, cut 12 to inch.	Same as for tam-arack No. 25.	3	Lbs. per sq. in. 40	Lbs. 16.4	200	Ft. per minute. 2,762	229.0	285	Tons. 3.455	66.3	Cu. ft. 208.0	Lbs. 36.37	Inches. 5½	P. ct. 39.23	Lbs. 2,580	P. ct. 71.0	Lbs. 6.70	° F. 126.9	0.00405
2		do.	Same as for red fir No. 4.	3	30	12.3	225	3,085	338.0	370	2.980	113.2	200.0	34.62	8½	37.34	2,980	86.0	6.51	176.0	.00890
3	Boiled	Straight, cut 8 to inch.	Same as poplar No. 5.	2	40	16.4	225	3,080	198.0	238	2.580	76.7	226.0	32.18	6¾	38.60	2,286	71.1	11.57	110.0	.00392
4	do.	do.	Same surface.	2	60	24.65	225	3,080	286.0	352	4.013	71.2	322.0	32.18	6¾	38.60	2,492	77.5	9.79	125.0	.00376
5	do.	do.	do.	2	80	32.8	225	3,080	334.0	415	4.475	74.6	355.0	32.18	7¾	38.60	2,520	78.4	12.60	130.6	.00331
6		Spiral, cut 8 to inch; straight, cut 10 to inch.	Same as for No. 21 California lodgepole.	2	40	16.4	100	1,364	138.8	150	.718	193.1	52.4	34.15	8	40.50	2,740	80.3	10.80	167.1	.00620
7		do.	Same surface.	2	60	24.65	100	1,364	191.0	222	1.218	157.0	85.4	34.15	8	40.50	2,855	83.6	4.61	163.6	.00568
8		do.	do.	2	80	32.8	100	1,364	259.0	294	1.997	129.7	130.0	34.15	7¾	40.50	3,075	90.0	5.22	163.9	.00580
9		do.	do.	2	100	41.0	100	1,364	287.0	322	2.550	112.6	163.3	34.15	8½	40.50	3,120	91.5	8.01	161.2	.00513

¹ For cooking conditions see Table 32.

TABLE 29.—Grinder runs on aspen.¹

Run No.	Preliminary treatment of wood.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.	Bone-dry pulp per 100 cubic feet solid ground wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid ground wood bone-dry.	Average temperature of grinding.	Horsepower divided by pressure × speed.
		Kind of burr.	Surface.		Lbs. per sq. in.	Lbs.		ft. per minute.		Tons.	Cu. ft.	Lbs.		Lbs.	Inches.	P. ct.	Lbs.	P. ct.	Lbs.	° F.	
1	Steamed...	Straight, cut 3 to inch, spiral, cut 12 to inch.	Stone dressed...	3	40	16.4	200	2,762	209.3	266	3.300	63.4	333.0	24.86	6½	51.95	1,870	75.2	6.13	133.3	0.00461
2	.....	.....	Same as red fir No. 3.	3	30	12.3	225	3,035	325.0	374	2.340	139.0	210.0	26.61	5½	43.28	2,227	83.8	6.86	175.7	.00856
3	Boiled...	Straight, cut 8 to inch.	Stone dressed...	2	40	16.4	225	3,080	179.0	209	2.824	63.4	321.0	25.33	6½	42.88	1,756	69.4	7.41	108.5	.00354
4	do.....	do.....	Same surface...	2	60	24.65	225	3,080	240.0	290	3.383	70.8	365.0	25.33	7½	42.88	1,856	73.3	9.01	124.1	.00316
5	do.....	do.....	do.....	2	80	32.8	225	3,080	277.0	318	4.590	60.5	479.0	25.33	7½	42.88	1,920	75.9	10.87	116.0	.00274
6	do.....	Straight, cut 8 to inch, spiral, cut 10 to inch.	Same as No. 9 birch.	2	40	16.4	100	1,364	137.0	164	.438	313.0	40.7	24.00	5½	46.70	2,150	89.6	3.26	171.1	.00612
7	.....	do.....	Same surface...	2	60	24.65	100	1,364	198.0	220	.895	221.0	80.2	24.00	5½	46.70	2,230	93.0	7.21	166.2	.00589
8	.....	do.....	do.....	2	80	32.8	100	1,364	253.0	294	1.390	182.0	128.7	24.00	5½	46.70	2,160	90.0	7.45	175.1	.00565
9	.....	do.....	do.....	2	100	41.0	100	1,364	285.0	324	1.760	162.0	166.0	24.00	6	46.70	2,115	88.1	5.00	164.0	.00510
10	.....	do.....	do.....	2	40	16.4	200	2,728	240.0	286	.565	426.0	55.7	24.00	6	46.70	2,027	84.5	5.69	187.3	.00336
11	.....	do.....	do.....	2	40	24.65	200	2,728	306.0	267	1.030	297.0	98.5	24.00	6½	46.70	2,090	87.1	6.92	180.3	.00455
12	.....	do.....	do.....	2	80	32.8	200	2,728	508.0	573	2.200	231.0	200.0	24.00	6½	46.70	2,200	91.6	6.22	176.5	.00568
13	.....	do.....	do.....	2	100	41.0	200	2,728	475.0	535	2.745	173.0	246.0	24.00	7	46.70	2,222	92.6	6.18	170.1	.00424

¹ For cooking conditions see Table 32.

TABLE 30.—Grinder runs on black gum.¹

Run No.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.	Bone-dry pulp per 100 cubic feet solid ground wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid ground wood.	Average temperature of grinding.	Horsepower divided by pressure × speed.
	Kind of burr.	Surface.																		
1	Spiral, cut 8 to 10 to inch.	Same as No. 21 loblobly pine.	2	Lbs. per sq. in. 40	Lbs. 16.40	175	Ft. per minute. 2,348	234	277	Tons. 0.895	261.0	Cu. ft. 75	Lbs. 30.71	Inches. 8	P. ct. 47.02	Lbs. 2,380	P. ct. 77.5	Lbs. 6.4	°F. 128	0.00047
2	do.	Same surface.	2	60	24.65	175	2,348	322	370	1.405	229.0	106	30.71	81	47.02	2,640	86.0	7.8	116	.00555
3	do.	do.	2	80	32.80	175	2,348	421	465	2.075	141.7	225	30.71	8	47.02	2,640	86.0	6.3	158	.00548
4	do.	do.	2	60	24.65	100	1,342	220	253	1.287	171.0	100	30.71	81	47.02	2,565	83.6	2.7	168	.00664
5	do.	do.	2	60	24.65	150	2,013	287	315	1.655	173.3	128	30.71	81	47.02	2,585	84.2	4.2	167	.00579
6	do.	do.	2	60	24.65	200	2,684	376	422	2.080	181.0	159	30.71	82	47.02	2,620	85.4	1.9	170	.00568
7	do.	do.	2	60	24.65	250	3,355	422	466	2.465	171.0	193	30.71	73	47.02	2,555	83.1	2.6	175	.00510
8	do.	do.	2	60	24.65	200	2,684	395	444	5.305	71.4	392	30.71	71	47.02	2,710	88.2	2.1	139	.00365
9	Steamed.	Stone dressed.	2	60	24.65	200	2,684	323	380	4.400	72.3	359	28.70	9	47.00	2,485	86.6	5.9	139	.00488
10	do.	Same surface.	2	60	24.65	200	2,684	305	378	3.000	83.4	317	28.70	7	47.00	2,310	80.5	4.4	140	.00461
11	do.	do.	2	60	16.40	200	2,684	241	279	2.565	96.1	218	28.70	81	47.00	2,295	84.0	2.0	141	.00517
12	do.	do.	2	80	32.80	200	2,684	358	469	4.440	80.7	371	28.70	81	47.00	2,390	83.7	6.1	144	.00406
13	do.	do.	2	60	24.65	175	2,348	294	370	3.595	81.7	278	31.40	63	42.07	2,580	82.2	5.3	149	.00509
2 14	Straight, cut 3 to 12 to inch.	Same as No. 29 loblobly pine.	2	20	8.20	200	2,774	137	186	1.950	70.8	158	31.40	7	42.07	2,460	78.3	20.1	130	.00603

² No. 14 was run on a coarse grit stone.¹ For conditions of cooking see Table 32.

TABLE 31.—*Runs on mixtures of woods.*¹

Kind of wood.	Run No.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horse power per ton bone-dry pulp in 24 hours.	Solid rossi wood ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.	Bone-dry pulp per 100 cubic feet rossi wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid rossi wood.	Average temperature of grinding.	Horsepower divided by pressure X speed.
		Kind of burr.	Surface.		Lbs. per sq. in.	Lbs.	Feed per minute.														
Hemlock-spruce.....	46-A	Straight, cut 3 to inch.	Same surface as run 45, 109-2.	3	50	20.5	175	2,450	392.0	465	4.275	91.7								152.5	0.00780
Hemlock.....	46-B	do.	do.	3	50	20.5	175	2,450	413.0	466	4.885	84.6								175.5	.00823
Spruce.....	46-C	do.	do.	3	50	20.5	175	2,450	407.0	466	4.878	83.5								160.0	.00810
Hemlock-Spruce.....	49-A	Straight, cut 3 to inch; spiral cut 12 to inch.	Stone dressed.	3	40	16.4	175	2,445	360.4	427	4.880	73.8								155.0	.00899
Hemlock.....	49-B	Spiral, cut 12 to inch.	Same surface..	3	40	16.4	175	2,445	370.0	426	4.885	75.7								168.3	.00922
Jack pine-tamarack..	50	Spiral, cut 8 to inch; straight, cut 10 to inch.	Same as No. 221 spruce.	2	60	24.65	225	3,069	280.0	330	3.000	93.2	151	24.44	6 1/2	36.57	2,088	75.0	11.69	127.0	.00370
Do.....	51	Straight, cut 10 to inch.	Same as No. 50.	3	60	24.65	225	3,069	423.0	489	3.970	106.5	282	24.44	6 1/2	36.57	1,940	74.4	9.87	139.0	.00559
Do.....	52	do.	Same as No. 51.	3	60	24.65	225	3,069	400.0	469	3.940	101.4	132	24.44	6 1/2	36.57	2,150	77.3	11.78	142.8	.00329
Western yellow pine-Montana lodgepole pine.	20	Straight, cut 3 to inch; spiral cut 12 to inch.	Same as No. 19; western yellow pine.	3	40	16.4	200	2,728	384.0	423	3.940	97.5	171	25.03	7 1/2	26.25	2,247	91.1	6.06	136.3	.00858
Do.....	21	Spiral, cut 12 to inch.	Same surface..	3	40	16.4	200	2,728	382.0	444	3.800	100.5	110	25.03	7 1/2	26.25	2,220	90.6	8.09	146.2	.00352
Do.....	22	do.	do.	3	40	16.4	200	2,728	368.0	416	3.535	104.0	208	25.03	8	26.25	2,230	89.6	8.68	146.9	.00822
Montana lodgepole pine-western larch.	23	do.	do.	3	40	16.4	200	2,728	355.0	413	3.307	107.2	109	25.03	8 1/2	26.25	2,200	86.4	3.86	149.4	.00793

¹ Wood received no further treatment after barking prior to grinding on a medium-grit Lombard stone.

TABLE 31.—*Runs on mixtures of woods—Continued.*

Kind of wood.	Run No.	Stone.		Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch of pocket area.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.		Bone-dry pulp per 100 cubic feet solid ground wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid ground wood, bone-dry.	Average temperature of grinding.	Horsepower divided by pressure X speed.
		Kind of burr.	Surface.													Lbs. per sq. in.	Lbs.					
Western yellow pine—Western larch.	24	Spiral, cut 12 to inch.	Same surface.	3	40	16.4	200	2,728	389.0	415	3,280	118.7	173	25.03	9	26.25	2,198	84.4	6.14	159.1	0.00869	
	25			do.	do.	3	40	16.4	200	2,728	360.0	401	3,115	115.7	210	25.03	9	26.25	2,170	84.2	6.14	154.8	0.00803
Western larch—western hemlock.	26	do.	do.	3	40	16.4	200	2,728	373.0	415	3,275	114.0	104	25.03	Split.	26.25	2,268	88.9	9.73	156.7	0.00833	
	15			do.	do.	3	40	16.4	200	2,728	323.0	352	2,353	137.2		109	24.62	23.84	2,212	92.1	8.26	154.0	0.00721
Western, hemlock—Sitka spruce.	16	do.	do.	3	40	16.4	200	2,728	312.0	392	2,163	144.0	65	24.62	do.	22.26	2,100	88.5	9.82	159.2	0.00886	
	17			do.	do.	3	40	16.4	200	2,728	347.0	392	2,348	148.0		139	24.62	23.84	2,190	90.5	9.23	163.0	0.00774
Montana lodgepole pine—western larch.	24	do.	do.	3	40	16.4	200	2,728	377.0	405	3,235	116.5	176	24.37	7½	24.76	2,180	84.7	5.99	151.2	0.00841	
	25			do.	do.	3	40	16.4	200	2,728	403.0	458	3,300	122.1		229	24.37	24.76	2,138	85.1	2.96	154.8	0.00900
California lodgepole pine—red fir.	22	do.	do.	3	40	16.4	200	2,728	366.0	410	2,095	175.0	113	21.65	Split.	23.88	1,917	87.5	8.82	170.2	0.00817	
	23			do.	do.	3	40	16.4	200	2,728	391.0	437	2,650	147.6		92	21.65	27.65	2,016	91.6	7.29	157.3	0.00874
Do.	24	do.	do.	3	40	16.4	200	2,728	376.0	431	2,137	176.0	137	22.14	do.	27.65	1,860	85.2	7.94	170.1	0.00840	
	25			do.	do.	3	40	16.4	200	2,728	377.0	444	2,270	166.0		117	21.65	27.65	1,988	88.4	24.90	162.7	0.00842
California lodgepole pine—Sitka spruce.	23	Spiral, cut 8 to inch; straight, cut 10 to inch.	Stone dressed.	3	40	16.4	225	3,069	476.0	542	4,980	95.6	254	20.30	54	61.66	2,160	96.2	11.50	157.0	0.00945	
Spruce—hemlock.	63	do.	do.	3	50	20.5	225	3,069	516.0	592	4,075	127.0	179	24.93	54	33.55	2,280	92.1	12.00	177.0	0.00820	
Tamarack—spruce.	54	do.	do.	2	65	26.6	225	3,069	415.0	503	4,705	88.2	185	30.70	54	25.00	2,410	89.4	13.75	157.0	0.00509	

NOTE.—Wood for runs 50-52, inclusive, was steamed for 5 hours at 75 pounds.

TABLE 52.—*Conditions of cooking wood prior to grinding.*

Kind of wood.	Run No.	Duration of treatment.	Pressure of treatment.	Kind of wood.	Run No.	Duration of treatment.	Pressure of treatment.	Kind of wood.	Run No.	Duration of treatment.	Pressure of treatment.	Kind of wood.	Run No.	Duration of treatment.	Pressure of treatment.
Balsam fir.....	7	8	60	Tamarack.....	19	4	60	Tamarack.....	72	6	75	Englemann spruce (Colorado).....	13	6	60
	15	5	75		20	8	20		73	4	75		14	6	60
	16	5	75		21	8	40		74	3	75		15	6	60
	17	5	75		22	8	60		75	2	75		16	6	60
	25	5	75		23	8	60		76	1	75		17	6	40
	26	5	75		24	8	60						18	6	20
	27	5	75		25	8	60	Western larch.....	1	8	60				
	28	5	75		26	8	60								
	29	5	75		27	8	60	Montana lodge-pole pine.....	8	8	60	Englemann spruce (Montana).....	8	6	60
Red fir.....	2	8	60		30	8	60		13	5	75		10	6	60
					31	8	60		14	5	75				
White fir.....	21	6	60		32	5	75		15	5	75	Sitka spruce.....	5	5	75
	22	6	60		33	5	75						6	7	75
	23	6	60		34	5	75	California lodge-pole pine.....	1	8	60		7	12	75
	24	6	60		35	5	75						16	5	5
	25	6	60		36	5	75	Western yellow pine	1	6	40	Poplar.....	1	8	60
	26	6	20		37	5	75		2	4	60		3	5	75
					38	5	75		3	8	60		4	5	75
Amabilis fir.....	9	6	60		39	5	75		9	12	5	White birch.....	1	8	60
					40	5	75		10	6	60		3	5	75
	10	6	60		41	5	75	White pine.....	10	6	60		4	5	75
	11	6	60		42	5	75		11	6	60	Black gum.....	9	6	30
	12	6	60		43	5	75	Jack pine.....	12	6	60		10	6	60
	13	6	60		44	5	75		25	2	40	Western hemlock....	11	6	60
	14	6	20		45	5	75		26	3	40		12	6	60
Alpine fir.....	9	6	60		46	5	75		28	5	75		9	5	75
	10	6	60		47	5	75		30	5	75	Loblolly pine.....	16	6	60
	11	6	60		48	5	75		31	5	75		17	6	60
	12	6	60		49	5	75		32	5	75		18	6	60
					55	5	75		33	5	75		19	6	60
Lowland fir.....	1	6	60		56	5	75		53	5	40		20	6	30
	2	6	60		57	5	75		54	2	60				
	3	6	60		58	5	75		55	8	60				
					59	5	75		60	5	75				
					60	5	75		61	5	75				
Noble fir.....	9	6	60		61	5	75		62	5	75				
	10	6	60		62	5	75		63	5	75				
	11	6	60		63	5	75		64	5	75				
	12	6	30		64	5	75		65	5	75				
					65	5	75		66	5	75				
Tamarack.....	12	4	40		66	5	75		67	5	75				
	13	2	20		67	5	75		68	5	75				
	14	2	40		68	5	75		69	5	75				
	15	2	60		69	12	75		70	10	75				
	16	2	60		70	10	75		71	8	75				
	17	4	20												
	18	4	40												

1 For the wood used in grinder run No. 38, tamarack, the temperature of treatment was only 255° F.

TABLE 33.—*Quality tests—balsam.*

Grinder run No.	Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Thickness.	Mullen test.				Schopper tests.						Tintometer indications.				
					Total.	Per 0.001 in. thickness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.			Stretch.		Breaking weight per sq. mm. sectional area.	Breaking length per horsepower per ton.	Red.	Green.	Blue.	Black.
									Meters.	Crosswise.	Lengthwise.	Average.	Per ct.						
1	104	80	36	0.0039	17.95	4.60	0.498	282	3,655	2.16	1.24	1.70	2,295	32.8	82	72	64	82	
2	103	80	33	0.0039	13.25	3.40	0.401	250	3,030	3.970	1.84	1.12	1,835	33.6	81	71	64	84	
3	111	80	31	0.0041	10.40	2.54	0.336	246	2,285	3.237	2.18	1.16	1,467	33.8	87	76	67	70	
5	115	80	31	0.00319	14.95	4.69	0.482	369	3,140	4.070	2.86	1.50	2,265	22.0	80	72	65	83	
6	116	80	33	0.00348	14.70	4.22	0.445	273	2,908	4.470	3.16	1.52	2,334	30.4	82	72	64	82	
7	242	80	30	0.0033	14.6	4.4	0.48	258	3,000	4.140	1.98	1.20	1,591	33.4	51	36	30	183	
8	224	80	34	0.0036	17.2	4.8	0.51	366	3,280	6.130	1.96	1.28	2,370	25.1	73	64	57	106	
9	241	80	32	0.0035	13.6	3.8	0.43	309	3,040	4.970	1.84	1.22	1,531	30.1	72	63	58	107	
10	240	80	29	0.0035	12.4	3.5	0.42	529	2,870	5.710	1.86	1.20	1,532	36.9	75	66	60	99	
11	225	80	31	0.0034	14.4	4.2	0.46	360	3,000	5.200	1.92	1.20	1,561	18.4	73	64	57	106	
12	238	80	32	0.0035	14.8	4.2	0.46	276	2,940	4.930	1.88	1.26	1,571	21.8	76	67	61	96	
13	239	80	31	0.0036	12.4	3.4	0.40	329	3,050	5.460	2.12	1.28	1,601	35.8	70	61	55	114	
14	218	80	30	0.0037	14.6	4.0	0.47	346	3,800	6.200	1.92	1.36	1,701	27.5	35	22	16	227	
15	270	100	45	0.0036	27.0	7.7	0.65	267	3,340	6.630	1.80	1.36	1,581	28.7	42	26	21	221	
16	277	100	48	0.0036	31.0	7.7	0.65	267	3,160	5.790	1.72	1.38	1,551	26.6	38	22	16	224	
17	302	100	46	0.0039	28.4	7.3	0.62	270	2,900	4.470	2.28	1.48	1,811	32.6	71	58	49	122	
18	338	80	34	0.0038	14.8	4.1	0.46	262	2,960	5.040	2.34	1.34	1,911	33.3	81	71	59	89	
19	339	80	32	0.0038	15.5	4.1	0.45	285	3,090	5.120	2.84	1.62	2,231	32.5	75	61	50	114	
20	329	80	32	0.0038	14.5	3.9	0.45	285	3,090	5.230	2.74	1.74	1,950	32.8	80	66	56	98	
21	340	79	30	0.0028	14.6	3.8	0.46	217	3,090	5.290	2.12	1.36	1,741	26.7	70	65	65	100	
22	449	80	34	0.0043	13.2	2.4	0.39	332	2,640	2.410	2.15	1.18	1,671	40.3	80	69	60	91	
24	741	80	34	0.0042	10.8	2.6	0.32	322	2,080	4.630	3.360	1.12	1.88	1,420	32.6	79	69	64	88
25	484	100	33	0.0028	23.1	8.3	0.57	206	3,190	6.920	5.060	2.96	1.32	2,114	32.6	49	38	31	182
26	485	100	31	0.0027	17.8	6.6	0.70	187	3,210	6.840	5.020	2.70	1.25	3,330	47.1	48	36	31	185
27	486	100	32	0.0027	20.6	7.5	0.64	156	3,360	6.820	5.090	2.15	1.69	3,360	50.9	50	37	32	181
28	481	100	33	0.0029	20.2	7.0	0.61	162	3,400	6.040	4.720	2.22	2.14	3,170	47.8	52	38	32	178
29	487	100	34	0.0029	21.2	7.2	0.62	165	3,170	6.190	4.680	2.86	2.13	3,120	45.9	52	39	32	177

1 Commercial.

TABLE 34.—Quality tests—red fir.

Grinder run No.	Paper machine run No.	Ground wood furnish in total	Weight per ream.	Thickness.	Mullen test.				Schopper tests.						Tintometer indications.			
					Total.	Per 0.001 in. thick-ness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.		Stretch.		Breaking weight per sq. mm. sec.	Breaking length per ton.	Red.	Green.	Blue.	Black.
					Points.	Points.	Point.		Meters.	Meters.	Per ct.	Per ct.	Grams.	Meters.	Parts.	Parts.	Parts.	Parts.
1	65	80	30	0.0040	8.3	2.08	0.276	236	2,156	3,580	1.14	0.88	1,108	44.0	83	60	89	
2	235	80	36	.0035	18.7	5.4	.52	242	2,800	4,140	1.74	1.48	2,220	33.0	44	30	203	
4	212	80	29	.0034	10.4	3.1	.56	323	3,110	5,950	1.36	1.10	2,030	25.0	72	59	52	117
6	395	82	32	.0037	17.6	4.8	.55	382	3,290	5,930	1.94	1.08	2,180	22.0	64	52	47	137
7	398	80	32	.0037	14.5	3.9	.45	749	3,170	5,560	1.48	.88	2,060	13.0	64	49	42	145
8	396	80	36	.0040	18.0	4.5	.50	616	3,080	5,740	1.80	1.06	2,220	14.3	62	50	45	143
9	391	80	34	.0041	12.8	3.1	.38	680	2,450	4,790	1.78	1.28	1,640	14.0	60	48	42	150
10	390	80	40	.0042	18.8	4.4	.47	664	3,190	5,740	2.20	1.28	2,240	14.3	66	54	47	133
11	392	79	41	.0046	16.4	3.6	.40	527	2,880	5,530	2.40	1.08	2,080	19.9	70	55	48	127
12	393	80	36	.0040	15.4	3.8	.43	504	2,790	5,180	1.48	1.02	1,880	18.4	70	56	50	124
13	400	80	35	.0040	14.6	3.6	.42	436	3,080	5,480	1.52	1.04	2,000	23.3	65	51	45	139
14	394	80	31	.0039	11.0	2.8	.35	415	2,600	4,440	1.16	.90	1,530	24.3	71	58	51	120
15	326	80	33	.0038	14.6	3.9	.45	326	4,370	3,590	2.54	1.40	1,760	24.5	61	53	49	137
16	401	80	28	.0034	12.0	3.5	.43	292	2,710	5,300	1.40	1.04	1,740	32.0	65	54	50	131
17	397	80	32	.0040	13.2	3.3	.41	247	3,050	5,020	1.70	1.04	1,37	39.9	72	59	51	118
18	399	80	31	.0039	9.9	2.5	.32	265	2,700	4,440	1.14	.86	1,480	42.1	71	57	57	115
19	cml 8	75	34	.0034	9.9	2.9	.29	212	1,850	3,550	1.52	.94	1,640	31.9	58	54	53	135
	451	80	33	.0043	10.8	2.5	.33	256	2,630	4,150	2.03	1.08	1,450	40.1	70	55	51	124

TABLE 35.—Quality tests—white fir.

Grinder run No.		Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Thickness.	Mullen test.				Schooper tests.						Tintometer indications.				
						Total.	Per 0.001 in. thickness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.			Stretch.		Breaking weight per sq. mm. sectional area.					Breaking length per horsepower per ton.
										Crosswise.	Lengthwise.	Meters.	Average.	Per cent.							Crosswise.	Lengthwise.	Average.
			Per cent.	Pounds.	Points.	Points.	Point.		Meters.	Meters.	Meters.	Per cent.	Per cent.	Per cent.	Grams.	Meters.	Parts.	Parts.	Parts.	Parts.
1	459	80	36	0.0050	10.0	2.0	0.28	472	2,080	3,440	2,760	1.74	0.90	1.32	1,150	20.9	70	63	58	109
2	460	80	37	0.0047	8.8	1.9	0.24	448	2,070	3,390	2,730	1.62	0.84	1.33	1,200	25.4	72	63	59	104
3	461	80	33	0.0043	8.0	1.9	0.24	369	2,020	3,310	2,660	1.46	0.90	1.18	1,230	30.0	73	66	59	102
4	462	80	32	0.0040	6.9	1.7	0.22	394	1,980	3,190	2,580	1.28	0.88	1.08	1,200	29.7	75	66	59	100
5	463	80	37	0.0045	9.4	2.1	0.25	363	2,200	3,580	2,890	1.64	0.98	1.31	1,340	31.9	70	63	55	112
6	464	80	36	0.0045	7.4	1.6	0.21	407	1,900	3,100	2,500	1.10	0.86	0.98	1,140	29.2	70	63	55	112
7	465	80	34	0.0042	7.4	1.8	0.22	380	1,840	2,980	2,410	1.16	0.86	1.01	1,140	28.8	73	65	57	105
8	466	80	31	0.0038	9.7	2.6	0.31	374	1,640	4,350	3,260	1.46	1.00	1.23	1,590	25.2	71	63	57	109
9	520	80	36	0.0043	8.4	2.0	0.24	421	1,640	3,090	2,300	1.68	1.08	1.38	1,110	23.4	74	63	56	107
10	505	80	38	0.0044	11.7	2.6	0.31	300	2,000	3,790	2,900	1.44	0.82	1.13	1,400	31.2	76	65	58	101
11	506	80	38	0.0046	8.8	1.9	0.23	370	1,500	2,890	2,200	1.90	1.24	1.57	1,070	25.8	72	64	57	107
12	507	80	42	0.0042	16.5	3.9	0.39	280	2,380	4,480	3,430	2.34	1.44	1.89	1,990	31.4	81	71	63	85
13	508	80	42	0.0043	15.2	3.5	0.36	300	2,000	4,290	3,140	2.44	1.56	2.00	1,780	29.0	79	70	62	84
14	509	80	42	0.0048	12.4	2.6	0.30	290	1,960	3,460	2,710	2.00	1.10	1.55	1,380	31.1	80	72	64	89
15	510	80	43	0.0048	12.6	2.6	0.29	291	1,850	3,550	2,700	2.04	1.20	1.62	1,380	32.0	79	70	62	89
16	511	80	46	0.0050	12.2	2.4	0.27	397	1,880	3,440	2,660	1.54	1.18	1.36	1,400	24.8	72	64	57	107
17	512	80	41	0.0046	11.8	2.5	0.29	345	1,900	3,610	2,800	1.76	1.10	1.43	1,470	28.0	74	64	59	103
18	513	80	46	0.0054	11.9	2.2	0.26	328	1,730	3,240	2,480	1.46	1.06	1.26	1,220	29.1	76	67	60	97
19	514	80	30	0.0038	6.2	1.7	0.21	358	1,650	2,860	2,160	1.16	0.82	0.99	1,040	30.0	76	65	59	100
20	517	80	50	0.0042	25.2	6.0	0.50	240	2,640	5,080	4,160	2.04	1.22	1.62	2,910	34.7	83	73	65	103
21	527	100	38	0.0033	18.0	5.4	0.47	242	2,380	3,200	2,790	1.56	1.04	1.30	2,490	33.2	49	36	30	185
22	496	100	35	0.0032	10.7	3.3	0.31	375	1,830	3,250	2,540	1.22	0.80	1.01	1,610	25.8	49	36	30	185
23	495	100	49	0.0042	17.4	4.1	0.36	210	2,240	4,870	3,500	1.92	1.04	1.48	2,330	36.7	50	35	29	186
24	526	100	52	0.0052	18.1	3.5	0.35	273	1,460	3,860	3,010	2.38	1.06	1.72	2,830	31.5	58	43	35	164
25	536	100	46	0.0053	18.0	1.9	0.22	405	1,480	2,640	2,060	1.14	0.72	0.93	1,040	23.1	65	63	47	135
26	537	80	36	0.0040	14.2	3.6	0.40	282	2,640	5,300	3,970	1.82	1.12	1.47	2,040	35.1	71	63	59	107
27	591	80	37	0.0042	14.7	3.5	0.40	268	2,670	5,250	3,960	1.78	1.20	1.49	2,040	36.9	73	63	57	107
28	592	80	41	0.0042	17.2	4.1	0.42	231	3,040	5,620	4,330	1.80	1.12	1.46	2,400	44.6	60	55	55	118
29	594	80	38	0.0041	12.8	3.1	0.34	278	2,480	4,420	3,450	2.36	1.12	1.74	1,810	36.5	67	70	58	96
30	587	80	34	0.0042	10.2	2.4	0.30	373	2,180	4,030	3,100	1.66	1.04	1.35	1,560	27.7	70	58	54	118
31	593	80	34	0.0044	10.0	2.2	0.29	420	2,080	3,680	2,800	1.52	1.18	1.35	1,406	23.6	71	61	53	115
32	589	80	34	0.0044	10.6	2.8	0.31	368	2,230	4,080	3,160	2.40	1.04	1.72	1,580	27.7	70	62	53	115
33	590	80	34	0.0048	13.8	2.9	0.34	338	2,520	4,210	3,300	1.62	1.12	1.37	1,760	29.2	69	58	53	120
34	591	80	33	0.0043	7.2	2.2	0.21	353	1,420	2,840	2,130	1.18	0.80	0.99	1,370	26.5	62	57	55	126
35	649	80	33	0.0041	8.2	2.0	0.25	322	2,070	3,510	2,790	1.32	0.78	1.05	1,220	34.7	75	66	58	101

1 Wood from tree 18 inches in diameter.

2 Wood from tree 42 inches in diameter.

TABLE 36.—Quality tests—Alpine fir.

Grinder run No.	Paper machine run No.	Ground furnish.	Weight per ream.	Thickness.	Mullen test.				Schopper tests.						Tintometer indications.				
					Total.	Per 0.001 in. thickness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.			Stretch.		Breaking weight per sq. mm. sectional area.	Breaking length per ton.	Red.	Green.	Blue.	Black.
									Crosswise.	Lengthwise.	Average.	Crosswise.	Lengthwise.							Average.
1	580	80	22	0.0026	7.1	2.7	0.32	368	2,070	3,790	2,930	2.70	1.12	1.95	24.9	81	73	65	81
2	581	80	36	.0040	11.6	2.9	.32	290	2,090	3,700	2,900	2.94	1.48	2.21	31.2	83	75	66	76
3	579	80	30	.0035	9.0	2.5	.30	262	1,980	1,780	1,880	2.30	1.32	1.81	23.9	83	74	67	76
4	578	80	35	.0042	9.0	2.1	.26	292	1,850	2,960	2,400	2.42	1.22	1.82	31.6	82	74	68	76
5	582	80	32	.0035	12.0	3.4	.38	262	2,240	4,180	3,210	3.12	1.38	2.25	32.0	83	75	67	75
6	577	78	35	.0038	13.0	3.4	.37	264	2,090	4,150	3,120	3.34	1.46	2.40	32.0	83	75	68	74
7	576	80	37	.0044	12.8	2.9	.35	265	2,650	4,600	3,840	1.94	1.02	1.48	39.1	81	74	67	78
8	575	80	34	.0041	11.6	2.8	.34	252	2,840	4,850	3,620	1.80	1.06	1.43	44.8	82	75	68	75
9	557	100	43	.0039	28.2	7.3	.66	188	3,200	6,970	5,080	3.04	1.40	2.20	41.0	54	42	36	168
10	558	100	37	.0035	22.5	6.5	.61	155	1,990	5,660	3,820	1.60	1.20	1.40	40.3	55	42	35	168
11	559	100	45	.0044	25.4	5.8	.56	159	2,080	5,200	3,640	1.68	1.04	1.36	40.9	56	41	35	168
12	560	100	41	.0038	25.2	5.7	.62	142	2,180	6,300	4,240	1.40	1.26	1.33	48.0	53	39	32	176
13	561	80	33	.0029	9.2	3.1	.28	300	1,670	3,020	2,340	1.16	1.16	.92	27.8	68	61	63	108
13	640	80	35	.0043	12.3	2.9	.35	240	2,830	5,120	3,980	1.70	1.06	1.38	47.4	76	70	67	87

1 Commercial.

TABLE 38.—Quality tests—lowland fir.

Grinder run No.	Paper machine run No.	Mullen test.				Horsepower per ton divided by strength factor.	Schopper tests.						Tintometer indications.			
		Total.	Per 0.001 in. thickness.	Per pound.	Thickness.		Breaking length.		Stretch.		Breaking weight per sq. mm. sectional area.	Breaking length per ton.	Red.	Green.	Blue.	Black.
		Points	Points	Points	Inch.		Meters.	Meters.	Per ct.	Per ct.	Grams.	Meters.	Parts.	Parts.	Parts.	Parts.
1	692	25.3	6.0	0.55	0.0042	154	3,850	6,700	1.74	1.08	3,510	62.4	50	37	32	181
2	691	25.0	5.9	0.55	0.0043	145	3,800	7,340	2.10	1.14	3,540	69.6	50	37	31	182
3	681	22.0	6.1	0.56	0.0036	147	3,300	5,790	1.84	1.02	2,920	55.3	46	34	30	190
4	717	13.5	3.0	0.35	0.0045	199	2,880	5,530	1.58	0.96	1,900	60.4	76	66	62	96
5	716	10.4	2.3	0.26	0.0046	216	2,340	4,580	1.48	0.86	1,470	55.3	78	67	61	94
6	713	3.2	2.1	0.26	0.0044	226	1,960	4,080	1.28	0.88	1,360	49.2	82	72	65	81
7	723	14.0	3.1	0.27	0.0045	220	2,550	5,160	1.40	1.12	1,790	47.4	78	73	63	89
8	712	10.6	2.4	0.29	0.0037	281	2,300	4,440	1.66	0.92	1,620	41.7	78	68	63	91
9	729	13.0	3.2	0.40	0.0037	243	2,750	5,120	1.44	0.96	1,960	54.5	76	67	61	96
10	724	15.0	2.8	0.36	0.0046	208	2,780	5,120	1.50	0.88	1,700	47.6	78	70	62	90
11	725	15.0	3.1	0.36	0.0048	208	2,780	5,120	1.80	0.88	1,800	52.8	80	67	61	92
12	715	13.1	3.0	0.35	0.0044	260	2,480	5,180	1.64	1.02	1,333	42.2	80	70	63	85
13	730	17.0	4.0	0.46	0.0042	170	2,950	6,130	2.04	1.14	2,140	58.0	76	68	61	95
14	708	13.0	2.9	0.33	0.0044	213	2,610	4,900	1.52	0.92	1,222	53.5	82	73	67	78
15	720	13.2	3.1	0.36	0.0042	251	2,630	5,140	1.78	1.04	1,411	46.7	73	65	60	102
16	722	12.4	3.4	0.41	0.0042	205	2,640	5,450	1.76	0.94	1,860	48.0	77	67	62	94
17	709	14.2	3.1	0.36	0.0039	230	2,800	5,200	1.76	0.94	1,800	48.4	83	73	68	76
17	726	12.6	3.1	0.38	0.0041	211	2,700	5,640	1.58	0.92	1,780	52.3	81	70	62	87

TABLE 39.—*Quality tests—noble fir.*

Grinder run No.	Paper machine run No.	Ground furnish in total	Weight per ream.	Thickness.	Mullen test.				Schopper tests.				Tintometer indications.					
					Total.	Per 0.001 in. thick- ness.	Points.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.		Stretch.		Breaking weight per sq. mm. sec.	Breaking length per horsepower per ton.	Red.	Green.	Blue.	Black.
				Inch.	Points.	Points.	Points.		Meters.	Meters.	Per cent.	Per cent.	Grams.	Meters.	Parts.	Parts.	Parts.	Parts.
1	735	80	32	0.0036	18.8	5.3	0.59	190	2,690	6,490	3.04	1.54	2,220	41.0	72	62	58	108
2	641	80	34	.0035	15.5	4.5	.46	185	3,140	5,960	1.92	1.12	2,340	53.5	73	67	60	100
3	658	80	35	.0038	15.3	4.1	.44	181	2,890	5,560	2.42	1.40	1,91	53.0	73	64	60	103
4	639	80	37	.0040	15.6	3.9	.42	165	3,090	5,440	2.20	1.14	1,67	61.3	73	63	53	111
5	642	80	37	.0037	19.0	5.2	.51	164	3,250	6,580	2.38	1.16	1,77	59.0	72	62	59	107
6	646	80	33	.0034	17.8	5.2	.54	148	3,500	6,510	1.98	1.02	2,50	62.7	71	62	57	110
7	736	80	35	.0038	19.4	4.4	.56	155	3,120	6,530	3.10	1.46	2,28	55.5	72	63	57	108
8	643	80	36	.0032	16.9	4.4	.47	179	3,040	5,950	2.22	1.16	1,69	55.4	72	62	57	109
9	706	100	40	.0032	22.5	6.9	.56	171	3,810	6,730	1.60	.90	1,95	55.2	50	35	30	185
10	701	100	42	.0033	23.0	6.9	.55	166	4,020	6,020	2.18	1.04	1,61	55.0	50	37	31	182
11	700	100	41	.0033	28.4	8.7	.69	138	4,320	7,270	5.80	2.64	1,10	60.7	50	37	31	182
12	663	100	32	.0033	16.0	4.9	.50	202	3,120	6,000	1.62	1.02	1,32	48.1	59	49	41	151
13	654	80	35	.0038	15.1	4.0	.43	179	3,100	5,870	2.70	1.40	2,05	58.2	72	64	58	106
14	724	80	41	.0042	24.9	6.0	.61	133	3,160	7,050	3.82	1.70	2,76	62.7	71	63	57	109
15	645	80	32	.0035	13.4	3.8	.42	222	2,820	5,320	2.08	1.10	1,59	43.7	72	64	60	104
16	113	80	35	.0028	12.6	4.5	.36	256	2,960	4,630	1.60	.96	1,28	37.4	63	56	55	126
17	647	80	34	.0035	15.6	4.8	.49	188	3,370	6,240	1.98	1.04	1,50	52.2	72	65	60	103
18	731	80	35	.0042	14.8	3.5	.42	144	2,930	5,920	1.70	1.08	1,39	72.8	71	62	56	111
19	737	80	33	.0038	17.9	4.7	.54	133	3,010	5,970	2.60	1.20	1,90	62.4	72	62	58	108

1 Commercial.

TABLE 40.—Quality tests—hemlock.

Grinder run No.	Paper machine run No.	Mullen test.				Schopper tests.						Tintometer indications.					
		Total.	Per 0.001 in.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.			Stretch.		Breaking weight per sq. mm.	Breaking length per horsepower.	Red.	Green.	Blue.	Black.	
						Crosswise.	Lengthwise.	Average.	Crosswise.	Lengthwise.							Average.
		Pounds.	Points.	Point.		Meters.	Meters.	Per ct.	Per ct.	Per ct.	Grams.	Meters.	Parts.	Parts.	Parts.	Parts.	Parts.
53	107	32	10.8	0.338	224	2,385	3,055	1.46	0.72	1.19	1,295	40.3	71	59	51	119	
54	105	33	10.25	0.311	237	2,135	3,425	1.22	0.92	1.07	1,150	37.6	75	61	54	110	
55	232	35	15.2	0.430	282	2,540	3,600	2.62	1.82	2.07	1,800	29.0	45	29	23	203	
56	219	30	9.2	0.3038	677	2,470	4,520	1.34	1.18	1.26	1,490	16.7	66	57	52	125	
60	257	54	28.2	0.548	380	3,070	5,870	2.48	1.50	1.99	2,820	22.6	42	27	20	211	
61	255	50	28.3	0.525	255	3,000	5,810	2.62	1.50	2.11	2,600	33.2	41	26	20	214	
62	256	55	28.3	0.51	256	2,860	5,620	3.22	1.58	2.40	2,730	32.5	41	26	19	213	

NOTE.—For run No. 63 see Mixture of woods.

TABLE 41.—Quality tests—western hemlock.

Grinder run No.	Paper machine run No.	Mullen test.					Schopper tests.					Tintometer indications.						
		Thickness.		Total.	Per 0.001 in. thickness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.		Stretch.		Breaking weight sectional area. per sq. mm.	Breaking length per horsepower.	Red.	Green.	Blue.	Black.	
		Inch.	Points.					Meters.	Average.	Crosswise.	Lengthwise.							Average.
		Per ct.	Pounds.	Inch.	Points.	Point.		Meters.	Meters.	Per ct.	Per ct.	Grams.	Meters.	Parts.	Parts.	Parts.	Parts.	
	215	80	31	0.0037	13.4	3.6	0.42	320	2,900	5,700	2.10	1.24	2,000	32.0	62	53	49	136
5	372	80	37	0.0040	19.6	4.9	0.53	245	3,290	6,260	2.58	1.48	2,220	36.8	67	55	48	130
6	373	80	36	0.0041	16.5	4.0	0.46	308	2,760	5,000	2.44	1.60	2,170	27.3	65	55	49	131
7	403	80	31	0.0033	16.6	5.0	0.54	306	3,100	4,420	2.04	1.14	2,170	26.8	66	55	48	133
8	402	80	26	0.0030	11.3	3.8	0.44	436	3,170	5,230	1.70	0.94	1,830	21.8	61	51	45	143
9	321	100	45	0.0036	28.0	7.8	0.62	296	3,440	5,580	2.68	1.36	2,160	24.6	36	22	16	226
10	352	80	33	0.0035	17.0	4.9	0.52	505	3,570	6,350	1.98	1.24	1,760	18.9	63	50	43	144
11	341	80	32	0.0044	15.9	3.6	0.50	171	2,920	4,780	2.10	1.32	1,760	45.1	75	61	53	111
12	342	80	32	0.0040	10.0	2.7	0.34	217	2,650	4,510	1.60	1.12	1,500	48.5	70	57	50	123
13	353	79	34	0.0043	10.1	2.4	0.30	234	2,400	4,320	1.56	1.24	1,360	47.7	71	58	50	121
14	354	80	33	0.0045	10.4	2.3	0.31	201	2,450	4,100	1.54	1.12	1,240	52.5	73	60	51	116
18	12	75	33	0.0028	10.1	3.6	0.31	406	2,430	4,290	1.36	0.92	2,160	26.7	56	53	53	138
18	445	80	34	0.0039	17.8	4.6	0.52	242	3,000	5,720	2.80	1.46	2,080	34.6	64	52	45	139

NOTE.—For runs 15-17, inclusive, see Mixture of woods.

1 Commercial.

TABLE 42.—Quality tests—*lanarack*.

Grinder run No.	Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Thickness.	Mullen test.			Schopper tests.						Tintometer indications.					
					Total.	Per 0.001 in. thick-ness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.			Stretch.		Breaking weight per sq. mm. sec-tional area.	Breaking length per horsepower	Red.	Green.	Blue.	Black.
									Meters.	Lengthwise.	Average.	Per ct.	Lengthwise.							Average.	Grams.	Meters.
1	109	80	32	0.0040	12.25	3.04	0.383	235	2,700	4,200	3,450	2.48	1.88	1,570	38.3	83	66	94	
2	35	80	32	0.0042	13.40	3.19	0.419	430	2,700	4,400	3,580	1.94	1.28	1,570	39.9	69	57	126	
3	1	80	32	0.0038	8.00	2.10	0.250	356	1,829	4,313	3,071	1.21	1.06	1,600	19.9	73	65	48	
4	15	80	33	0.0044	8.90	2.02	0.270	287	2,140	3,705	2,922	1.24	0.78	1,199	34.4	79	52	105	
5	31	80	32	0.0040	11.40	2.85	0.356	288	2,460	4,635	3,548	1.88	0.90	1,130	37.8	68	56	104	
6	32	80	32	0.0043	9.25	2.15	0.289	288	1,920	3,760	2,840	1.18	0.72	1,510	25.7	73	61	115	
7	34	80	32	0.0048	8.05	1.68	0.278	278	1,612	3,110	2,361	0.90	0.68	903	33.7	74	55	110	
8	9	80	33	0.00355	11.80	3.32	0.358	762	2,376	3,698	3,037	2.94	1.54	1,905	33.0	65	59	116	
9	117	60	33	0.00372	13.95	3.75	0.398	791	2,672	4,365	3,519	2.08	1.52	1,823	36.2	80	56	113	
10	119	80	33	0.0031	9.4	2.03	0.161	734	2,469	2,625	1,938	1.98	0.74	1,736	36.2	77	58	126	
11	9	80	33	0.00426	8.35	1.04	0.101	391	1,852	2,780	2,351	1.88	0.92	1,002	34.0	80	70	88	
12	114	80	34	0.00447	8.35	1.866	0.2845	245	2,586	2,780	2,258	1.90	1.04	906	33.2	87	77	66	
13	113	80	34	0.00447	5.70	1.660	0.190	251	2,065	2,705	1,705	1.00	0.56	993	28.0	65	56	127	
14	112	80	30	0.00344	10.35	2.18	0.296	250	2,370	3,600	2,985	1.20	0.80	1,186	40.4	77	61	108	
15	88	80	35	0.00428	11.75	2.74	0.356	251	2,565	4,000	3,283	1.68	1.00	1,373	36.7	75	59	114	
16	101	80	33	0.0044	15.45	3.51	0.441	236	2,950	4,740	3,845	1.64	0.98	1,511	44.3	67	51	138	
17	93	80	35	0.0037	15.50	4.00	0.470	208	3,110	4,800	3,955	1.98	1.04	1,820	40.5	72	58	119	
18	98	80	31	0.00387	15.50	4.00	0.470	245	2,250	3,310	2,780	1.04	0.76	1,012	44.3	81	63	101	
19	94	80	31	0.00498	7.95	1.595	0.257	202	2,420	4,450	3,687	1.98	1.06	1,683	45.2	73	55	108	
20	99	79	33	0.00407	13.30	3.26	0.403	204	2,924	4,450	3,687	1.98	1.06	1,683	45.2	73	55	108	
21	89	80	33	0.00364	15.75	4.33	0.477	203	3,000	4,500	3,740	1.68	0.90	1,780	39.8	67	52	138	
22	89	80	30	0.0037	9.95	2.79	0.332	175	2,515	3,550	3,033	1.18	0.62	1,315	31.2	52	33	190	
23	84	80	34	0.00376	16.25	4.32	0.478	203	2,990	4,975	3,953	2.04	1.00	1,975	47.6	51	36	184	
24	100	80	36	0.0036	8.5	1.70	0.236	232	1,922	4,975	2,536	0.92	0.80	1,037	36.8	83	72	64	
25	233	80	35	0.0036	16.8	4.6	0.48	210	2,510	5,200	3,800	2.04	1.38	1,950	38.4	43	27	210	
26	220	80	32	0.0040	11.2	2.8	0.35	455	2,520	4,700	3,610	1.76	1.26	1,600	22.6	64	54	136	
27	282	100	44	0.0045	17.5	3.90	0.40	151	2,780	4,430	3,600	1.94	1.34	1,960	59.7	44	29	207	
28	288	100	51	0.0053	19.0	3.60	0.37	173	2,450	3,900	3,180	2.52	1.38	1,780	49.7	43	27	211	
29	289	100	45	0.0045	17.3	3.80	0.38	169	2,410	4,310	3,360	2.05	1.48	1,910	52.2	43	28	213	
30	281	100	43	0.0044	16.6	3.80	0.38	194	2,640	4,680	3,660	1.80	1.38	2,000	49.5	44	26	209	
31	286	100	46	0.0050	17.6	3.60	0.38	191	2,870	4,490	3,250	1.74	1.26	1,730	44.9	49	32	224	
32	275	100	46	0.0041	18.8	4.60	0.41	220	2,870	4,910	3,800	2.32	1.36	2,270	43.2	40	24	195	
33	279	100	53	0.0049	22.4	4.50	0.42	210	2,630	4,930	3,780	1.86	1.56	2,280	44.9	39	23	222	
34	284	100	39	0.0038	16.0	4.2	0.41	214	2,960	4,950	3,950	1.66	1.32	2,264	45.0	42	26	214	

35	386	100	38	.0038	16.7	4.4	.44	245	2,770	5,120	3,940	1.60	.94	1.27	2,220	36.6	47	38	24	191
36	383	100	50	.0051	21.0	4.1	.42	195	2,840	4,910	3,880	1.72	1.02	1.37	2,140	47.4	49	33	24	194
37	380	100	44	.0044	22.6	5.1	.51	188	2,750	5,290	4,020	3.18	1.28	2.23	2,270	42.0	42	27	19	142
38	364	80	44	.0049	17.3	3.5	.41	298	2,730	5,040	3,880	2.22	1.46	1.84	1,720	31.8	60	49	40	159
39	249	100	51	.0048	23.2	4.8	.46	278	2,880	2,690	2,780	2.82	.88	1.58	1,670	21.8	35	21	15	229
40	251	100	47	.0044	21.5	4.8	.46	201	2,680	5,030	3,860	2.32	1.36	1.84	2,200	41.7	36	23	17	224
41	254	100	53	.0050	25.8	5.2	.49	196	2,790	5,300	4,040	2.90	1.52	2.21	2,440	42.0	36	23	17	224
42	250	100	47	.0042	21.8	5.2	.46	290	2,850	4,490	3,670	1.90	1.12	1.51	2,220	27.5	36	22	16	226
43	253	100	42	.0038	19.3	5.0	.46	237	2,490	4,800	3,640	1.50	1.12	1.54	2,200	33.4	39	24	17	220
44	253	100	44	.0040	20.2	5.0	.46	224	2,610	4,850	3,730	2.02	1.32	1.67	2,190	36.2	42	26	19	213
45	272	100	55	.0049	24.0	4.9	.44	236	2,910	4,990	3,790	2.22	1.40	1.81	2,270	36.6	36	21	14	229
46	379	100	55	.0049	16.7	3.4	.30	318	2,910	4,280	3,300	1.80	1.28	1.54	2,130	34.6	39	39	22	225
47	327	80	43	.0046	17.5	3.8	.40	735	2,800	4,300	3,550	2.78	1.38	2.08	1,820	32.6	36	21	14	229
48	320	100	52	.0049	21.0	4.3	.40	198	2,880	4,040	3,360	2.34	1.34	1.84	1,990	42.3	41	25	18	216
49	348	80	35	.0037	7.8	1.7	.22	286	1,680	3,190	2,540	1.14	1.04	1.07	1,970	39.0	66	56	46	132
53	53	111	35	.0033	7.4	2.2	.21	454	1,640	2,960	2,300	1.10	.72	.91	1,400	24.1	52	46	46	136
53	454	80	37	.0035	12.0	2.6	.32	288	2,250	3,950	3,100	1.54	.98	1.26	1,490	32.5	76	63	56	105
55	686	100	53	.0048	23.0	4.8	.43	255	3,210	5,480	4,340	2.20	1.24	1.72	2,910	39.6	42	31	27	200
56	689	100	55	.0047	25.9	5.6	.47	222	3,320	5,730	4,520	1.98	.98	1.48	3,260	43.2	45	33	27	195
57	690	100	49	.0043	23.1	5.3	.47	227	3,230	5,860	4,540	2.16	1.16	1.66	3,030	42.7	44	33	27	195
58	683	100	60	.0052	25.4	4.9	.42	268	2,750	5,160	3,900	1.94	1.24	1.59	2,840	35.2	44	32	27	197
58	687	100	48	.0044	18.8	4.3	.39	308	2,840	5,170	4,000	2.00	1.38	1.69	2,560	33.3	49	25	30	186
60	684	100	50	.0046	20.7	4.5	.41	279	2,820	5,450	4,140	1.50	1.24	1.37	2,670	36.2	43	32	28	193
61	685	100	48	.0042	23.6	5.6	.49	269	3,520	5,060	4,290	1.68	.94	1.31	2,960	32.5	46	33	28	193
62	488	100	44	.0037	14.8	4.0	.34	239	2,330	3,900	3,120	2.20	1.08	1.64	2,160	38.4	45	33	28	194
63	489	100	39	.0036	14.8	4.1	.38	207	2,130	3,720	2,920	2.98	1.36	2.17	1,860	37.1	45	33	28	196
64	490	100	36	.0032	12.7	3.9	.35	230	2,180	3,300	2,640	2.95	1.15	2.05	1,750	32.8	45	33	28	194
65	491	100	36	.0032	14.2	4.5	.40	221	2,400	3,980	3,190	1.52	.84	1.18	2,100	36.1	46	34	28	192
66	492	100	29	.0025	9.5	3.8	.33	286	2,210	3,290	2,750	.96	.63	.80	1,780	29.1	45	34	28	193
67	493	100	37	.0033	15.0	4.6	.40	257	2,420	4,560	3,490	1.73	1.10	1.42	2,200	34.0	42	30	23	203
68	494	100	38	.0032	17.4	5.4	.45	220	2,400	4,420	3,410	1.78	1.14	1.46	2,480	34.4	44	32	26	198
69	528	100	44	.0042	12.8	3.1	.29	232	1,870	3,700	2,780	2.16	1.02	1.59	1,730	41.7	36	25	20	219
70	529	100	44	.0043	12.4	3.1	.28	252	2,350	3,100	2,300	2.46	1.02	1.74	1,330	32.5	39	25	23	211
71	530	100	43	.0038	12.2	3.2	.28	260	1,740	3,610	2,675	2.98	1.46	2.22	1,730	36.8	40	27	23	210
72	531	100	51	.0046	19.2	4.2	.38	202	1,960	4,180	3,070	3.48	1.34	2.41	1,930	40.0	42	30	25	203
73	532	100	52	.0047	21.1	4.5	.41	180	2,180	4,550	3,360	4.32	1.66	2.99	2,110	45.5	46	35	30	189
74	533	100	50	.0049	16.6	3.4	.33	225	1,890	3,570	2,730	3.32	1.44	2.38	1,650	36.8	49	37	29	185
75	534	100	53	.0055	17.6	3.2	.33	212	1,970	3,490	2,720	3.20	1.40	2.30	1,560	38.8	54	42	36	168
76	535	100	50	.0052	13.3	2.6	.27	244	1,840	3,230	2,540	2.52	1.34	1.93	1,510	38.4	47	41	153	133
77	523	100	64	.0078	12.6	3.6	.20	289	1,600	1,730	1,700	1.76	1.88	1.82	2,030	29.4	67	56	50	126
78	721	80	80	.0044	16.6	3.8	.22	389	2,720	5,950	4,340	1.94	.98	1.46	2,630	26.5	66	56	51	126
79	655	80	39	.0045	11.2	2.5	.49	639	2,620	4,320	3,470	1.98	1.20	1.59	1,500	18.2	62	52	45	140
80	719	82	40	.0040	18.2	4.6	.46	822	3,690	6,040	4,560	2.14	1.14	1.64	2,470	12.3	62	51	45	142
81	718	80	41	.0043	17.0	4.0	.42	888	2,960	5,500	4,200	1.78	.98	1.38	2,150	11.3	61	50	43	146

1 Commercial.

NOTE.—For runs 50 to 52, inclusive, and run 54 see quality tests—mixtures of woods.

TABLE 43.—*Quality tests—western larch.*

Grinder run No.	Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Thickness.	Mullen test.				Schopper tests.						Tintometer indications.			
					Total.	Per 0.001 in. thickness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.	Stretch.			Breaking weight per sq. mm. sectional area.	Breaking length per horsepower.	Red.	Green.	Blue.	Black.
					Points.	Points.	Points.	ton		Crosswise.	Lengthwise.	Average.						
1	108	80	33	0.0075	14.9	3.97	0.451	280	Meters.	Per ct.	Per ct.	Per ct.	Grams.	Meters.	Parts.	Parts.	Parts.	Parts.
2	221	80	34	0.0048	6.6	1.4	.20	518	4,620	2.26	1.28	1.77	1,750	29.8	38	38	29	180
3	328	80	34	0.0047	10.0	2.2	.26	716	2,910	1.14	.98	1.06	869	21.7	56	42	36	166
4	328	80	36	0.0042	11.3	2.7	.31	900	3,360	1.94	1.30	1.62	1,250	14.4	81	47	36	136
5	343	80	36	0.0046	4.4	.9	.13	685	4,310	1.56	1.25	1.41	1,520	12.0	59	45	35	161
6	739	80	33	0.0045	9.5	1.7	.24	500	2,030	1.78	.58	.68	1,570	18.5	62	48	42	148
7	456	80	39	0.0055	9.5	1.7	.24	500	3,050	1.40	.90	1.15	1,030	20.0	66	53	46	135
8	457	80	42	0.0056	9.6	1.7	.23	420	2,410	1.62	1.02	1.32	1,000	23.2	63	52	45	140
9	457	80	40	0.0056	7.0	1.3	.18	480	2,720	1.62	.92	1.17	830	22.8	61	53	47	136
10	458	80	40	0.0056	7.0	1.3	.18	480	1,970	1.42	.92	1.17	830	22.8	61	53	47	136

TABLE 44.—Quality tests—Montana lodgepole pine.

Grinder run No.	Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Thickness.	Mullen test.				Schopper tests.						Tintometer indications.					
					Total.	Per 0.001 in. thick-mess.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.			Stretch.			Breaking weight per sq. mm. sec.	Breaking length per horsepower	Red.	Green.	Blue.	Black.
									Crosswise.	Lengthwise.	Average.	Crosswise.	Lengthwise.	Average.						
					Points.	Points.	Point.		Meters.	Meters.	Per ct.	Per ct.	Grams.	Meters.	Parts.	Parts.	Parts.	Parts.		
1	70	80	32	0.0038	16.15	4.95	0.505	247	3,430	5,780	2.08	1.12	2,140	37.0	84	85				
2	38	80	33	0.0045	14.20	3.16	0.430	245	2,335	4,530	2.08	1.18	1,445	33.9	86	80				
3	30	80	32	0.0044	8.90	2.02	0.278	250	2,035	4,100	2.08	1.18	1,445	33.9	86	81				
4	2	80	31	0.0039	7.60	1.87	0.235	272	2,048	4,452	1.16	0.84	1,210	44.1	86	81				
5	36	80	34	0.0039	13.25	3.40	0.390	277	2,468	5,110	2.14	1.22	1,810	35.1	88	68				
6	46	80	33	0.0039	11.90	3.05	0.361	268	2,468	4,440	2.46	1.22	1,810	35.1	88	79				
7	37	80	30	0.0037	8.90	2.40	0.296	298	1,923	4,035	2.02	1.10	1,536	35.1	88	76				
8	7	80	34	0.0033	17.35	6.26	0.510	203	2,170	5,138	1.55	0.98	1,258	33.7	73	76				
9	222	80	30	0.0040	11.6	2.9	0.38	299	2,630	4,980	2.16	1.35	1,705	35.4	55	27				
13	283	100	42	0.0034	23.3	7.0	0.55	257	3,820	6,950	1.80	1.36	3,730	37.1	69	90				
14	378	100	46	0.0038	30.5	8.0	0.66	194	2,820	5,720	4.62	1.52	2,930	33.4	22	15				
15	280	100	47	0.0038	25.2	6.6	0.54	246	3,110	5,740	4.40	1.30	3,040	33.6	26	18				
16	330	80	35	0.0045	13.6	3.0	0.39	247	2,600	4,300	2.12	1.18	1,636	35.9	81	210				
17	331	80	36	0.0047	14.2	3.0	0.39	262	3,000	4,580	2.02	1.18	1,600	37.1	82	210				
18	346	80	49	0.0045	17.1	3.8	0.35	316	3,120	5,470	2.12	1.22	1,671	38.9	81	89				
19	345	80	36	0.0044	14.4	3.3	0.40	265	2,770	4,720	2.10	1.28	1,691	38.9	68	87				
20	429	80	30	0.0036	12.2	3.4	0.40	323	2,880	5,120	1.72	0.94	1,790	35.3	67	95				
21	430	80	30	0.0035	13.2	3.8	0.44	308	2,930	5,840	1.84	1.00	2,010	32.3	73	108				
22	431	80	37	0.0042	17.4	4.1	0.44	231	2,980	5,420	2.10	1.02	1,980	41.3	68	96				
23	432	80	31	0.0040	12.0	3.0	0.39	243	2,640	4,530	1.88	0.90	1,550	37.8	79	91				
26	1 14	75	33	0.0028	8.9	3.2	0.27	510	1,870	3,980	1.20	0.76	1,980	21.2	60	54				
26	447	80	33	0.0038	13.8	3.6	0.42	328	2,840	4,940	2.34	1.48	1,820	28.2	71	46				

1 Commercial.

NOTE.—For runs 24 and 25, see Mixture of woods.

TABLE 45.—*Quality tests—lodgepole pine (California).*

Grinder run No.	Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Thickness.	Mullen test.				Schopper tests.								Tintometer indications.			
					Total.	Per 0.001 in. thickness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.			Stretch.			Breaking weight per sq. mm. sectional area.	Breaking length per horsepower	Red.	Green.	Blue.	Black.
									Crosswise.	Lengthwise.	Average.	Crosswise.	Lengthwise.	Average.						
1	236	80	33	0.0031	18.4	6.0	0.56	222	2,530	5,620	4,080	1.78	1.38	1.58	2,120	32.8	45	28	21	206
2	213	80	32	.0041	12.2	3.0	.38	362	2,760	5,180	3,970	1.46	1.90	1.18	1,630	28.9	72	62	56	110
10	360	80	34	.0042	15.0	3.6	.44	527	2,950	6,100	4,520	1.96	1.30	1.63	1,920	19.5	78	69	61	92
11	361	80	35	.0040	17.6	4.4	.50	428	2,850	5,550	4,200	3.32	1.82	2.57	1,910	19.6	76	67	59	98
12	362	80	36	.0043	15.3	3.6	.42	593	2,490	5,140	3,820	2.36	1.60	1.98	1,690	15.3	77	65	57	101
13	371	80	36	.0043	14.2	3.3	.39	534	2,240	4,620	3,430	2.38	1.60	1.99	1,500	16.5	62	52	46	140
14	363	80	38	.0044	17.2	3.9	.45	555	2,700	5,180	3,940	2.84	1.52	2.18	1,700	15.8	83	73	64	80
15	323	80	32	.0030	11.3	3.7	.36	448	2,030	3,550	2,790	1.58	1.10	1.34	1,680	17.3	80	67	60	93
16	369	82	35	.0044	12.8	2.9	.37	362	2,580	4,710	3,640	2.28	1.48	1.88	1,540	27.2	78	68	58	96
17	387	84	31	.0038	11.8	3.1	.38	309	2,800	4,370	3,580	1.56	1.78	1.17	1,520	30.5	84	74	59	83
18	376	80	34	.0044	12.0	2.7	.35	332	2,200	4,220	3,210	2.00	1.58	1.79	1,280	27.7	80	70	60	90
19	433	80	34	.0039	16.1	4.1	.47	509	2,840	5,740	4,290	1.92	1.06	1.49	2,030	17.9	87	80	60	90
20	434	80	32	.0038	13.6	3.6	.42	468	2,840	5,510	4,180	2.02	.96	1.49	1,920	21.3	74	60	55	111
21	435	80	31	.0038	12.4	3.3	.40	349	2,800	5,400	4,100	1.46	.82	1.19	1,790	29.4	70	62	53	115
26	cml. 7	75	34	.0034	7.4	2.2	.22	352	1,450	2,740	2,100	1.32	.80	1.06	1,320	27.1	62	57	57	124
26	450	80	34	.0050	9.6	1.9	.28	277	2,230	3,750	2,990	1.68	.94	1.31	1,120	38.6	75	62	55	108

NOTE.—For runs 22 to 25, inclusive, see Mixture of woods.

TABLE 46.—Quality tests—western yellow pine.

Grinder run No.	Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Thickmess.	Mullen test.				Schopper tests.						Tintometer indications.					
					Total.	Per 0.001 inch of thickness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.			Stretch.			Breaking weight per square millimeter sectional area.	Breaking length per horsepower per ton.	Red.	Green.	Blue.	Black.
									Meters.	Meters.	Meters.	Per cent.	Lengthwise.	Average.							Per cent.	Per cent.
1	102	79	35	0.00316	11.4	3.61	0.326	282	2,296	3,456	2,876	1.36	0.68	1.02	1,878	31.3	79	57	49	115
2	106	80	34	0.0031	11.9	2.34	0.350	218	2,240	3,770	3,005	1.16	.90	1.93	1,250	39.4	84	70	62	84
3	5	80	34	0.0043	11.15	2.59	0.328	226	1,778	4,583	3,181	1.01	1.05	1.03	1,375	43	81	61	53	105
4	223	80	35	0.0049	11.3	2.3	0.32	324	2,340	4,400	3,370	1.86	1.28	1.57	1,340	32.5	79	67	59	95
8	300	100	47	0.0044	28.6	6.5	.61	247	3,560	6,000	4,780	2.46	1.58	2.02	2,990	31.8	51	34	25	190
9	271	100	33	0.0031	16.2	5.23	.49	226	2,870	5,300	4,080	1.76	1.30	1.53	2,350	36.9	50	34	24	192
10	273	100	46	0.0042	25.0	5.0	.54	223	3,090	5,620	4,360	1.86	1.36	2.11	2,680	36.3	48	30	22	200
11	319	100	35	0.0037	15.4	4.2	.44	719	2,970	5,540	4,260	1.84	1.40	1.62	2,260	13.5	72	59	49	120
12	347	80	36	0.0038	12.5	3.3	.35	293	2,950	4,830	3,800	1.94	1.22	1.58	1,630	38	80	68	59	93
13	351	80	34	0.0044	13.5	3.1	.40	346	2,660	5,080	3,870	1.78	1.18	1.48	1,560	28	81	69	58	92
14	349	80	34	0.0045	11.4	2.5	.33	424	2,500	4,460	3,480	1.92	1.18	1.55	1,350	24.8	81	68	57	94
15	350	80	34	0.0046	12.5	2.7	.37	364	2,690	4,900	3,800	1.76	1.12	1.44	1,460	20.8	81	67	55	97
16	408	80	37	0.0048	14.6	3.0	.40	286	2,890	5,380	4,140	1.60	.88	1.24	1,820	36.2	76	64	55	105
17	422	80	37	0.0046	11.2	2.4	.30	271	2,420	4,060	3,240	1.56	1.04	1.30	1,400	39.9	76	64	55	105
18	409	80	32	0.0046	8.0	1.7	.25	263	2,180	3,330	2,760	1.00	.66	.83	1,060	41.9	77	65	56	102
19	423	80	41	0.0053	11.2	2.0	.27	233	2,070	3,680	2,880	1.40	.98	1.19	1,200	45.8	77	63	54	106
27	448	75	32	0.0033	5.4	1.6	.17	379	1,150	2,710	1,930	1.78	.74	.76	1,040	29.9	61	56	56	127
27	448	80	36	0.0048	9.4	2.0	.26	248	2,050	3,500	2,780	1.92	.92	1.42	1,150	43.1	74	62	51	113

1 Commercial.

NOTE.—For runs 20 to 26, inclusive, see Mixture of woods.

TABLE 47.—*Quality tests—jack pine.*

Grinder run No.	Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Thickness.	Mullen test.				Schopper tests.						Tintometer indications.				
					Total.	Per 0.001 in. thick-ness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.			Stretch.		Breaking weight per sq. mm. sec-ondal area.	Breaking length per horsepower	Red.	Green.	Blue.	Black.
									Crosswise.	Lengthwise.	Average.	Crosswise.	Lengthwise.							Average.
25	120	80	31	0.00445	8.4	1.89	0.271	267	2,272	3,000	2,635	1.28	0.74	1.01	963	36.4	87	72	76
26	231	80	34	.0036	14.6	4.0	.43	258	2,180	4,530	3,360	1.92	1.30	1.61	1,630	30.4	50	34	26
27	214	80	34	.0047	11.8	2.5	.35	427	2,340	4,710	3,530	2.24	1.12	1.68	1,420	23.6	76	64	103
28	276	100	45	.0042	22.5	5.3	.50	296	3,140	4,860	4,000	2.28	1.26	1.77	2,340	27.1	98	36	200
29	285	100	49	.0048	22.8	4.8	.46	265	2,900	5,480	4,190	2.08	1.56	1.82	2,440	34.3	51	33	192
30	287	100	43	.0044	20.3	4.6	.47	250	2,680	5,030	3,860	2.06	1.66	1.81	2,200	32.9	48	30	24
31	269	100	40	.0038	18.2	4.9	.46	264	2,770	4,940	3,860	2.16	1.28	1.72	2,180	31.8	46	28	206
32	301	100	47	.0050	21.0	4.2	.45	515	3,280	5,390	4,340	2.40	1.36	1.88	2,360	17.7	65	50	147
33	298	100	37	.0042	13.0	3.1	.35	251	2,180	3,580	2,880	1.70	1.48	1.59	1,440	32.8	48	31	197

TABLE 48.—Quality tests—loblolly pine.
FALL-CUT WOOD.

Grinder run No.	Paper machine run No.	Ground furnish.	Weight per ream.	Thickness.	Mullen test.				Schopper tests.				Tintometer indications.							
					Total.	Per 0.001 in. thick-ness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.		Stretch.		Breaking weight per sq. mm. sec.	Breaking length per horsepower	Red.	Green.	Blue.	Black.		
									Crosswise.	Lengthwise.	Average.	Crosswise.							Lengthwise.	Average.
			Pounds.	Inch.	Points.	Points.	Point.		Meters.	Meters.	Per ct.	Per ct.	Per ct.	Grams.	Meters.	Parts.	Parts.	Parts.	Parts.	
1	611	80	40	0.0050	11.0	2.2	0.28	330	2,150	3,840	1.62	0.90	1.26	1,420	32.4	81	70	61	88	
2	610	80	42	0.0052	11.1	2.1	0.26	314	2,180	3,815	1.58	0.84	1.17	1,330	33.7	80	71	61	88	
3	612	80	44	0.0050	15.2	3.0	0.35	329	2,320	4,020	1.92	1.26	1.59	1,840	30.6	63	73	65	99	
4	616	80	45	0.0054	16.0	3.0	0.36	360	2,550	4,040	1.94	1.08	1.51	1,660	25.5	82	72	64	81	
5	614	80	40	0.0047	16.2	3.4	0.41	474	2,620	5,310	1.92	1.06	1.49	2,020	20.4	84	72	65	79	
6	603	80	42	0.0052	14.3	2.8	0.34	276	2,525	3,950	1.78	0.96	1.37	1,610	34.5	75	65	58	102	
7	742	80	40	0.0049	10.6	2.2	0.26	362	2,100	4,130	1.42	0.94	1.18	1,390	33.1	76	70	62	92	
8	604	80	37	0.0043	10.8	2.5	0.29	325	2,320	4,090	1.46	0.96	1.21	1,590	32.8	74	65	59	102	
9	598	100	49	0.0044	20.4	4.7	0.42	278	2,780	4,890	1.64	0.84	1.24	2,570	28.0	42	30	25	203	
10	634	80	37	0.0042	10.3	2.4	0.28	396	2,170	4,040	1.84	0.86	1.20	1,170	28.7	75	68	63	94	
11	632	80	33	0.0042	7.3	1.7	0.22	415	1,770	3,470	2,780	1.54	0.86	1.20	1,240	32.6	80	70	62	87
12	631	80	38	0.0049	9.9	2.0	0.26	328	1,940	3,620	1.48	0.92	1.20	1,240	32.6	80	71	62	87	
13	605	80	37	0.0050	9.2	1.8	0.25	353	1,930	3,830	2,880	1.22	0.94	1.08	1,340	32.6	74	68	60	98
14	636	80	38	0.0050	8.2	1.6	0.22	325	1,910	3,320	1.28	0.82	1.05	1,000	36.6	78	69	61	92	

SPRING-CUT WOOD.																			
3	609	80	40	0.0045	14.1	3.1	0.35	396	2,590	4,920	3,760	1.68	1.12	1.40	1,990	27.2	71	61	113
4	608	80	38	0.0047	11.0	2.6	0.29	425	2,270	4,300	3,285	1.54	0.90	1.22	1,585	26.6	54	57	116
5	613	80	39	0.0047	12.2	2.3	0.31	350	2,340	4,220	3,290	1.66	1.04	1.35	1,610	30.3	74	64	105
6	615	80	41	0.0046	15.5	3.3	0.37	354	2,810	4,530	3,670	2.10	1.12	1.61	2,040	28.0	72	61	113
7	617	80	39	0.0045	13.2	3.0	0.35	411	2,790	4,700	3,740	1.68	0.88	1.28	1,840	26.0	73	62	110
8	617	80	39	0.0045	13.0	3.0	0.35	411	2,790	4,700	3,740	1.68	0.88	1.28	1,840	26.0	73	62	110
9	606	80	37	0.0040	12.0	3.0	0.36	502	2,395	5,090	3,740	1.28	0.92	1.10	1,900	20.7	73	65	106
10	607	80	27	0.0035	19.2	2.6	0.34	515	2,395	4,885	3,640	1.28	0.80	1.04	1,790	20.8	68	58	122
11	597	100	48	0.0041	21.9	5.3	0.46	263	3,110	5,650	4,380	1.80	1.00	1.43	3,040	36.2	39	30	206
12	599	100	48	0.0041	23.0	5.6	0.48	248	2,720	6,080	4,400	2.00	1.24	1.62	3,030	37.0	41	31	202
13	600	100	58	0.0053	26.5	5.0	0.46	240	3,060	6,610	4,310	1.80	1.14	1.47	2,840	40.7	43	31	206
14	601	100	50	0.0040	18.8	4.7	0.45	271	3,060	4,940	4,000	1.92	1.06	1.19	2,840	32.8	40	33	176
15	602	100	42	0.0040	18.8	4.7	0.45	271	3,060	4,940	4,000	1.92	1.06	1.19	2,840	32.8	40	33	176
16	602	100	42	0.0040	18.8	4.7	0.45	271	3,060	4,940	4,000	1.92	1.06	1.19	2,840	32.8	40	33	176
17	602	100	42	0.0040	18.8	4.7	0.45	271	3,060	4,940	4,000	1.92	1.06	1.19	2,840	32.8	40	33	176
18	602	100	42	0.0040	18.8	4.7	0.45	271	3,060	4,940	4,000	1.92	1.06	1.19	2,840	32.8	40	33	176
19	602	100	42	0.0040	18.8	4.7	0.45	271	3,060	4,940	4,000	1.92	1.06	1.19	2,840	32.8	40	33	176
20	602	100	42	0.0040	18.8	4.7	0.45	271	3,060	4,940	4,000	1.92	1.06	1.19	2,840	32.8	40	33	176
21	602	100	42	0.0040	18.8	4.7	0.45	271	3,060	4,940	4,000	1.92	1.06	1.19	2,840	32.8	40	33	176
22	638	80	38	0.0050	13.2	3.0	0.31	338	3,020	5,700	4,390	1.50	0.86	1.18	1,550	41.9	70	67	95
23	618	80	42	0.0054	13.2	2.4	0.31	338	3,020	5,700	4,390	1.50	0.86	1.18	1,550	41.9	70	67	95
24	637	80	45	0.0057	13.8	2.4	0.30	340	2,350	4,750	3,590	1.24	1.04	1.14	1,480	34.8	67	60	112
25	637	80	45	0.0057	13.8	2.4	0.30	340	2,350	4,750	3,590	1.24	1.04	1.14	1,480	34.8	67	60	112
26	619	80	45	0.0053	15.6	2.9	0.35	365	2,800	4,210	3,500	1.86	0.92	1.39	1,710	32.8	72	62	106

SPRING-CUT WOOD.

					Points.	Points.	Point.		Meters.	Meters.	Per ct.	Per ct.	Per ct.	Grams.	Meters.	Parts.	Parts.	Parts.	Parts.
3	609	80	40	0.0045	14.1	3.1	0.35	396	2,590	4,920	1.68	1.12	1.40	1,990	27.2	71	61	55	113
4	608	80	38	0.0047	12.0	2.3	0.29	425	2,270	4,200	1.54	0.90	1.22	1,585	26.6	70	60	54	116
5	612	80	39	0.0047	11.2	2.6	0.31	350	2,370	4,220	1.66	1.04	1.35	1,610	30.3	74	64	57	105
6	615	80	41	0.0046	15.2	3.3	0.37	354	2,810	4,530	2,100	1.12	1.61	2,040	28.0	72	61	54	113
7	617	80	39	0.0045	12.5	3.0	0.35	411	2,790	4,700	1.68	0.88	1.28	1,840	26.0	73	62	55	110
8	606	80	35	0.0040	12.0	3.0	0.36	502	2,380	5,000	1,280	0.92	1.04	1,800	20.7	73	65	56	106
9	607	80	27	0.0035	19.2	2.6	0.34	515	2,395	4,885	1,280	0.80	1.04	1,790	20.8	68	58	52	122
10	597	100	48	0.0042	21.9	5.3	0.46	203	3,110	5,630	4,380	1.86	1.43	3,040	26.2	39	30	25	206
11	599	100	48	0.0041	23.0	5.6	0.48	248	2,720	6,080	4,400	2.00	1.62	3,030	37.0	41	31	26	202
12	600	100	58	0.0053	26.5	5.0	0.46	230	3,000	5,610	1,800	1.14	1.47	2,840	40.7	45	31	26	200
13	601	100	42	0.0040	18.8	4.7	0.45	271	3,060	4,940	4,000	1.32	1.06	2,840	32.8	51	40	33	176
14	602	100	50	0.0064	18.8	3.0	0.38	298	2,900	4,340	3,370	1.34	1.48	1,540	29.7	62	54	47	137
15	638	80	38	0.0054	8.0	1.6	0.21	328	1,770	3,560	2,660	1.50	0.80	1,960	38.7	70	61	53	95
16	618	80	42	0.0050	13.2	2.4	0.31	338	3,020	5,700	4,390	1.24	1.14	1,550	41.9	78	67	60	112
17	637	80	45	0.0057	15.8	2.4	0.340	340	2,350	4,750	3,550	1.04	1.29	1,480	34.8	72	62	54	112
18	619	80	45	0.0053	15.6	2.9	0.35	305	2,800	4,210	3,500	1.86	1.39	1,710	32.8	73	63	58	106

NOTE.—Pulp for No. 29 was made on a coarse-grit stone.

TABLE 49.—*Quality tests—white pine.*

Grinder run No.	Paper machine run No.	Ground furnish. in total	Weight per ream.	Thickness.	Mullen test.				Schopper tests.						Tintometer indications.								
					Total.	Per 0.001 in. thickness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.			Stretch.			Breaking weight per sq. mm. sec.	Breaking length per horsepower	Red.	Green.	Blue.	Black.			
									Points.	Points.	Points.	Crosswise.	Lengthwise.	Average.							Crosswise.	Lengthwise.	Average.
1	497	80	37	0.0039	14.7	3.8	0.40	305	2,380	4,620	3,500	Meters.	Per ct.	1.22	1.82	1,810	28.7	76	66	60	98		
2	501	80	37	.0044	13.0	3.0	.35	288	2,070	4,090	3,080	Meters.	Per ct.	1.14	1.76	1,560	30.5	77	67	60	96		
3	502	80	36	.0043	12.6	2.9	.35	257	2,120	4,010	3,060	Meters.	Per ct.	1.16	1.67	1,530	34.0	79	70	64	87		
4	503	80	38	.0046	11.2	2.5	.30	256	1,940	3,760	2,850	Meters.	Per ct.	1.12	1.64	1,400	37.0	79	70	64	88		
5	498	80	37	.0042	17.3	4.1	.47	236	2,280	4,890	3,580	Meters.	Per ct.	1.12	1.62	1,790	32.2	77	67	61	95		
6	504	80	34	.0040	13.3	3.4	.39	266	2,070	4,620	3,340	Meters.	Per ct.	1.16	1.70	1,600	32.2	79	69	64	86		
7	499	80	37	.0043	14.2	3.3	.38	268	2,230	4,290	3,260	Meters.	Per ct.	1.22	1.64	1,610	33.2	79	69	62	90		
8	500	80	38	.0044	12.8	2.9	.34	281	1,880	3,770	2,820	Meters.	Per ct.	1.10	1.64	1,410	29.6	78	69	63	90		
9	564	100	36	.0034	18.2	5.3	.50	259	2,270	4,760	3,520	Meters.	Per ct.	.84	1.67	2,260	27.1	57	43	36	164		
10	561	100	35	.0034	17.6	5.2	.49	222	2,220	5,210	3,720	Meters.	Per ct.	2.88	1.28	2,080	33.5	59	59	43	158		
11	562	100	40	.0039	19.6	5.1	.49	221	2,310	5,260	3,780	Meters.	Per ct.	3.76	1.58	2,320	34.8	59	43	36	162		
12	563	100	36	.0035	14.8	4.2	.41	270	2,140	4,510	3,320	Meters.	Per ct.	3.68	2.44	1,980	30.0	59	44	38	159		

TABLE 50.—Quality tests—Englemann spruce (Montana).

Grinder run No.	Paper machine run No.	Ground furnish in total	Weight per ream.	Thickness.	Mullen test.				Schopper tests.						Tintometer indications.					
					Total.	Per 0.001 in. thick- ness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.			Stretch.		Breaking weight per sq. mm. sec.		Breaking length per horsepower	Red.	Green.	Blue.	Black.
									(Crosswise.	Lengthwise.	Average.	(Crosswise.	Lengthwise.								Average.
1	565	80	37	0.0041	12.8	3.1	0.35	226	2,350	4,160	1.04	1.00	1.32	41.2	79	71	64	86		
2	566	80	35	.0040	10.0	2.5	.29	229	2,110	3,790	1.28	.84	1.06	44.5	84	74	65	87		
3	568	80	38	.0044	10.6	2.4	.28	242	2,110	4,030	1.72	1.04	1.38	45.5	82	74	65	77		
4	570	80	27	.0034	7.1	2.1	.26	248	2,090	3,660	1.24	.74	.99	44.6	83	74	66	87		
5	573	80	32	.0039	8.7	2.2	.27	282	2,320	3,710	1.26	.82	1.04	39.6	79	70	64	87		
6	567	80	33	.0038	11.2	2.9	.34	198	2,530	4,540	2.20	1.10	1.05	52.6	82	73	66	79		
7	569	80	35	.0042	9.7	2.3	.28	187	2,210	3,550	1.74	.86	1.30	55.1	84	74	67	75		
8	554	100	33	.0028	21.5	7.7	.65	121	3,160	6,260	4.71	.92	1.70	59.9	49	36	32	183		
9	555	100	37	.0034	22.9	6.6	.62	128	3,030	6,280	3.16	1.30	2.53	58.8	55	42	35	168		
10	556	100	41	.0039	23.5	6.0	.57	125	2,770	5,730	2.62	1.04	1.83	59.7	59	47	40	154		
11	571	80	36	.0044	10.8	2.5	.30	220	2,140	4,160	1.38	.92	1.15	47.8	77	69	60	94		
12	572	80	33	.0038	10.0	2.6	.30	195	2,430	4,360	1.52	.86	1.19	58.1	83	75	67	75		
13	574	80	36	.0043	10.9	2.5	.30	193	2,440	4,180	1.40	.92	1.16	57.1	84	75	69	72		
14	667	80	29	.0033	8.9	2.7	.31	277	2,950	4,780	1.18	.78	.98	44.9	71	65	60	104		
15	673	80	45	.0047	15.7	3.3	.35	210	2,890	5,150	1.94	1.02	1.48	54.7	80	72	67	81		
16	675	80	41	.0046	14.5	3.1	.35	211	2,850	5,280	1.82	1.00	1.41	62.8	82	72	70	71		
17	674	80	38	.0043	13.2	3.1	.35	213	2,850	5,110	2.14	.98	1.55	53.8	79	72	63	86		
18	669	80	40	.0047	14.3	3.0	.36	213	2,620	5,130	1.56	.92	1.24	50.6	75	71	64	80		
19	677	80	36	.0043	10.5	2.4	.29	235	2,540	4,640	1.42	.86	1.14	52.5	81	73	66	80		

TABLE 51.—*Quality tests—Engelmann spruce (Colorado).*

Grinder run No.	Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Thickness.	Mullen test.				Schopper tests.						Tintometer indications.			
					Total.	Per 0.001 in. thickness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.		Stretch.		Breaking weight per sq. mm. sec.	Breaking length per horsepower	Red.	Green.	Blue.	Black.
					Points.	Points.	Points.		Meters.	Meters.	Per ct.	Lengthwise.	Per ct.	Meters.	Parts.	Parts.	Parts.	Parts.
1	466	80	35	0.0039	15.6	4.0	0.45	246	2,880	5,390	2.00	1.18	1.59	2,190	75	67	62	96
2	467	80	30	.0034	10.2	3.0	.34	267	2,560	4,360	2.12	1.14	1.63	1,830	79	73	67	81
3	468	80	35	.0040	11.8	3.0	.34	251	2,580	4,680	1.78	1.08	1.43	1,910	79	73	67	81
4	740	80	37	.0044	10.7	2.5	.29	346	2,150	4,030	1.36	.92	1.14	1,560	72	65	60	103
5	469	80	31	.0040	9.0	2.3	.29	266	2,400	4,050	1.64	1.02	1.33	1,540	81	72	66	81
6	470	80	32	.0038	10.2	2.7	.32	252	2,400	4,450	1.58	1.06	1.32	1,710	81	74	67	78
7	471	80	31	.0036	9.2	2.6	.30	260	2,500	4,070	1.64	1.04	1.34	1,610	81	73	67	79
8	472	80	32	.0038	10.6	2.8	.33	230	2,510	4,200	1.96	1.08	1.52	1,660	79	72	65	84
9	515	80	36	.0042	13.2	3.1	.27	335	2,200	4,890	1.86	1.10	1.48	1,870	79	70	64	87
10	516	80	35	.0040	11.4	2.9	.33	226	2,140	4,230	1.56	.92	1.34	1,630	82	73	65	80
11	517	80	35	.0043	12.1	2.8	.30	204	2,380	3,360	1.78	.82	1.24	1,440	84	77	69	70
12	518	80	36	.0045	10.7	2.4	.35	223	2,170	3,920	1.38	1.22	2.30	3,200	55	41	35	169
13	538	100	48	.0040	34.4	8.7	.72	157	2,720	6,150	4.40	1.66	2.31	3,020	52	39	31	178
14	539	100	40	.0035	26.2	8.0	.66	134	2,750	5,540	4.140	1.06	2.31	3,050	52	38	30	180
15	540	100	37	.0031	22.6	7.2	.61	155	2,510	6,030	4.270	1.12	1.88	2,850	54	41	33	172
16	541	100	45	.0039	23.3	6.0	.57	160	2,310	5,930	4.120	1.10	1.86	3,560	54	41	33	180
17	524	100	45	.0039	31.4	8.1	.70	140	3,220	7,410	5.320	1.12	1.61	3,000	60	47	41	152
18	525	100	46	.0045	25.8	5.8	.56	154	3,220	6,770	5.000	2.62	1.12	3,000	71	60	55	114
19	116	80	36	.0032	9.3	2.9	.26	292	1,580	2,630	1.26	.58	1.63	1,480	68	60	60	112
19	650	80	32	.0040	9.7	2.4	.30	253	2,140	4,480	1.62	.92	1.27	1,370	76	71	64	89

Commercial.

TABLE 52.—Quality tests—Sitka spruce.

Grinder run No.	Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Thickness.	Mullen test.				Schopper tests.						Tintometer indications.					
					Total.	Per 0.001 in. thick- ness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.			Stretch.			Breaking length per sq. mm. sec.	Breaking length per horsepower	Red.	Green.	Blue.	Black.
									Crosswise.	Lengthwise.	Average.	Crosswise.	Lengthwise.	Average.						
2	211	80	30	0.0034	13.4	4.0	0.45	262	2,950	5,400	4,170	2.24	1.14	1.09	1,990	35.4	66	58	53	Parts. 123
5	263	100	51	0.0041	28.6	6.5	.56	234	3,070	6,000	4,540	2.66	1.58	2.12	2,940	34.6	44	28	22	Parts. 206
6	264	100	51	0.0041	33.8	8.2	.66	195	3,120	6,700	4,910	2.26	1.44	1.85	3,280	38.1	38	23	18	Parts. 221
7	265	100	42	0.0034	24.2	7.0	.58	195	3,380	6,850	5,120	2.10	1.46	1.78	3,380	45.1	35	21	16	Parts. 228
8	365	80	35	0.0037	17.8	4.8	.51	245	2,930	5,400	4,160	3.32	1.56	2.44	2,040	33.2	77	65	57	Parts. 101
9	366	80	39	0.0041	18.1	4.4	.46	244	3,040	5,610	4,320	2.38	1.54	1.96	2,070	38.5	74	63	56	Parts. 107
10	367	80	36	0.0038	16.2	4.3	.45	240	2,860	5,240	4,320	2.74	1.44	2.09	1,960	37.5	72	62	56	Parts. 110
11	368	80	36	0.0043	17.0	4.0	.44	239	2,640	5,010	3,820	3.06	1.56	2.31	1,850	36.4	72	61	55	Parts. 112
12	388	80	36	0.0036	18.3	5.1	.51	415	3,360	6,140	4,800	2.02	1.18	1.73	2,480	36.4	66	54	50	Parts. 130
13	389	80	38	0.0038	20.2	5.3	.53	294	3,490	6,120	4,800	2.34	1.12	1.60	2,560	30.8	71	60	53	Parts. 116
14	370	80	33	0.0035	16.2	4.6	.49	286	3,020	6,720	4,370	2.60	1.46	2.03	2,090	31.2	68	57	51	Parts. 124
15	343	80	36	0.0038	15.4	4.1	.43	335	3,200	5,760	4,480	1.86	1.26	1.56	2,250	31.1	71	59	50	Parts. 120
16	324	81	32	0.0032	15.4	4.9	.48	779	2,800	5,570	4,180	2.44	1.72	2.08	2,240	19.5	60	50	43	Parts. 147
17	295	100	48	0.0037	27.2	7.3	.56	429	3,190	6,160	4,680	2.76	1.76	2.26	2,400	11.2	35	21	16	Parts. 228
18	325	80	26	0.0027	10.6	3.9	.41	976	3,190	5,510	4,350	2.36	1.62	1.99	2,300	10.9	64	52	45	Parts. 139
19	13	75	40	0.0034	9.8	2.9	.25	408	1,450	3,640	2,540	1.24	.98	1.11	1,720	24.9	65	60	60	Parts. 115
19	446	80	33	0.0040	12.6	3.2	.38	208	2,640	4,610	3,620	2.44	1.16	1.80	1,600	35.5	73	61	50	Parts. 116

1 Commercial.

TABLE 53.—Quality tests—white birch.

Grinder run No.	Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Thickness.	Mullen test.			Schopper tests.						Tintometer indications.						
					Total.	Per 0.001 in. thickness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.			Stretch.		Breaking weight per sq. mm. sectional area.	Breaking length per horsepower.	Red.	Green.	Blue.	Black.	
									Crosswise.	Lengthwise.	Average.	Crosswise.	Lengthwise.							Average.
1	237	80	32	0.0029	15.8	Points. 5.5	0.49	135	Meters. 2,470	5,130	3,800	Per ct. 1.52	1.12	1.32	Grams. 2,121	Meters. 57.4	Parts. 34	20	16	230
2	216	80	33	0.0046	6.4	1.4	0.19	596	1,660	2,630	2,140	1.34	1.26	1.14	840	18.9	74	63	58	105
3	322	100	48	0.0042	24.7	5.8	0.51	150	2,580	4,600	3,590	2.96	1.96	1.11	2,310	46.7	36	22	16	226
4	278	100	52	0.0049	24.0	4.9	0.46	155	2,730	3,800	3,260	2.24	1.34	1.77	1,990	45.8	38	24	19	219
5	274	100	57	0.0053	27.8	5.2	0.49	152	2,950	4,880	3,920	2.72	1.24	1.98	2,300	52.5	39	24	19	218
6	425	80	34	0.0046	9.8	2.1	0.29	667	2,190	3,870	3,030	1.58	0.92	1.25	1,280	15.7	69	59	54	118
7	427	80	35	0.0046	8.6	1.9	0.25	629	2,010	3,540	2,780	1.44	0.76	1.10	1,110	17.7	66	56	60	118
8	426	80	34	0.0049	8.7	1.8	0.25	519	2,010	3,520	2,820	1.02	0.66	0.84	960	21.8	66	55	47	132
9	428	80	34	0.0049	7.4	1.5	0.22	512	1,810	2,900	2,360	1.10	0.64	0.87	1,130	21.0	73	60	53	114

TABLE 54.—Quality tests—aspens.

Grinder run No.	Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Thickness.	Mullen test.				Schopper tests.				Tintometer indications.								
					Total.	Per 0.001 in. thickness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.		Stretch.		Breaking weight per sq. mm. sectional area.	Breaking length per horsepower.	Red.	Green.	Blue.	Black.			
									Crosswise.	Lengthwise.	Average.	Crosswise.							Lengthwise.	Average.	
1	234	80	32	0.0028	12.8	4.6	0.40	158	Meters.	4,130	3,110	Per ct.	1.45	Grams.	1,760	Meters.	49.1	44	30	23	203
2	217	80	33	0.0042	9.8	2.3	0.30	464	Meters.	2,080	4,130	Per ct.	1.24	Grams.	1,340	Meters.	22.0	73	63	56	108
3	262	100	61	0.0049	28.2	5.7	0.46	138	Meters.	2,240	3,880	Per ct.	1.66	Grams.	3,060	Meters.	61.2	37	23	18	222
4	261	100	55	0.0045	29.9	6.6	0.54	131	Meters.	2,810	4,960	Per ct.	3.06	Grams.	2,680	Meters.	64.6	36	23	18	223
5	260	100	63	0.0052	32.2	6.2	0.51	118	Meters.	3,290	5,850	Per ct.	2.72	Grams.	3,140	Meters.	67.8	38	23	18	221
6	436	80	31	0.0039	11.0	2.8	0.36	870	Meters.	2,760	5,240	Per ct.	2.13	Grams.	2,820	Meters.	42.3	72	64	56	108
7	437	80	29	0.0038	9.2	2.4	0.32	690	Meters.	2,460	4,120	Per ct.	1.48	Grams.	1,680	Meters.	14.9	73	63	56	108
8	438	80	28	0.0038	8.4	2.2	0.29	606	Meters.	2,440	4,250	Per ct.	1.20	Grams.	1,390	Meters.	18.4	69	62	54	115
9	439	80	34	0.0045	9.8	2.2	0.29	559	Meters.	2,440	3,500	Per ct.	1.01	Grams.	1,390	Meters.	17.7	76	66	57	101
10	440	80	35	0.0040	14.2	3.6	0.41	1,040	Meters.	2,690	4,870	Per ct.	1.19	Grams.	1,780	Meters.	8.8	72	60	50	118
11	441	80	32	0.0039	12.0	3.1	0.38	781	Meters.	2,740	4,640	Per ct.	1.28	Grams.	1,680	Meters.	12.4	73	60	53	114
12	442	80	33	0.0041	12.2	3.0	0.37	625	Meters.	2,660	4,270	Per ct.	1.06	Grams.	1,550	Meters.	15.0	73	67	49	111
13	443	80	32	0.0041	10.9	2.7	0.34	509	Meters.	2,640	4,490	Per ct.	1.14	Grams.	1,520	Meters.	20.6	73	61	52	114

TABLE 55.—Quality tests—black gum.

Grinder run No.	Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Thickness.	Mullen test.				Schopper tests.						Tintometer indications.			
					Total.	Per 0.001 in. thickness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.		Stretch.		Breaking weight per sq. mm. sec.	Breaking length per ton.	Red.	Green.	Blue.	Black.
				Inch.	Points.	Points.	Points.		Meters.	Lengthwise.	Average.	Meters.	Grams.	Meters.	Parts.	Parts.	Parts.	Parts.
1	727	80	34	0.0043	10.3	2.1	0.30	870	2,100	5,130	3,680	1.18	1.00	14.0	76	68	64	92
2	732	80	35	.0045	8.7	2.2	.28	818	1,800	4,270	3,040	1.42	1.16	13.3	80	71	65	84
3	728	80	35	.0046	8.6	1.8	.25	867	1,860	3,950	2,900	1.38	1.06	20.5	80	72	66	82
4	629	80	37	.0052	9.5	1.8	.26	658	1,760	3,280	2,520	1.84	.86	14.7	81	74	70	75
5	738	80	33	.0048	8.6	1.8	.26	667	1,680	3,830	2,760	1.28	.96	15.9	76	66	64	94
6	651	80	43	.0055	10.8	2.0	.23	787	2,080	3,880	2,980	1.84	1.06	16.5	77	71	66	86
7	630	80	41	.0056	8.9	1.6	.22	777	1,540	3,000	2,270	1.56	.96	13.3	81	72	68	79
8	628	80	47	.0067	7.6	1.1	.16	465	1,210	2,110	1,660	1.34	.84	22.3	85	74	67	74
9	688	100	42	.0056	7.4	1.3	.18	401	1,410	2,460	1,940	1.22	.86	26.8	88	56	50	126
10	693	100	48	.0049	21.2	4.4	.44	190	2,370	5,460	3,920	1.86	1.40	47.0	45	33	31	191
11	695	100	43	.0043	18.0	4.2	.42	229	2,560	5,240	3,850	2.58	1.14	40.0	49	37	32	182
12	694	100	53	.0054	20.9	3.9	.39	207	2,560	4,890	3,720	2.08	1.42	46.1	50	38	33	179
13	656	80	44	.0060	6.5	1.1	.15	545	1,370	2,440	1,900	1.08	.90	23.2	77	68	64	91
14	711	80	47	.0066	5.1	.8	.11	644	1,980	1,820	1,400	1.00	.66	19.8	82	73	67	78

NOTE.—Pulp for No. 14 was made on a coarse-grit stone.

TABLE 56.—*Quality tests.*
MIXTURE OF WOODS.

Grinder run No.	Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Thickness.	Mullen test.				Schopper tests.						Tintometer indications.				
					Total.	Per 0.001 in. thickness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.			Stretch.		Breaking weight per sq. mm. sectional area.	Breaking length per horsepower.	Red.	Green.	Blue.	Black.
									Meters.	Meters.	Average.	Crosswise.	Lengthwise.							Per cl.	Per cl.	Average.
50	312	100	42	0.0040	17.4	4.4	0.41	227	2,580	4,780	3,680	2.62	1.44	2.03	39.4	39	23	16	222
51	314	100	42	.0039	16.5	4.2	.39	273	2,360	4,560	3,400	2.28	1.58	1.93	32.5	42	44	17	217
52	313	100	49	.0044	19.6	4.4	.40	254	2,640	5,020	3,830	3.08	1.50	2.29	37.8	38	22	15	225
WESTERN YELLOW PINE.																			
20	407	80	32	0.0039	13.8	3.5	0.43	227	2,980	4,850	3,920	1.72	.90	1.31	40.2	79	66	57	98
21	424	80	34	.0042	12.6	3.0	.37	272	2,650	5,230	3,940	1.48	.96	1.22	39.2	75	64	64	107
22	410	80	35	.0045	13.5	3.0	.39	267	2,790	5,060	3,920	1.56	.84	1.20	37.7	70	59	52	119
23	411	80	31	.0038	12.8	3.4	.41	262	3,000	5,200	4,130	1.46	.82	1.14	38.5	70	59	51	120
24	406	80	32	.0041	11.4	2.8	.36	330	2,440	4,270	3,360	1.52	.90	1.21	38.3	67	54	45	134
25	412	80	32	.0041	11.4	2.8	.36	321	2,740	4,290	3,520	1.76	.80	1.28	30.4	69	56	47	128
26	413	80	36	.0046	13.6	3.0	.38	300	2,770	4,970	3,870	1.68	.92	1.30	34.0	68	55	47	130
WESTERN HEMLOCK.																			
15	404	80	31	0.0035	18.2	5.2	0.59	233	3,310	5,730	4,520	2.32	1.14	1.73	33.0	65	54	48	133
16	414	80	37	.0040	19.5	4.9	.53	272	3,390	6,510	4,950	2.14	1.20	1.67	34.4	64	54	47	135
17	415	80	35	.0036	21.2	5.9	.60	247	4,040	6,620	5,330	2.26	1.02	1.64	36.0	65	55	49	131

MONTANA LODGEPOLE PINE.

24	417	80	35	0.0040	13.8	3.4	0.39	289	2,520	4,760	3,640	2.76	1.48	2.12	1,760	31.2	58	47	40	155
25	416	80	36	.0042	15.4	3.7	.43	284	2,440	4,640	3,540	2.78	1.44	2.11	1,620	29.0	65	54	47	134

CALIFORNIA LODGEPOLE PINE.

22	418	80	35	0.0041	15.5	3.8	0.44	398	3,080	5,810	4,450	1.98	1.12	1.55	2,090	25.4	67	57	49	127
23	419	80	31	.0038	12.0	3.1	.38	388	2,770	5,120	3,940	2.02	1.06	1.54	1,770	26.7	67	56	49	128
24	420	80	30	.0035	13.3	3.8	.44	400	3,160	5,860	4,510	1.70	1.00	1.35	1,960	25.7	73	61	52	114
25	421	80	35	.0038	16.6	4.4	.48	346	3,290	5,820	4,560	2.16	1.02	1.59	2,290	27.5	69	58	51	122

GREEN BALSAM.

23	110	75	33	0.0029	8.4	2.9	0.26	368	1,820	3,460	2,640	1.12	.74	.93	1,690	27.6	63	57	57	123
23	453	80	33	.0040	14.2	3.5	.43	222	2,880	4,820	3,850	1.90	1.00	1.45	1,720	40.2	83	77	66	74

HEMLOCK.

63	19	75	36	0.0031	9.8	3.2	0.27	470	1,790	3,830	2,810	1.12	.84	.98	1,860	22.1	55	50	50	145
63	452	80	34	.0039	14.5	3.7	.43	296	2,940	5,100	4,020	1.82	1.00	1.41	1,870	31.7	78	66	60	96

TAMARACK.

54	112	75	36	0.0034	9.9	2.9	0.27	327	1,860	3,560	2,710	1.14	.78	.96	1,800	30.7	59	54	54	133
54	455	80	37	.0046	13.6	3.0	.37	238	2,520	4,580	3,550	1.78	1.06	1.42	1,650	40.2	77	66	61	96

1 Commercial.

TABLE 57.—Commercial runs.

Stock No. of pulp.	Kind of wood.	Run No.	Kind of burr.	Number of pockets used.	Pressure on 14-inch cylinder.	Pressure per square inch.	Revolutions per minute.	Peripheral speed.	Average horsepower to grinder.	Maximum horsepower to grinder.	Bone-dry pulp in 24 hours.	Horsepower per ton bone-dry pulp in 24 hours.	Solid rossi wood ground in 24 hours.	Weight per cubic foot bone-dry wood.	Average diameter of wood.	Moisture in wood.	Bone-dry pulp per 100 cubic feet solid rossi wood.	Efficiency of conversion.	Screenings per 100 cubic feet solid rossi wood bone-dry.	Average temperature of grinding.	Horsepower divided by pressure $\times$ speed.	
					Lbs. per sq. in.	Lbs.		Feet per minute.		Tons			Cu. ft.	Lbs.	In.	Per cent.	Lbs.	Per cent.	Lbs.	$^{\circ}$ F.		
	Green jack pine.	14	Diamond point, cut 6 to inch	3	50 20.5	20 20.5	171	2,400	436	7.030	64.3		83.0	24.84			46.23	2,030	83.1	16.3	109	.00853
	Seasoned jack pine.	14	do.	3	50 20.5	20 20.5	171	2,400	447	6.220	72.7		83.0	24.84			37.16	2,170	85.5	14.8	148	0.00885
	Hemlock.	14-1	Spiral, cut 10 to inch.	3	50 20.5	20 20.5	175	2,435	349	447.3	103.1	334.0	24.8	24.8			57.18	2,210	86.4	10.6	145	.00907
	do.	14-1	do.	3	50 20.5	20 20.5	175	2,432	368	464.4	115	398.0	24.8	24.8			57.18	2,077	83.7	18.5	167	.00939
	do.	8	Spiral, cut 10 to inch.	3	40 16.4	16 4	176	2,450	306	426.3	435	328.0	24.8	24.8			57.18	2,083	84.0	20.3	168	.00740
	do.	23	Diamond point, 10 to inch.	3	40 16.4	16 4	176	2,440	301	380.3	300	92.4	313.0	24.8			57.18	2,105	84.9	23.5	173	.00750
	do.	30	Spiral, cut 10 to inch.	3	40 16.4	16 4	176	2,432	331	392.3	725	89.5	355.0	24.8			57.18	2,102	84.7	17.0	177	.00833
	Hemlock.	46A	Spiral, cut 3 to inch; straight, cut 12 to inch.	3	50 20.5	20 20.5	175	2,445	427	507.5	175	83.0	334.0	24.84			46.23	2,030	83.1	16.3	109	.00853
	Spruce.	51	do.	3	50 20.5	20 20.5	175	2,445	443	528.5	575	79.4	100.0	25.6			37.16	2,232	83.2	17.4	171	.00884
	Hemlock.	24	do.	3	40 16.4	16 4	175	2,445	395	430.5	388.0	91.8	388.0	25.60			37.16	2,220	86.7	14.86	176	.00924
	Spruce.	1	do.	3	50 20.5	20 20.5	175	2,445	401	481.0	28.40	83.5	280.0	28.40			47.17	2,230	86.2	17.2	173	.....
	do.	52	do.	3	50 20.5	20 20.5	175	2,445	414	494.4	310	96.3	386.0	25.20			47.17	2,230	86.2	17.6	178	.00825
	Jack pine.	50	do.	3	50 20.5	20 20.5	175	2,445	418	484.4	370	97.5	405.0	25.0			46.90	2,160	86.1	11.2	180	.00833
	Hemlock.	2	do.	3	40 16.4	16 4	200	2,795	402	412.0	97.5	409.5	22.72	22.72			39.33	2,012	88.5	13.75	168	.01002
1	Spruce.	222	do.	2	80 32.8	32 8	225	3,069	474	560.6	610	71.6	551.0	25.37			32.24	2,400	94.6	14.65	166	.00760
2	Western hemlock.	18	do.	2	50 20.5	20 20.5	225	3,069	479	560.6	800	126.0	338.0	24.77			32.24	2,250	91.0	10.80	169	.00760
3	Sitka spruce.	19	do.	2	50 20.5	20 20.5	225	3,069	458	541.4	495	102.0	435.0	23.00			22.60	2,065	89.9	32.50	169	.00760
4	Montana lodgepole pine.	26	do.	2	55 22.55	22 55	225	3,069	500	581.3	630	137.8	334.0	24.61			25.00	2,175	88.3	12.20	173	.00723
5	Western yellow pine.	27	Spiral, cut 8 to inch; straight, cut 10 to inch.	3	40 16.4	16 4	225	3,069	455	541.7	055	64.5	635.0	24.67			26.98	2,220	90.0	30.20	137	.00904
6	Green balsam fir.	22	do.	3	40 16.4	16 4	225	3,069	481	543.5	330	90.4	546.0	20.75			26.40	1,950	94.1	8.45	151	.00955
7	California lodgepole pine.	26	do.	2	80 32.8	32 8	225	3,069	496	580.6	405	77.5	642.0	22.45			26.30	1,996	88.9	21.6	156	.00992
8	Red fir.	19	do.	2	80 32.8	32 8	225	3,069	483	580.5	710	84.6	571.0	21.59			26.50	2,000	92.7	12.6	158	.00979

9	{ Spruce..... Hemlock..... Green balsam }	63	do.....	3	50	20.5	225	5,069	516	592	4.075	127.0	{ 179.0 179.0 254.0 209.0 24.93 }	54	33.55	2,230	92.1	12.00	177	.00820
10	{ spruce..... Tamarack..... }	23	do.....	3	40	16.4	225	3,069	476	542	4.980	95.6	{ 254.0 209.0 24.93 }	54	61.66	2,160	96.2	11.50	157	.00945
11	{ do..... do..... }	53	do.....	3	40	16.4	225	3,069	430	505	4.510	95.4	{ 324.0 324.0 32.44 }	54	25.25	2,780	85.6	10.10	170	.00854
12	{ do..... do..... }	54	do.....	2	65	26.6	225	3,069	415	503	4.705	88.2	{ 185.0 205.0 23.74 }	54	25.00	2,410	89.4	13.75	157	.00509
13	{ Noble fir..... Alpine fir..... }	16	do.....	3	50	20.5	225	3,020	393	504	4.275	92.0	{ 442.0 21.05 }	(1)	34.80	1,933	91.9	14.8	151	.00636
14	{ do..... do..... }	13	Spiral, cut 12 to inch; straight, cut 3 to inch.	3	50	20.5	225	3,020	430	579	5.110	84.0	{ 479.0 21.60 }	73	43.00	.....	.....	16.2	156	.00695
15	{ White fir..... do..... }	35	Spiral, cut 8 to inch; straight, cut 10 to inch.	3	45	18.5	225	3,020	384	477	4.775	80.4	{ 498.0 20.80 }	(1)	20.58	1,920	92.2	16.4	162	.00687
16	{ Engelmann spruce, Colorado. }	19	do.....	2	70	28.7	225	3,020	368	479	4.840	76.0	{ 488.0 21.17 }	61	58.26	1,980	93.6	12.8	153	.00425
17	{ Amabilis fir..... do..... }	15	do.....	2	80	32.8	225	3,020	397	502	4.900	81.0	{ 485.0 21.10 }	(1)	25.27	2,020	95.7	10.3	159	.00401

1 Split.

TABLE 58.—Quality tests of papers made from "commercial" pulps.

Stock No. of pulp.	Kind of wood.	Grinder run No.	Paper machine run No.	Ground wood in total furnish.	Weight per ream.	Thickness.	Mullen test.				Schopper tests.				Tintometer indications.					
							Total.	Per 0.001 in. thick-ness.	Per pound.	Horsepower per ton divided by strength factor.	Breaking length.		Stretch.		Breaking weight per sq. mm., sec.	Breaking length per horsepower.	Rod.	Green.	Blue.	Black.
											Meters.	P. c.	Lengthwise.	Average.						
							Points.	Points.	Point.		Meters.	P. c.	P. c.	P. c.	Grams.	Meters.	Parts.	Parts.	Parts.	Parts.
1	White spruce.....	222	444	11	320.0040	0.37	11.9	3.0	0.37	194	2,730	1.68	0.88	1.28	1,610	51.9	72	60	52	116
2	Western hemlock.....	18	445	8	320.0029	0.37	8.8	3.0	0.28	256	1,880	2.80	1.26	1.04	1,760	39.2	58	58	58	118
3	Sitka spruce.....	19	446	12	320.0038	0.37	17.8	3.6	0.52	242	3,000	2.80	1.46	2.13	2,080	34.6	52	45	45	139
4	Lodgepole pine (Montana).....	20	447	10	320.0028	0.37	10.1	3.6	0.52	242	3,000	2.80	1.46	2.13	2,080	34.6	52	45	45	139
5	Western yellow pine.....	27	448	10	320.0034	0.37	12.6	3.2	0.38	208	2,440	3.60	1.16	1.80	1,600	26.7	63	61	50	116
6	Balsam fir.....	22	449	13	320.0038	0.37	9.8	2.9	0.25	208	2,440	3.60	1.16	1.80	1,600	26.7	63	61	50	116
7	Lodgepole pine (California).....	26	450	14	320.0028	0.37	13.8	3.6	0.42	328	2,840	2.94	1.24	1.98	1,720	24.9	65	60	60	116
8	Red fir.....	19	451	18	320.0034	0.37	9.8	2.9	0.26	248	1,870	3.90	1.20	1.98	1,980	28.2	71	57	46	126
9	Hemlock (one-half spruce).....	63	452	80	320.0031	0.37	14.5	3.7	0.27	210	2,150	2.70	1.18	1.74	1,940	29.9	61	56	56	127
10	Balsam fir (one-half spruce).....	23	453	80	320.0040	0.37	14.2	3.5	0.27	470	1,790	3.830	1.12	1.84	1,800	22.1	80	69	60	145
11	Tamarack.....	53	454	80	320.0029	0.37	8.4	2.9	0.26	368	2,940	3.500	1.52	1.90	1,720	31.7	78	66	60	145
12	Tamarack (one-half spruce).....	54	455	80	320.0040	0.37	13.6	3.0	0.37	238	2,520	3.550	1.78	1.06	1,650	40.2	77	66	61	96
13	Noble fir.....	16	647	80	320.0035	0.37	16.6	4.8	0.49	188	3,370	3.560	1.14	1.78	1,960	30.7	59	54	54	133
14	Alpine fir.....	13	640	80	320.0043	0.37	12.6	4.5	0.36	256	2,800	4.630	1.60	1.96	2,100	37.4	63	56	55	126
15	White fir.....	35	649	80	320.0041	0.37	8.2	3.1	0.28	300	2,340	3.020	1.16	1.68	1,920	27.8	68	61	63	108
16	Engelmann spruce (Colorado).....	19	650	80	320.0038	0.37	9.7	2.4	0.30	233	2,430	3.100	1.18	1.80	2,170	34.7	75	66	66	108
17	Amabilis fir.....	15	653	80	320.0038	0.37	13.8	3.7	0.42	232	2,840	3.130	1.26	1.58	1,970	26.5	62	57	55	126
							10.2	3.1	0.28	290	3,700	2.780	1.74	1.01	1,860	34.3	68	61	60	111

APPENDIX B.

(Containing the following paper samples.)

Kind of wood used.	Untreated wood.			Cooked wood.
	Grinder run No. (Exp. paper).	Stock No. Unprinted news.	Stock No. Printed news.	Grinder run No.
White spruce.....	222	1	1	190
Western hemlock.....	18	2	2	9
Sitka spruce.....	19	3	3	6
Lodgepole pine (Montana).....	26	4	4	14
Western yellow pine.....	27	5	5	8
Balsam fir.....	22	6	6	27
Lodgepole pine (California).....	23	10	10	
Red fir.....	26	7	7	1
Hemlock.....	19	8	8	2
Tamarack.....	63	9	9	161
Noble fir.....	53	11	11	27
Alpine fir.....	54	12	12	
White fir.....	16	13	13	11
Engelmann spruce (Colorado).....	13	14	14	12
Amabilis fir.....	35	15	15	224
Jack pine.....	19	16	16	14
White pine.....	15	17	17	10
Aspen.....	27	.....	.....	30
Birch.....	8	.....	.....	11
Black gum.....	2	.....	.....	3
Loblolly pine (fall cut).....	9	.....	.....	5
Loblolly pine (spring cut).....	3	.....	.....	10
Lowland fir.....	6	.....	.....	19
Engelmann spruce (Montana).....	28	.....	.....	18
Western larch.....	13	.....	.....	2
	16	.....	.....	10
	8	.....	.....	1

¹ Or No. 62.

² Or No. 10.

1890-1891

1891-1892

White Spruce.

Grinder Run No. 222.

Western Hemlock.

Grinder Run No. 18.

Sitka Spruce.

Grinder Run No. 19.

Lodgepole Pine. --- Montana..

Grinder Run No. 26.

Western Yellow Pine.

Grinder Run No. 27.

Balsam Fir.

Grinder Run No. 22.

Balsam Fir.

Grinder Run No. 23.

Lodgepole Pine. --- California.

Grinder Run No. 26.

Red Fir.

Grinder Run No. 19.

Hemlock.

Grinder Run No. 63.

Tamarack.

Grinder Run No. 53.

Tamarack.

Grinder Run No. 54.

Noble Fir.

Grinder Run No. 16.

Alpine Fir.

Grinder Run No. 13.

White Fir.

Grinder Run No. 35.

Engelmann Spruce --- Colorado.

Grinder Run No. 19.

Amabilis Fir.

Grinder Run No. 15.

1897

1898

Jack Pine.

Grinder Run No. 27.

White Pine.

Grinder Run No. 8.

Aspen.

Grinder Run No. 2.

Birch.

Grinder Run No. 9.

Black Gum.

Grinder Run No. 3.

Loblolly Pine --- fall cut.

Grinder Run No. 6.

Loblolly Pine --- Spring Cut.

Grinder Run No. 28.

Lowland Fir.

Grinder Run No. 13.

Engelmann Spruce --- Montana.

Grinder Run No. 16.

Western Larch.

Grinder Run No. 8.

Stock No. 1.

White Spruce.

Stock No. 1

White Spruce

AND OTHER SP

S—HARRY SALLEE PICKLES THE **Stock No. 1** HUGGINS' MEN L

Vin Three Out of Four From Reds Tinker's Men on Their Heads After First bard Three Cincinnati Twirlers

looking for right off the reel. "Reb" Oakes punched a single to center, scoring Mowrey and Sheekard. Marsans tossed the ball home and Oakes grabbed second. Gee, how those Red outfielders love to zing the ball around! O'Leary walked. Joe Tinker danced the high-land fling in the middle of the diamond.

"You're wilder than Powell," shouted "Tink" to his pitcher. "Don't bawl me out, that's something I can't stand," replied Works.

"Well, if I can't bowl you out, I

fundo voice back of the Reds' bench.

"I'd like to climb into the stand and choke you to death," said "Tink."

"Gee, but you're a nice, mild, gentle sort of an animal," said the bass drummer as he fled to a safer spot.

Harry Sallee spanked the leather savagely all afternoon. Harry and "Tink" led their respective teams with the big stick. "Tink" got three rousing wallops and the "Higginsport Huckleberry" also hit the center of the bull's-eye three times.

"Sal" started the

FEV

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Carnegie Is Coming Here For Peace Talk Thursday; College Contest To-Night

Other Distinguished Guests Arriving—Lineal Descendant to Unveiling Jefferson Statue.

Distinguished guests who will participate in the dedication of the Jefferson Memorial building, the unveiling of the Jefferson statue and the deliberations of the Fourth American Peace Congress already are arriving in St. Louis.

Andrew Carnegie, who will deliver an address Thursday afternoon at the session of the Peace Congress, is expected to reach St. Louis to-morrow afternoon or Thursday morning. He will be accompanied by Mrs. Carnegie. They will be the guests while in St. Louis of Robert S. Brookings at his home on Lindell boulevard.

Miss Natalie Norton of Elsberry, Mo., a lineal descendant of Thomas Jefferson, was chosen yesterday to unveil the Jefferson statue. Miss Norton is the daughter of Porter Norton of Elsberry.

The first of the Peace Congress ceremonies, which will continue throughout the week, will be to-night in the Sheldon Memorial Auditorium. This is the Missouri oratorical contest of the Intercollegiate Peace Association.

Former Judge Selden P. Spencer will preside. A student from each of six Missouri colleges will compete. The first prize of \$75 is offered by the Intercollegiate Peace Association, and the second prize of \$50 is offered by the American Peace Congress.

Tierney St. Louis U. Orator.

Central College, at Fayette, will be represented by Edward Verson Nash, who will speak on "Our Relation to Peace." John Leo Tierney of St. Louis University will speak on "International Peace." George C. Wilson of the University of Missouri will speak on "They, Too, Are Brothers."

Washington University will be represented by R. J. Puchschmidt, whose oration is entitled "The Justice and Honor of Nations." Westminster College, at Fulton, is represented by Sidna Poage Dalton. His subject is "The Demand for International Peace." William Jewell College, at Liberty, will be represented by Frank R. Birkhead, who will have for his subject "War, the Sum Total of Wretchedness."

More than 1,000 delegates from all sections of the country and many distinguished persons from abroad will at-

MRS. D. A. McDOUGAL.

MRS. MARGARET J. MONROE.

MRS. ARTHUR H. GEISSLER.

MRS. CLAUDIA HAZEN WHITE.

MISS ALICE

Stock No. 2.

Western Hemlock.

nce or friendship, but rather one o
osing the best possible man for th

Western Hemlock.

0011

LOSES ITS CHARTER

U.S.

5201-03 Delmar

The smallest thing you ever saw is a ponderous mass when compared with the variation allowed in some of the parts which go into Chalmers cars

Accurate fit is the most essential feature of a good running shoe. Durable motor

The Smallest

1913 Model 17-5-Pass

Made in China

Chalmers
MOTOR

**FOR JOBS
TODAY**

**Get Great Clash
e and Gordon
ner's Scalp.**

**N RUNS FAST
Is in Line
at Arms to
Wray.**

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value of said rec-
the City Council
to effect its per-
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sergeant-at-arms,
Democrats and
the fact that he is
re-elected, Moone
and Gordon doubt-

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many lines at a fra

CLEAR

About
SPRI

Hal

Silk
75c, \$

50c Silk

SILK
at \$4.5

Hand
40%

SHIRTS
Go at **95c**
\$2.50 Imported Madras

SHIRTS
Go at **75c**
\$1.50 Negligee and Pleated

HATS
at **95c** Each
75c qualities of

SHIRTS and DRAWERS
All styles and sizes,
at **45c**

White Shirts
ALL
30% Off

"Where
Quality is

Stock No. 3.

Sitka Spruce.

RECORD OF BIRTHS

Boys.

and A. Allee, 5609 Michigan.
and S. Bahr, 8424 Pennsylvania.
and L. Lewis, 3021 Rauschenbach.
and M. Juch, 4431 Penrose.
and C. Knaus, 4431 Wilmington.
and D. Jaffke, 4638 S. Grand.
and A. Leisinger, 4324 Clayton.
and A. O'Connell, 5219 Theodosia.
and A. Langer, 4205 Warne.
and E. Evans, 1806 Nebraska.
and A. Schutt, 2352 Arkansas.
and M. Seville, 1842 S. Fourteenth.
and M. Fischer, 4508 N. Broadway.
and M. Murray, 8501 Grace.
and C. Wenc, 1418 N. Ninth.
and K. Schuermann, 2906 Palm.
and M. Rogers, 4207 Fair.
and N. Etz, 2804 Market.

Girls.

and I. Hanneck, 2629 Gravela.
and H. Hoffman, 2314 La Salle.
and A. Vogel, 3634 Tholozan.
and M. Mowrey, 2903 Sullivan.
and L. Hiseleyer, 4361 N. Broadway.
and M. Weston, 4816 Washington.
and B. Stevens, 1016 S. Eighth.
and A. Spencer, 6214 Washington.
and B. Odenwalder, 2609 S. Eighteenth.
and A. Zibb, 1040 Emmet.
and A. Mundwaller, 2018 Menard.

MARRIAGE LICENSES

Sold Gold Wedding Rings, \$3 to \$25.
JACCARD'S, Broadway, cor. Locust.

Leonzo Alford Gales	2645 Pine
Annie Snapps	2645 Pine
Carl Ullman	6276 Wilson
Emel Vosburg	1916 Knox
Albert Cox	8513 Bell
Hubel Frederick	2735 Wyoming
Marcus Roscoe Cutler	Moweaqua, Ill.
George Gilliland	Moweaqua, Ill.
Alma B. Bliss	Chicago, Ill.
Nell M. Stanton	2810 Eads
John Lehen	721 Lami
Pauline Schwald	East St. Louis, Ill.
Al Lillard	Natchez, Miss.
Try Griffin	Natchez, Miss.
Charles J. Lusch	2639 January
Edith Wood	Alton, Ill.
John E. R. Schellenberg	1523 S. Seventh
Mrs. Emma Lehrmann	1523 S. Seventh
James D. Veatch	5667 Von Versen
Helen S. Butler	6039 Suburban
Walter Seim	3722 Texas
Willie O'Connell	4468 McPherson
Charles Ketchum	Taylorville, Ill.
Maconda Durbin	Taylorville, Ill.
Henry Spies	Donaldson, Ill.
Emma Umphres	Donaldson, Ill.
Victor Louis Huber	4817 Goethe
Christine Gronewald	5737 Kennerly
Philip Frost	2911 Arsenal
Antonia Bratoz	2911 Arsenal
Peter Carpiw	153 St. George
M. Katherina Slipec	156 St. George
August H. Hofeldt	Chicago, Ill.
Lidia B. Haskell	Maplewood, Mo.
Edna E. McAninch	Cleveland, O.
Elise M. Swain	Kilmundy Hill
Gilbert P. Strellinger	Detroit, Mich.
Marguerite D. Stevenson	4622 Westminster
Eleonora Sawcuj	1428 N. Ninth
Stefanosz Stolarczyk	1425 N. Ninth
Nelson H. Brown	3012 Clark
Mrs. Cora A. Bohn	4224 Papin
Arthur R. Clarkson	1525 Marcus
Louis Schuermann	1811 N. Leffingwell
Fletcher D. Asbury	Dallas, Tex.
Mrs. Marie K. Kelly	3955 Ashland
Otto G. Gewart	2327 Rauschenbach
Elizabeth Kutz	1308 North Market
Tom Quacatto	Panama, Ill.
Elizabetha Battu	Panama, Ill.
Clarence Wobbe	2012 N. Nineteenth
Irene Ottensmeyer	1444 Dodder
Henry Zurmuehlen	4400 Vista
Gusta Schwarz	Tipton, Mo.
Frank L. Bartlett	Gricksville, Ill.
Lena L. Wilkinson	2704 Geyer
Constans Olzevsky	1407 N. Ninth
Rozalia Rogavska	1420 N. Ninth
Dee Roy Simons	Madison, Ill.

MARRIAGE AND DEATH NOTICES.

Marriage and Death Notices inserted in The Republic will be forwarded by telegraph to any one or all of the morning papers named below for simultaneous publication, without extra charge, if a request to do so accompanies the copy. Notices received after midnight cannot be forwarded, however, until the next evening: Syracuse-Post-Standard, Providence Journal, Chicago Record-Herald, Pittsburgh Dispatch, Cleveland Plain Dealer, St. Paul Pioneer-Press, St. Paul Pioneer-Press, St. Paul Pioneer-Press, Minneapolis Tribune, Buffalo Courier, Cincinnati Enquirer, New York Times, Philadelphia Public Ledger, Boston Globe.

PEETZ BROS.

NEW FUNERAL CHAPEL.
NOW LOCATED AT 2739 LAFAYETTE AV.
UNEXCELLED SERVICE.

HENRY LEIDNER,

Undertaker's Parlor for Services FREE.
2232 St. Louis Avenue.
Tyler 517. Central 1708.

ELMER SHEPARD,

UNDERTAKER, 5921 EASTON AV.
Cabany 3797, Lady Assistant, Delmar 2148.

ALBERT HARRAL,

FUNERAL CHAPEL, 2320 UNION BL.
DELMAR 211. FOREST 4784.

VALHALLA CEMETERY

Highest beauty—perpetual care. Grounds on St. Charles Rock road, one mile west of Wellston. Olive 4480; Central 2496.

Alexander, the Undertaker

Motor service Funeral parlors.
Receives, Forwards, Interers.
Bermet 461. 2833 Olive. Central 4169.

DEATHS.

HARRISON—Entered into rest on Monday, April 28, 1913, William I. Harrison, aged 55 years.

Funeral from George N. Lynch's undertaking parlors, 2229 Olive street, at 1 p. m., April 29. Interment private.

KUHN—Entered into rest, suddenly, on Sunday, April 27, 1913, at 10 o'clock p. m., Lucy Kuhn, beloved daughter of Emil and Emma Kuhn, sister of Olga and Ferdinand Kuhn, aged 19 years 4 months and 6 days.

Funeral will take place from the family residence, 2462 Plover avenue, on Wednesday, April 30, at 9:30 o'clock a. m., to Church of the Nativity (Walnut Park), thence to Calvary Cemetery. Friends are respectfully invited.

MILLER—Entered into rest on Monday, April 28, 1913, at 4:25 p. m., Christine Miller (nee Laura Miller) daughter of Christine Sutton (nee Miller), Kate Stelzer (nee Miller), Louisa Bohley (nee Miller), Theophilus Miller and Emil Miller, and our dear sister, sister-in-law, mother-in-law and grandmother, at the age of 62 years.

Funeral Wednesday, April 30, at 2 p. m., from residence, 3340A Ohio avenue, to SS. Peter and Paul Cemetery. Interment private.

MITCHELL—Entered into rest Monday, April 28, 1913, at 6:30 a. m., after a lingering illness, William P. Mitchell, beloved son of Mrs. Susan Mitchell Mott (nee Robbins) and the late John Mitchell, and dear brother of Mrs. J. E. Barclay, John, Frank, Clarence, Irene, Helen, Loretto, Michael and Joseph Mitchell.

Funeral will take place from residence, 314 Chouteau avenue, Wednesday, April 30, at 8:30 a. m., to Immaculate Conception Church, thence to Calvary Cemetery. Friends of family invited to attend.

Deceased was a member of Peace Lodge, No. 109, B. of L. F. and E.

POHLE—Entered into rest Saturday, April 26, 1913, at 11 p. m., Julius Pohle, dearly loved husband of Margarette Pohle (nee Fishback), dear father of William, Harry, Gertrude and Violet Pohle, our dear brother.

BUSI

If you have the 14c solid gold mou terms, Loftis Bros.

SITUATIONS

CASHER—Ex out of town, desir of May; can write spectable. Address Mo.

COOK—Situati good references.

DRESSMAKER fancy gowns, Phone Sidney 321.

FANCY gowns excellent dressm lent fitting. Side

HOUSEGIRL—work, 2621A Ea

HOUSEWOMAN woman for house K 62, Republic.

LAUNDRESS—colored laundres days, Phone Bo

LAUNDRESS—last 4 days of Olive 3153.

LAUNDRESS—waists 13c, city Central 9737L.

LAUNDRESS—take home, se. Washington, Bon

NURSE—Situ price reasonable.

NURSE—Situ dress F 68, Repl

Stove

A. G. BRAUER

HELP W

HOUSEGIRL—5067 Cates.

HOUSEGIRL—4263 West Pine.

HOUSEGIRL—Illy, 4123 West

HOUSEGIRL—family 3 grown Minerva.

HOUSEGIRL—housework; no good wages. 46

HOUSEGIRL—2 in family. Ap ster Groves, to

HOUSEGIRL—work; must hav wages \$25 a m Versen av., or t

MAID—White and cooking; fan Telephone Caba

COOK—Compe 4359 Lindell.

COOK—Germa rant; no Sunda

GIRL to cook \$5 weekly, Cal Westminster.

NIG

We want 20 shorthand; easy Draughton's Coll

Clerks

EXPERIENCE copyist; \$10 Le

STENOGRAPH lady stenograph bookkeeping; m bldg.

GIRL, experie mining ladies' Mfg. Co., 1105

NCED T TRADE

FAIR ADVANCE IN WHEAT AND CORN

MANY ISSUES SET ON EUROPEAN F

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Crop News Favorable, but Statis-
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Closing Prices.
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92 b 91% b

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93% s 55% s
56% s 56% s

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34% b 24% @ 24%
24% 34 b

45 19.62
50 @ 52 19.67
30 @ 52 19.47

55 s 10.90
80 s 10.82 b
77 @ 80 b 10.85 b

22 s 11.30
90 s 10.95 b
72 @ 75 19.77 @ 20

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s. sharply be-

arkets.

osing Prices.
il 28. April 28.

10% s 93% @ 9% s

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94 1.64%
93 93%
93% 93%

ST. LOUIS FUTURE PRICES.

	Closed Saturday.	Range Yesterday.	Closed Yesterday.
Wheat—			
May...92% @ $\frac{1}{2}$ a	92% @ 92% @ $\frac{1}{2}$	92% @ $\frac{1}{2}$ a	
July...89% a	89% @ 90% a	90% b	
Sept...89% a	89% @ 90% a	90% @ $\frac{1}{2}$ b	
Corn—			
May...54% a	54% @ 55% @ 55	55 b	
July...55% a	55% @ 55% a	55% a	
Sept...55% a	55% @ 55% a	55 b	
Oats—			
May...33% a	33% @ 33% a	33% b	
July...33% @ $\frac{1}{2}$ a	33% @ 33% a	33% b	
Sept...33% a	33% @ 33% a	34% a	

Cables were irregular, but Liverpool closed higher on a less favorable European political outlook and largely on the strength of this wheat was on the upturn in the local market. News in this country was mainly favorable, both in the winter and spring belts, but there were decided signs of manipulation by the bull crowd at Chicago and little attention was paid to anything but the Chicago blackboard.

There were reported sales for export at the various domestic centers, but nothing startling and primary receipts for the day were enormous, 1,369,000 bu., comparing with only 530,000 bu. a year ago. Statistics showed up mildly bullishly, but the decrease in the domestic visible was not large for this season and weather in all directions was all that could be desired.

May wheat, which opened a split higher at 92 $\frac{1}{2}$ ¢, sold up to 92% @ $\frac{1}{2}$ ¢, where it closed, thus recording an advance for the day of $\frac{1}{2}$ ¢. The more distant deliveries were correspondingly firm and on the upturn, July wheat ranging from 89% to 90% and the Sept. delivery closing $\frac{1}{2}$ ¢ @ $\frac{1}{2}$ ¢ higher at 90% @ $\frac{1}{2}$ ¢ bid.

Strength extended as well to the market for cash wheat. Offerings were liberal, 19 cars of soft winter and 43 cars of hard winter, but there was a brisk demand and prices were higher, especially on hard winter, which was taken by local and outside mills, mainly the latter, at an advance of $\frac{1}{2}$ ¢ to 1¢. Several cars of soft winter were offered and selections sold at \$1.12 to \$1.12 $\frac{1}{2}$. Southern Illinois mills picked up the choice.

Elsewhere the cash demand was good. Minneapolis reported an active cash market, with Chicago houses the best buyers, and No. 1 Northern selling at a premium of $\frac{1}{2}$ ¢ over May. The flour demand was better. Kansas City and Chicago reported good buying, with the latter city claiming some goodly sales for export. Winnipeg wired that the cash demand there was better.

Minneapolis stocks decreased 175,000 bu. for two days this week and a wire from that point said that seeding is

NEW YORK, April 28.—Austria's generally delicate political situation in Austria of Berlin, Paris and London to a This condition was reflected in no market and resulted in a new level issues. The copper shares were the Copper losing $1\frac{1}{2}$ points on the very

The first half hour, however, saw remaining after last week's persist rest of the day the tendency was to

Prices, to be sure, did not rally particularly hopeful sign that on the trading grew very dull. Nevertheless movement plainly had run its course

The pressure against the investment of the class of Northwestern, Great tinctly firmer.

New York Central rallied well in Lake Shore notes had been sold in Lo new obligations put out by the Vande

ABSENCE OF LIQUIDATION

There were fairly reassuring symptoms of further liquidation in the bond market like the Erie convertibles, the Interl Railways 5s were noticeably weak, higher rank were done at the improve

Had it not been for the fear of our market probably would have had tions toward the end of the session play of weakness on the foreign developments have become of great corporate borrowing has begun to

Several of the tobacco stocks from the high of the year, American Lorillard and G. W. Helme show American Tobacco this afternoon rallied

RESISTANCE OF STEEL

The resistance of Steel to professional points of the market for the last small. This morning it broke below out under that figure. It is no doubt outlook for a very favorable March mates from Pittsburgh of the net ear would be a new high record for the

The general feeling is, however, \$38,000,000.

The \$50,000,000 railroad investment proving to be a big toy for the Rebels miles of the line are being operated President Randolph wanted to make fare.

The Rebels have free week-end joy all the population of the towns get the road as fast as they can go. So the first time since 1908.

firm. Sales: 350 sks. hard clear to arrive at \$3.85 tube, 155 hbbs. soft patent (direct order by local mill) at \$5.75 wood, 2 cars of by Southern Illinois mill at \$0 wood; and for export—2,000 sks. (1105) hard clear to the Continent, 500 sks. hard patent to United Kingdom.

Quote in Jute sks.: Soft—Patents at \$4.45 @ 4.75; straights at \$4.25 @ 4.45; extra fancy at \$3.70 @ 3.85; fancy at \$3.15 @ 3.30; 1st grades at \$2.80 @ 2.90. Hard—Patents \$4.15 @ 4.25; straights \$3.90 @ 4.10; first clears \$3.15 @ 3.30; second clears at \$2.85 @ 3; 1st wood \$2.50 @ 2.70; 2nd wood \$2.25 @ 2.40.

Stock No. 4.

Lodgepole Pine. --- Montana.

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Sensenbrenner's
WE GIVE EAGLE STAMPS
LOW HEEL
PUMPS
FOR WOMEN

Best gunmetal call,
tip or plain toe,
turn or welt soles.
Nothing like it in
town for less
than \$3.50.
\$2.50

Roommate Found Dead in Bed.
Oscar P. Hoffman, 36 years old, a
hatter, was found dead in bed Sun-
day by his roommate, George H. Par-
sons, at 3119 Olive street. The physi-
cian summoned said death was due to
carbolic acid poisoning. An inquest will
be held this morning.

Free Bridge Committee to Consider Building of Approaches Before Then.
There is little chance that the special
free bridge bond election will be held
before September. The Election Com-
missioners have informed Mayor Kiel
that the election could not be held un-
til July at least.
The Mayor is opposed to holding the
election in midsummer, as many voters
will be away on vacations, so the elec-
tion probably will be postponed until
after vacation time.
The Joint Free Bridge Committee of
the Municipal Assembly will convene
again Thursday afternoon to discuss
the advisability of selecting an ap-
proach to the bridge before the elec-
tion.

BOND ELECTION IN FALL
Attorneys Moses N. Sale, Jesse Mc-
Donald, Lee Meriwether and Glendy B.
Arnold, for the Democrats, and Seiden
P. Spencer and George B. Webster, for
the Republicans, will hold a conference
soon to agree upon the plans for the
general recount of the ballots of the
entire city.
An order directing the Election Com-
missioners to open the ballot boxes in
the Eighth Ward has been issued by
Judge George C. Hitchcock of the Cir-
cuit Court.
It was issued on the application of
Rudolph Schneider, defeated Republican
candidate for the House, who has laid
claim to the seat occupied by James F.
Ford, Democrat.

Testimony in Hearing Did Not Reflect on Eben Richards.
The statement in issue of April 26,
that "Pierce testified son-in-law signed
his name without his knowledge," and
"Eben Richards, son-in-law of Henry
Clay Pierce, signed Mr. Pierce's name
sent as guarantee for loans aggregat-
ing \$2,100,000," is absolutely untrue, and
is cruelly hurtful to Mr. Richards and
myself. There is no foundation for your
statement in the official notes of my
testimony before Commissioner Muench,
wherein I stated as follows:
When Mr. Thompson was loaning his
securities to Mr. Van Blarcom and I was
loaning my securities to Mr. Van Blarcom,
quest of Mr. Van Blarcom, with the full
knowledge of all the officers of the Na-
tional Bank of Commerce, my son-in-
law, Mr. Richards, joined in guaranteeing
the National Bank of Commerce the pur-
chase of \$2,100,000 mortgage bonds at the
end of a year. Under just what circum-
stances I do not recollect now my guar-
antee with Mr. Van Blarcom was also
given to the Mississippi Valley Trust
Company for \$600,000.
During the past many years Mr. Rich-
ards has held my full power of attor-
ney, and now holds it.
Please conspicuously publish this let-
ter in full in your to-morrow's issue.
H. C. PIERCE.
St. Louis, April 28.

PIERCE MAKES A DENIAL
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Plot Against Kaiser Bared
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to his father, who died in 1907. Yester-
cause of sentiment, the trunk belonging
to his father, who died in 1907. Yester-
day the boy prevailed on his father to
donated the old trunk containing the cans
without looking into it.
His wife advised him to keep it be-
cause of sentiment, the trunk belonging
to his father, who died in 1907. Yester-
day the boy prevailed on his father to
open it, and \$5 and \$10 gold pieces were
found, neatly wrapped in paper.

Stops Mother About to Throw Treasure
in Garbage Can.
DECATUR, Ill., April 28.—Wayne
Uhrich, 8-year-old son of Walter Uhrich,
a barber, was responsible for the dis-
covery of \$3,000 in gold in two small
cans contained in a larger can in the
coal shed last week.
The small boy's curiosity alone pre-
vented his mother throwing the can in-
to the garbage heap, and Uhrich when
they moved recently would have aban-
doned the old trunk containing the cans
without looking into it.
His wife advised him to keep it be-
cause of sentiment, the trunk belonging
to his father, who died in 1907. Yester-
day the boy prevailed on his father to
open it, and \$5 and \$10 gold pieces were
found, neatly wrapped in paper.

Stock No. 4

Lodgepole Pine—Montana.

MARRIAGE OF GIRL, 17, VOIL

Stock No. 5.

Western Yellow Pine.

When Mr. Thompson was loaning his securities to Mr. Van Blarcom and I was loaning my securities to Mr. Van Blarcom, and in my absence and at the request of Mr. Van Blarcom, with the full knowledge of all the officers of the National Bank of Commerce, my son-in-law, Mr. Richards, joined in my name with Mr. Van Blarcom in guaranteeing the National Bank of Commerce the purchase of \$1,545,000 Tennessee Central Railroad general mortgage bonds at the end of a year. Under just what circumstances I do not recollect now my guarantee with Mr. Van Blarcom was also given to the Mississippi Valley Trust Company for \$600,000.

During the past many years Mr. Rich-

Oscar P. Hoffman, 35 years old, a hatmaker, was found dead in bed Sunday by his roommate, George H. Parsons, at 3119 Olive street. The physician summoned said death was due to carbolic acid poisoning. An inquest will be held this morning.

Best gunmetal calf,
tip or plain toe,
turn or welt soles.
Nothing like it in
town for less
than \$3.50.

Charles Dixon, 12 years old, adopted by the Bakers.

"The custody of the boy is sought by his Uncle George J. Dixon, who alleges the Bakers, who are Protestants, failed to raise the boy a Catholic, as they agreed. The case was brought here to reverse an order of Judge Bird that he be turned over to his uncle. The writ was made returnable in thirty days, when the matter will be heard on its merits.

The Court denied the writ of prohibition sought by Jean Lassance of Paris, France, to prevent Judge Hugo Grimm of the St. Louis Circuit Court from entertaining any further appeal from a decision of the Probate Court of St. Louis in the final distribution of the estate of Peter Petz, deceased.

Lassance was one of the heirs to the estate and objected to this. The estate is inventoried at \$23,719, and Lassance's share under the distribution and will is \$1,310.

Following is a partial list of the motions disposed of and the other proceedings in the court in banc to-day:

Gold Issue Mining and Mineral Company, resp., vs. Pennsylvania Fire Insurance Company of Philadelphia, app.; respondent's motion to transfer to St. Louis Court of Appeals; appellant's suggestion in opposition to motion to transfer; motion overruled.

William P. Houston, resp., vs. Pulitzer Publishing Company, app.; appellant's motion to tax cost of printing abstract of record allowed for \$81.

Floyd D. Jackson, plf., resp., vs. Edward Butler et al., def., app.; defendant appellant's motion to tax cost of printing abstract of record allowed for \$94.50.

State ex rel. Tebbetts, rel., vs. Holtcamp, Judge; relator's motion to amend and affidavit in support; motion to amend sustained.

State ex rel. Circuit Attorney, rel., vs. Joseph A. Wright, resp.; respondent's motion to strike out certain statements from relator's reply; taken with case.

State ex rel. Joseph A. Wright, rel., vs. McQuillin, Judge, resp.; application of Eliza P. O'Hara for leave to file brief; leave granted.

State ex rel. Tebbetts vs. Holtcamp, J.; in the matter of Letitia Todd Breck vs. Rickards et al.; argued and submitted together, with petitioner's reply to return of respondent filed in 17483.

MARRIAGE OF GIRL, 17, VOID

Foster Mother Refuses to Let Young Wife Live with Husband.

The marriage of Cora Berger, 17 years old, and Otto Berger, whom she was persuaded to marry when she was 15 years old, was annulled by Circuit Judge McQuillin yesterday.

A woman in whose bakery the girl was employed induced her to marry Berger, a baker at the place, she stated. The marriage took place at St. Charles. The woman for whom the girl worked accompanied her and Berger.

They returned to St. Louis immediately after the marriage and called at the home of the girl's foster mother, Mrs. Henry Duewel, of 3227 Hickory street. Mrs. Duewel would not let the girl live with Berger.

Robbed, Thrown from Eads Bridge.

Adam J. Dettling, who says he is an engineer of Bonne Terre, Mo., was found by Patrolman Brosnahan of the Carr Street Station on the levee last night, with his clothes dripping wet.

was instructed nearly two weeks ago to convey recognition to the new Republic as soon as those formalities had been complied with.

It is said at the State Department, however, that the failure of the Assembly up to this point to choose a Speaker, owing to sharply drawn party issues, is a sufficient obstacle to delay the execution of the instructions.

Notwithstanding the advantage that might be gained by an immediate recognition, it is believed here that the

was under the impression that such action

The basic fact that formed was extended that the follow the Japanese Government obtains.

True Timekeeper

Standard Time

The Jeweler's Chronometer and Burlington Time Tables are standard of accurate timekeeping. Watches are set by chronometer. Appointments in on the Burlington Route are made by Burlington time tables and kept by means of Burlington "On Time" Service.

Hundreds of trains daily maintain Burlington's "On Time" record.

To Kansas City

"On Time"

Go via the Burlington

- and there are many other features.
 - Observation-Club Car; you can eat, smoke
 - Spacious Smoking Room; private enough
 - Midnight Train—the famous "Night Hawk"
 - No stop to Kansas City; no confusion, no sleep on the "Night Hawk."
 - Complete dining car service; meals at any
 - Appetizing breakfast—just the kind you'll
- "On Time" Every Day is the Burlington

"Night Hawk" leaves St. Louis every
Arrives Kansas City 7:5

Two other perfect
the "Early Bird" leave
p. m.—the "Day Light"
9:06 a. m.

Just call up—we will

Stock No. 6.

Balsam Fir.

INFLATION; CATTLE ARE WEAK

Moderate, but Demand
nap—Native Beeves
ff 15c to 20c.

RECEIPTS.	
.....	2,000
.....	10,000
.....	3,000
.....	1,350

CATTLE—Beef Steers—An or-
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Nothing topchy changed
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bal Western markets had a
and buyers were out after a
market lacked the support
of fair-quality steers went to
by in the morning at \$8.05 @
was about the only steady
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No. Av. Pr.	No. Av. Pr.
22.. 1358 88.25	38.. 1173 88.05
19.. 1054 7.25	5.. 716 7.15
8.. 659 6.75	3.. 620 6.50

HEIFERS—Bulls—Not an overly
ly arrived and butcher cattle
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a. Very few bunches choice
ad the best price was \$8.25,
from \$7.35 @ 8, those of lesser
from \$6.75 @ 7.25.
scarce and with a fairly good
a goodly showing of choice
mailed from steady to strong. A
as established and this figure
several good-quality offerings.
ged hands from \$7 to the top.
od kinds changed hands from
eral near the cutter class sold
The supply of carners and
net generous and values held
dls were generally steady bulk
moving at \$6 @ 7.25.

No. Av. Pr.	No. Av. Pr.
13.. 132 88.25	2.. 626 87.60
1.. 594 7.00	19.. 815 7.25
1.. 860 6.25	1.. 580 6.00
1.. 540 5.35	14.. 232 4.75

COWS		
2.. 1030 7.25	5.. 1086 7.00	
1.. 1080 6.50	2.. 1100 6.25	
1.. 680 5.75	1.. 910 5.50	
2.. 660 4.75	1.. 840 4.25	
1.. 650 3.75	2.. 700 3.50	

BULLS		
1.. 910 5.25	2.. 1179 7.00	
1.. 1020 6.90	2.. 1125 6.90	
2.. 1285 6.75	3.. 1104 6.50	
2.. 1450 5.85	1.. 1340 5.00	

Yearlings—A slim showing of
was on hand. Choice kinds were
scarcely made change. Bulls
was a steeper for the prime
to good grades of veals sold
25, poorer classes and skim-
at \$8 @ 9, fully steady.
were scarce, but one or two
would have made good kids
a weights of quality changed
\$7.25 @ 8; heavies, of fair to
sold from \$6.25 @ 7.
ES AND YEARLINGS.

No. Av. Pr.	No. Av. Pr.
3.. 132 10.25	2.. 125 10.00
6.. 108 9.25	5.. 138 7.00
42.. 147 7.25	1.. 330 6.50
1.. 190 5.50	13.. 317 4.10

\$7.20 @ 8.90; Texas steers \$6.70 @ 7.75; Western
cows \$6.90 @ 8; stockers and feeders \$6.10 @ 8;
cows and heifers \$3.90 @ 8.25; calves \$6.25 @ 8;
9.25. Sheep—Receipts 25,000; weak to 15c
lower; native \$6 @ 7.15; Western \$6.25 @ 7.15;
yearlings \$6.50 @ 7.90; lambs, native \$6.60 @
8.70; Western \$7 @ 8.75.

KANSAS CITY, Mo., April 28.—Cattle—
Receipts 8,400, including 700 Southern; 10c
to 20c lower; dressed beef and export steers
\$7.90 @ 8.50; fair to good \$7 @ 7.85; Western
steers \$6.75 @ 8.25; stockers and feeders \$6.50
@ 7.90. Southern steers \$6.25 @ 8. Southern
cows \$4.25 @ 7; native cows \$4.25 @ 7.35; na-
tive heifers \$6.75 @ 8.25; 2 bulls \$5.75 @ 7.25;
calves \$6 @ 9.50. Hogs—Receipts 10,000; 15c
to 25c lower; bulk \$8.25 @ 8.45; heavy \$8.25 @
8.40; packers and butchers \$8.20 @ 8.35; light
\$8.30 @ 8.50; pigs \$7.25 @ 8. Southern hogs
12,000; steady to 10c lower; choice \$8.75 @
\$7.50 @ 8.60; yearlings \$6.25 @ 7.00; weaners
\$5.50 @ 6.75; ewes \$5 @ 6.50; stockers and feed-
ers \$4 @ 5.50.

ST. JOSEPH, Mo., April 28.—Cattle—Re-
ceipts 1,500; slow steers \$7.25 @ 8.75; cows
and heifers \$4.25 @ 8.50; calves \$5.50 @ 8.75.
Hogs—Receipts 5,500; 15 @ 20c lower; top
\$8.50; bulk \$8.30 @ 8.40. Sheep—Receipts 7,
000; lower; lambs \$7.50 @ 8.65.

SOUTH OMAHA, Neb., April 28.—Cattle—
Receipts 4,400; lower; native \$6.75 @ 8.00;
cows and heifers \$3 @ 8. Southern steers
\$6.75 @ 8.25. Texas steers \$6 @ 7.65; cows and
heifers \$5.75 @ 7.50; calves \$7.75 @ 9.75. Hogs
—Receipts 6,700; lower; heavy \$8.20 @ 8.35;
light \$8.30 @ 8.40; pigs \$7.40 @ 8; bulk \$8.25 @
8.35. Sheep—Receipts 12,000; steady; year-
lings \$7.50 @ 8.75; ewers \$6.40 @ 7; lambs
\$8.25 @ 8.90.

Miscellaneous Markets.
GRASS SEEDS (Per 100 Lbs.)—Dull and
unchanged; some demand for millet and
good timothy, but no call for clover. Prices
easy or nominal; offerings next to nothing.
Quote: Millet—Trashy, mixed, etc.,
@ 1.40; fine, clean, sound @ 1.50;
@ 1.40 to 1.60; clean @ 1.80; fine, clean, sound
@ 1.80; Hungarian @ 1.15 @ 1.30; timothy @ 1.10
for tallings to \$2.25 @ 2.50 for trashy, \$2.90
@ 3 for fair and \$3.20 @ 3.35 for prime; clover
at from \$5 @ 10 for weedy to \$15 for the bet-
ter. Average run; redtop at \$8 for re-
cleaned seed; sorghum grad trashy, etc.,
less. No offerings worthy of mention on
regular market; order business only fair.

STOCK PEAS—Quotable per bu. at from
\$1.50 to \$1.80.

SORGHUM-CANE SEED—Quotable at 90c
to \$1.15 per 100 lbs. according to quality.

SUNFLOWER SEED—Quotable at \$2.75 @
3.50 per 100 lbs.

ONION SETS—Bottoms quotable at \$1.40
per bu. for red and yellow and \$2 for white
—dressed less orders higher.

DRIED FRUIT—Little or none offering;
prices nominal; sun-dried quarters apples at
2 @ 2 1/2c; evaporated rings apples at from 3c
for ordinary to 4c for choice; sun-dried
peaches at 5c to 5 1/2c; cores and peelings
apple 1/2 @ 3/4c.

BEAN & PEAS—Quote, on, orders:
White beans—Choice hand-picked at \$2.40;
prime at \$2.30; screened at \$2.10 @ 2.15—
inferior and artificially dried \$2.05 @ 2.10;
black-eye \$2 @ 2.15 for Southern to \$2.80 @
2.90 for California; Scotch peas at \$1.75 per
bu.; split peas at \$2.70 per bu. for yellow
and \$3.25 for green; pink beans 5 1/2c @
per lb.; lima beans 6 1/2c; lentils 5c; red kidney
4 1/2c.

CASTOR BEANS—Nominal at \$1.50 per
bu.

HONEY—Quote Southern extracted and
strained—Bright amber in bbls. 6c per lb.,
in cans 6 1/2 @ 7c; dark 1/2 @ 1c per lb. less.
Comb—Amber 14c; dark and inferior 9 @ 11c
per lb.; broken and leaking 7 @ 8c; fancy
clover 15 @ 16c; very dull.

SORGHUM—Prime quotable at 40c per gal.
SALT—Quote: Granulated at \$1.10 per bbl.
and medium \$1.15 tr. this side.

ROOTS—Quote golden seal \$3.35; lady
slipper 14c; Seneca 36 @ 38c; pink 20c; black
7c—damp, dirty less; May apple 4c; snake
2c; black and black leafy less; Kansas
black snake (Echinacea) 10c; split root
half price; Oklahoma black snake 9c—Mis-
souri worthless; Angelica 5c; wahoo bark of
root 20c—bark of tree 5c; blood 4 1/2c; blue-
flag 2 1/2c; sassafras bark of root 5c; wild
ginger 6c and black 8c; wild leop leaves
bright 9c, but dark less; wild Ginseng \$6.25
@ 6.50; cultivated do. \$1 @ 2.50.

BROOM CORN—Firm. Good demand for
all grades at the following prices: Quote
per ton, at first hands, on trk. Dwarf—Fair
\$60 @ 65; standard \$65 @ 75; light green earl
\$85 @ 90; standard brush—\$90 @ 100; com-
mon \$80 @ 90; choice at \$90 @ 100; common,
crooked, damaged, discolored, etc., less.

POP CORN—On cob, per 100 lbs., at from
\$1 to \$1.60—latter for choice rice; inferior
less.

NUTS—Quote: Pecans at 7c to 8c per lb.
Peanuts 3 @ 3 1/4c per lb. for farmers' stock.

MOSS—Quote, per lb.; Gray mixed 1 1/2 @
1 1/4c; gray, brown and black mixed 1 1/2 @ 2c;
black and black mixed 2 @ 2 1/2c; machine-
dressed xxx 3 @ 4 1/2c; xxx 4 @ 4 1/2c; xxx 5 @
5 1/2c—inferior less.

RUBBER BAGS, ETC.—Country bags 80c
per 100 lbs.; old rope, manilla \$1.50; com-
mon 40c. Rubber—No 88; arctic—trimmed

DEALINGS IN COTTON FEATURE

New Low Ground Is In
General Selling an
able Report

Balsam NEW YORK, April 28.—
In the cotton market to
regularity of May notices
about 80,000 bales.

It was reported that hou-
erpol connections and lo-
ple were taking up the cot-
was a good demand for M-
early trading, but no ag-
port developed and the
new low ground in the lat-
der renewed general sel-
vorable new crop or wea-

The market opened 6 po-
2 points higher, sold 4 to
higher, and closed stead-
vance of 7 points on Apr-
ally 6 to 13 points under
figures of Saturday.

New York Cotton Quo-
Reported by Francis, Bro. &
Fourth street.

Month.	Open.	High.	Low.
Jan.	11.08	11.14	10.99
Mar.	11.13	11.13	11.03
May.	11.26	11.44	11.22
July.	11.40	11.33	11.32
Aug.	11.27	11.38	11.20
Sept.	11.17	11.17	11.05
Oct.	11.10	11.16	11.08
Nov.	11.13	11.19	11.00
Spot	11.70	.....	.....

St. Louis Cotton M-
Tone of market dull; uncha-
bales.
Ordinary
Good ordinary
Low middling
Middling
Good middling
Middling fair
Tinges 1/4c to 1c off from
Receipts at principal points
Galveston, 2,909 bales, ag-
year.

New Orleans, 1,097 bales,
last year.
Mobile, 1,317 bales, against
Savannah, 1,933 bales, ag-
year.
Charleston, 381 bales, again
Houston, 3,550 bales, ag-
year.

Memphis, 606 bales, against
Net receipts at all United S-
three days were 18,226 bales
bales last week and 28,535 bal-
ported 70,013 bales, against
Stock 605,614 ordinary 5,863;
Total receipts from Sept. 1
9,019,799 bales, against 11.3
the corresponding period the
Local warehouse statement;

Stock on hand Sept. 1..... 1
Net receipts since Sept. 1.....
Net receipts yesterday.....
Net shipments since Sept. 1.....
Net shipments yesterday.....
Stock on hand.....
Gross receipts yesterday.....
Gross receipts since Sept. 1.....
Gross shipments yesterday.....
Gross shipments since Sept. 1.....

Cotton at Liverp-
LIVERPOOL, England, A-
—Spot in fair demand; pri-
dling fair 7.25c; good midd-
dling 6.70c; low middling 6
nary 6.20c; ordinary 5.86c;
cluding 500 for speculation
7,700 American. Receipts 5,
can. Futures opened stead-

W.L. DOUGLAS \$3.50, \$4.00 & \$4.50 SHOES

THE LARGEST MAKER OF MEN'S \$3.50 & \$4 SHOES IN THE WORLD
 Look in W. L. Douglas store windows and you will see shoes for \$3.50, \$4.00 and \$4.50 that are just as good in style, fit and wear as other makes costing \$5.00 to \$7.00, the only difference is the price. Shoes in all leathers, styles and shapes to suit everybody. If you could visit W. L. Douglas large factories at Brockton, Mass., and see for yourself how carefully W. L. Douglas shoes are made, you would then understand why they are warranted to fit better, look better, hold their shape and wear longer than any other make for the price.

CAUTION The Best \$2.00 and \$2.50 Boys' Shoes in the World. See that W. L. Douglas name is stamped on the bottom.

TAKE NO SUBSTITUTE.
 If W. L. Douglas shoes are not for sale in your vicinity order direct from the factory and save the middleman's profit. Shoes for every member of the family, at all prices, by Parcel Post, postage free. Write for Illustrated Catalog. It will show you how to order by mail and why you can save money on your footwear.

W. L. DOUGLAS, Brockton, Mass.

DOUGLAS SHOE CO.: 616 Olive St., St. Louis

THREE PLUN SCAFFOLD,

Two Others, Wor
Get Fractured
Broken Leg

VICTIMS CARRIED

Workmen Fall Thi
and Cries Bring
to Their d

One man was injured and two others seriously on a scaffold on which the teaming at the William Green company, Second and Rutger way yesterday afternoon feet.

Joseph Ferris, who had but a short while, and was unknown to his fellow workmen, fell from the scaffold unconscious at the City hospital, fractured skull and internal injuries.

James Dixon, 33 years old, of 3820 Page boulevard, fell from the scaffold in two places. The top of his head was taken to St. Mary's hospital.

The three men were working on a big steel tank they were building.

Enos Konoskia, the other victim, fell from the scaffold until the other men, who were working on the tank, brought ladders and helped him up. They were up a line of men forming a ladder.

ED: Can you take a hint? at Loftis' for \$1 a week. 2d fl.

CAN'T QUIT SURE

High State Court Release Request to Quit Mink
 JEFFERSON CITY, Mo., The Supreme Court in and refused the application of J. D. Shewalter of Independence, his name withdrawn from the bar of the court.

Why Judge Shewalter resigned his name stricken from the bar, why the court refused to grant the request does not appear in the day's proceedings, only the entry of the request and the court's decision.

When the habeas corpus writ was granted by R. Nelson of Kansas City brought to the court for

INDIA TEA

**Strength and Richness
Equal to Coffee Drinkers**

Stock No. 10.

Balsam Fir.

DEALINGS

General Selling
New Low Ground
 was a good demand
 early trading, but
 new low ground in
 the market opened
 2 points higher, sold
 higher, and closed
 value of 7 points on
 ally 6 to 13 points
 figures of Saturday.
 New York Cattle
 Reported by Francis,
 North street.

Month. Open. High.
 Jan. 11.08
 Mar. 11.13
 May. 11.26
 Aug. 11.44
 Nov. 11.68
 Dec. 11.77
 Jan. 11.83
 Mar. 11.88
 May. 11.97
 Aug. 12.07
 Nov. 12.17
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THREE PLUNGE V SCAFFOLD, 1 D

Two Others, Working in
Get Fractured Ribs /
Broken Leg.

VICTIMS CARRIED UP L.

Workmen Fall Thirty Fe
and Cries Bring Forei
to Their Aid.

One man was injured probab
and two others seriously hurt
scaffold on which the three we
ing at the William Graver Ta
pany, Second and Rutgers stre
way yesterday afternoon. The
feet.
Joseph Ferris, who had been
but a short while, and whose
was unknown to his fellow lab
fractured skull and internal in
James Dixon, 33 years old,
Shenandoah avenue, had th
broken, and the left leg of Jan
22, of 3820 Page boulevard, wa
taken to St. Mary's infirmary
The three men were at wor
scaffold inside a big steel tan
they were building.
Enos Konoskia, the forema
until the other men, under h
tion, brought ladders and lowe
inside the tank. They were the
up a line of men formed on e

ED: Can you take a hint? You can
at Lottis for \$1 a week. 2d floor. 308
39 DIVORCES ARE GR
Seven New Suits for Marital
Are Filed.

Divorces granted yesterday
Dudley F. from Mary M. Will
B. from Frank J. Swatek, Joh
Annie Mallon, Emma from W
Patchin, Mary N. from Thomas
Eva A. L. from Robert Bisho
beth from Peter McNally, J
from Orlando Gardner, Ma
Thomas Smith, Lulu from R
Buesing, Carrie from Levi Key
from W. E. Long, Alma wor
Raymond, Mary D. from John
Winneth from George V

W.L. DOUGLAS
\$3.50, \$4.00 & \$4.50
SHOES

THE LARGEST MAKER OF MEN'S
\$3.50 & \$4 SHOES IN THE WORLD
Look in W. L. Douglas store
or windows and you will see shoes
just as good in style, fit and wear as
other makes costing \$5.00 to \$7.00.
The only difference is the price. Shoes
of leathers, styles and shapes to suit
everybody. If you could visit W. L. Douglas
factories at Brockton, Mass., and see for
yourself how carefully W. L. Douglas shoes
are made, you would then understand why
they are warranted to fit better, look
better, hold their shape and wear
longer than any other make for the price.
See that W. L. Douglas name
is stamped on the bottom.
TAKE NO SUBSTITUTE.
If W. L. Douglas shoes are not for sale in your vicinity
order direct from the factory and save the middleman's
profit. Shoes for every member of the family,
at all prices, by Parcel Post, postage free.
Write for Illustrated Catalogue. It
will show you how to order by mail and why
you can save money on your footwear.
W. L. DOUGLAS, Brockton, Mass.

GLAS SHOE CO.: 616 Olive St., St. Louis

INDIA TEA

length and Richness
al to Coffee Drinkers

Stock No. 7.

Lodgepole Pine. --- California.

HER REPORT

recast by States.
N. D. C., April 28.—Forecast:
and warmer Tuesday.
bably fair.
r and warmer Tuesday.
bably fair; moderate, varia-

generally fair Tuesday and
Fair Tuesday and Wednes-
outh winds.

Fair Tuesday and Wednes-

braska—Fair Tuesday and
day; not quite so warm

r Tuesday and Wednesday;

d warmer Tuesday. Wednes-

Tuesday and Wednesday;

ture; moderate, varia-

r Tuesday and Wednesday;

re.

aken at 8 p. m., seventy-

ime.

Dr.	Tp.	Mx.	Prec.	Weather.
N	62	64	...	Clear
S	70	82	...	Clear
SE	52	58	...	22 Cloudy
W	54	62	...	20 Clear
N	56	58	...	06 Cloudy
W	50	52	...	Cloudy
N	50	50	...	42 Cloudy
NE	54	56	...	28 Rain
N	60	64	...	Clear
NE	36	40	...	Cloudy
W	56	66	...	Clear
W	50	54	...	Cloudy
S	66	72	...	Pt cloudy
N	48	48	...	Clear
NW	46	46	...	26 Rain
N	44	46	...	70 Cloudy
SE	68	72	...	Clear
SE	70	74	...	Clear
NE	62	66	...	Clear
N	44	44	...	34 Cloudy
NW	74	80	...	Pt cloudy
SE	64	68	...	Clear
N	48	48	...	12 Clear
D.S	70	74	...	Clear
SE	72	78	...	Clear
NE	62	64	...	Clear
NE	42	48	...	Clear
S	68	70	...	Pt cloudy
NW	82	84	...	02 Cloudy
SW	82	84	...	Clear
SW	48	52	...	10 Clear
NE	52	54	...	Cloudy
SW	58	64	...	Clear
E	68	70	...	Clear
SW	84	88	...	Clear
NW	70	70	...	Clear
SW	68	74	...	Clear
NW	42	52	...	02 Cloudy
S	68	72	...	Clear
N	52	52	...	12 Pt cloudy
NW	64	70	...	04 Clear
E	62	66	...	Clear
N	62	66	...	Clear
SE	64	68	...	Clear
SW	60	68	...	Clear
W	46	46	...	08 Cloudy
NW	64	64	...	Clear
NW	72	80	...	Clear
NW	60	70	...	Clear
N	60	64	...	01 Cloudy
NW	50	52	...	Cloudy
N	70	74	...	Clear
SE	54	64	...	1.08 Clear
W	50	56	...	Cloudy
S	54	66	...	01 Rain
the	56	58	...	Clear
S	75	84	...	Clear
SE	68	68	...	Clear
E	58	62	...	1.72 Cloudy
W	86	90	...	Clear
NW	46	46	...	82 Rain
NW	52	54	...	04 Cloudy
SW	78	82	...	Clear
NW	54	56	...	12 Clear
S	80	82	...	02 Cloudy
S	62	64	...	Cloudy
SW	62	64	...	Clear
E	64	68	...	Clear
S	72	74	...	Clear
C.S	80	84	...	Clear
W	62	66	...	Clear
SW	54	58	...	Clear
W	64	68	...	Clear
NE	60	72	...	Clear
NE	70	74	...	Clear
S	64	66	...	Clear
SE	48	50	...	Cloudy
N	60	64	...	Clear
NE	62	66	...	Clear
NW	54	62	...	Cloudy
SE	70	74	...	Clear
N	60	70	...	Pt cloudy

It's not food that counts—It's water.
Spend a few dimes for CRYSTAL WATER
and be happy and healthy.

A Cooler Free.

Five Gallons CRYSTAL WATER 37½c
in your office. 50c in your home. The dif-
ference to pay cost of delivery.

St. Louis Crystal Water and Soda Co

Main 600. **Stock No. 7** Central 396

FIRE INSURANCE

Lodgepole Pine --- California

The Jefferson Mutual Fire Insurance Co., of St. Louis

OFFICE, No. 317 CHESTNUT ST.

Phone—Bell, Main 1665.

MERCHANTS' EXCHANGE

Kinloch, Central 581.

This company begs to inform its members and the general public that
in position to write Fire Insurance after April 30, 1913, as heretofore.

servative policy of underwriting will be carried out as in previous years.

If you have desirous business to offer, call or phone and we will be
service.

The following well-known business men compose its officers and di-

DIRECTORS.

Wm. G. Mueller

Wm. Koeneemann

Gustav Bischoff

Otto J. Wilhelmi

Otto F. Stifel

Frank W. Fuerbas

Christoph Hilke

F. W. Hoffmeister

Ernst Har mann

Aug. F. Klasing

Henry Griesedieck Jr.

Julius L. Winkeln

Aug. F. Klasing,

Julius L. Winkelmeyer,

L. W. Schonebeck,

President

Vice-President

Sec'y and Treas.

C. Kraleman & Son

AGENTS.

H. von Heinrichst

Miss Alice Wezman

Otto A. Hambe

Henry Schubert

Chas. T. Bessehl

Adolph T. Prag

Schiele & Kleinsack

Matthias Becker Jr.

All trains will be Resumed

St. Louis to the East

via

BALTIMORE & OHIO

Southwestern R. R.

Effective at Midnight Sunday, April 27

With the exception of "Queen City Limited," leaving St. Louis at
which has been annulled for the present.

F. D. Gildersleeve

A. G.

KIEL MEETS B. P. I. ON BOAT

PROTESTANTS FORM

Mayor Makes Trip to Chesley Island
on Erastus Wells.

Joint Commission of Two
Adopts Merger Plan

The harborboat Erastus Wells, the
vessel on which former Mayor Kreis-
mann and his "cabinet" of advisers
met and discussed city affairs almost
weekly last summer, was the scene yester-
day of a similar conference between
Mayor Kiel and members of the Board
of Public Improvements.

COLUMBUS, O., April 28.—
commission of the Protest-
and the United Brethren in
session here to-day, u
adopted a basis of union o
churches, forming a new de
to be known as the United
Church.

The main object of the trip was an in-
spection of Chesley Island, one of the
sites suggested for a municipal gar-
bage-reduction plant.

The report of the commissi
be ratified by the general c
of their respective churches

Accompanying the party was J. T.

Graduates: Misses Mattie Con-
Wright, Letha E. Hard, Nellie
srs. George Wilton, William G.
Ryan and Russell Carter.

LOUIS COUNTY.

Wood Business Men Banquet.

Wood Business Men's Association
rd annual banquet last night at
in Maplewood. Addresses were
recounting Attorney Lashly and
te G. A. Wurdeman.

ELEGATES IN SESSION

Meeting Refers Free Bridge to Various Organizations.

Elegates representing fifteen
nizations attended the regu-
ly meeting of the Central
ncil at the Public Library
ast night.

Gundlach spoke in favor of
o buy ground for more parks
ig the cost assessed against
rty that was benefited by
blishment.

Winn, superintendent of the

Lodging-House, told of the
mplished by that institution

ed the establishing of a larger
central part of the city.

egates approved the bill for
vement of the street car ser-
vposed the repeal of the Pub-
ce Commission. The Free

ngle was referred to the vari-
lizations.

Is providing for the ventila-
treet cars, for the wrapping
and for the disposal of ashes,
fing, were approved.

AS AUTO RACERS HELD

Quick Causes Arrest of Two in White Slave Case.

GELES, Cal., April 28.—Delv-
r into the white slave bands
ngeles the police to-day ar-
William Le Casse and Richard
orth, automobile racing driv-
charges preferred by Evelyn
15-year-old schoolgirl.

se was arrested in the apart-
a former society woman,
isband is now suing for di-
ollingsworth tried to evade
barricading himself in his
t the police tore down the

ald Asked to Succeed Dunn.

me of Capt. William J. Mac-
r the office of Supervising In-
f Steamboats in the St. Louis
to succeed Joseph J. Dunn,
a few weeks ago, was sent
enate last week. Capt. Mac-
is been United States Inspector
boat Boilers in this district
x years. The promotion will
vacancy in the office of Inspec-
boilers. This will be filled by
ent from the civil-service list
anser from another district.

Heads Banking Institute.

annual election of the St. Louis
of the American Institute of
last night the following offi-

walked out of the shop on a strike because
the company has failed to employ union men
in the polishing room.

MARQUETTE RECEIVER ASKED

Court Is Petitioned to Remove Officers of Downtown Hotel.

Arthur Thacher applied to the Circuit
Court yesterday for a receiver for the
Glancy & Watson Hotel Company, which
conducts the Marquette Hotel, at Eight-
eenth street and Washington avenue.

The company is capitalized for \$100,-
000. Thacher owns ten shares of the
stock and T. H. Glancy, president and
manager, owns 750 of the 1,000 shares.

The company was organized in Febru-
ary, 1907, with Glancy and M. D.
Watson managers at salaries of \$3,600
a year, it is stated. Glancy bought Wat-
son's interest in August, 1910, and has
been drawing \$600 a month salary, it
is asserted.

The court is asked to remove Glancy
and the Board of Directors and require
an accounting.

Engineers Discuss St. Louis Chapter.

Charles F. Rand and Bradley Stough-
ton, president and secretary, respect-
ively, of the American Institute of Min-
ing Engineers, were entertained at a
dinner at the St. Louis Club last night
by Missouri and Illinois members of
the association. The advisability of or-
ganizing a local chapter of the insti-
tute as a "get-together proposition" for
Missouri and Illinois engineers was dis-
cussed. Both Mr. Rand and Mr. Stough-
ton addressed the diners, while other
speakers were former Gov. D. R. Francis,
H. A. Buehler, State Geologist, of
Rolla, Mo., and Capt. R. W. Hunt of
Chicago.

Poultry.

NEW YORK, April 28.—Live Poultry—To-
day is the Hebrew Last Passover, and with
the buyers absent, there was no business
and no poultry was unloaded. Some 9 cars
arrived on trk., but will not be unloaded till
to-morrow.

Dressed Poultry—Receipts 1,438 pkgs.
Very little fresh-killed poultry here of any
description, a few lots of fowls went at
18½¢@19¢, but large fowls are difficult to
strain up to 18½¢. Old roosters scarce and
firm. Squabs a trifle easier and only fancy
exceeding \$4 on an 8-lb. average. There
were a few lots of frozen fowls thrown on
the market and held 19¢, but buyers
are reluctant to pay that price, and very
little business reported. Frozen roosters
held with more confidence. Frozen turkeys
active.

Fresh-Killed Poultry—Dry-packed turkeys,
hens, av. 22¢@23¢; toms, young, av. 22¢;
do, old 21¢.

Fowls—Box-packed, 12 birds to box: West-
ern dry-picked, 60 lbs., 19¢; do. 48¢@53 lbs.,
19¢; do. 36¢@42 lbs., 17½¢@18½¢; do., under
36 lbs., 10¢@16½¢; do. bbls., over 5 lbs.,
18½¢; do. 4 lbs. each, 18½¢@19¢; Western
dry-picked, iced, 18½¢@19¢; do. bbls., 3¢@3½
lbs. each, 17¢@18¢; do. bbls., Southern and
Southwestern, 17½¢@19¢; scalded, bbls.,
other Western, av. 17½¢@18½¢; do. scalded,
14½¢.

Squabs—White, fancy, 10 lbs. to doz.,
\$5¢@5.50; do. 9 lbs. to doz., \$4.50¢@4.75; do.,
8 lbs. to doz., \$4¢@4.25; do. 7 lbs. to doz.,
\$3.25¢@3.50; do. 6 lbs., 19¢@24¢; do. 5 lbs.,
\$2.25¢@2.50; do. bbls., per doz., 65¢@75¢.

Guinea Fowls—Old, per pair, 85¢@90¢; do.
young, per pair, \$1¢@1.15.

Frozen Poultry—Turkeys—Young toms,
fancy, under 16 lbs. each, 25½¢; do.
over 17 lbs. each, 24½¢@25¢; do. av. mixed
sizes 23½¢@24¢; do. Texas and small, West-
ern, 22¢@23¢; young hens, fancy, per lb.,
23¢@24¢.

Fowls—Dry-picked, No. 1, 60 lbs. and over
to doz., 19¢; do. 45¢@55 lbs. to doz., 19¢;
do. 28¢@42 lbs. to doz. 18½¢; do. under 25

weys 16c; small and po-
cocks 16c; chickens 19c;
6c to 10c; ducks 13c; ca-
17c.

PIGEONS AND SQ-
pigeons at 75c per doz. S-
ers (7@8 lbs. to the doz.
large homers (9@10 lb
some small sold at 43¢;
and dead pigeons 60c pe

VEALS—Market firme
few offered, but rapid
arrive until about noon
for choice medium weigh
lbs. 9c per lb.; do. 150
180 to 200 lbs. at 8c; rou-
tics of over 200 lbs., a
under-weight, at 6@7c.
bucks at 3¢. Yearling
for sale to 6½¢@7½¢;
lambs—Choice fat, weigh
at \$4.50¢ per head; st-
Sheared sheep sell at 1c
than full-weighted.

ROASTING PIGS—Quo-
at \$2¢@2.25; 25¢@30-lb. at
FRESH PORK—Quo-
dressed, 3¼¢@4¼¢; do.
dressed, large, 6c; do.
4c; do. round 3c; su-
large, 11c; do. medium,
black bass, 2¼ lbs. and
@2¼ lbs. 10c; do. ord-
12c; spoonbill cat, 4¢;
over 1½¢; do. less
large, collar bones off,
collar bones on, 9c; bull-
collar bone on, 6c; white
do. round 2¼¢; grass pig
shell turtle, dressed, 7c;
meat 3¼¢; frogs, large,
medium 75c; do. small 6c.

HIDES, FURS.

FEATHERS—Prime wax
prime gray do. 44¢; do.
27¢@31¢; xx 15¢@18¢; x-
tare 10¢ per cent on x-
large. Ducks—White 44¢;
Prime dry-picked bod-
quill-mixed 2c. Turke-
quill-mixed 18c.

BEEFWAX—Quote pri-
impure and inferior less
SHEEP PELTS—White
\$1 each, for green or d-
spring lambs at 10c to 12c
kill. Dry 10c per lb. f-
sandy and heavy.

GOAT SKINS—Quote
5¢@15¢.

WOOL—A few small
arriving and little
given herewith; market
and accurate prices no
The trade awaiting a se-
question; besides shears
Quote, nominal price
17c for low to 18
12c for heavy to 16
15¢@17c; burry 11¢@13
for slight; Southern
burry to 17c for clear,
to 16c and fine 11c for
medium 16¢@17c; do. h-
ern or Western 17c f-
bright medium; 10c to 12
for hard burry to 16c f-
20c for burry to 28c f-
15c for burry to 25c f-
for long lustrous.

TO GROWERS OF
D successfully with forel-
realize top market price
put the wool in prop-
tion. The wool must be
in fleeces with a light
After all dung, skirts and
ter practicable is remov-
separate from burry, m-
fine, etc., and otherwise
as possible for manufa-
ture.

FURS—The season
as offerings are more
prices are about two-
ues. Current receipts
coon 25c to \$1, mink 8¢
to 50c skunk (Central 5¢
rat (do.) 40c to 45¢; fox
cat 10¢ to 15¢; gray fox 8¢
@4¢; wolf 25¢.

HIDES—Market inave-
ners buying only for
Green salted in light
good many "shedders"
ble. Dry quoted.

Wet Salted.
Round 13¼¢
No. 1 13½¢
No. 2 12½¢
Bull 10½¢
Glue stock 8½¢

Uncured or fresh 1½¢
cured ¾¢ per lb. less
horse hides \$8.50 each
and pony \$1.50¢; no
pigs half price.

London Wa-
LONDON, April 28
demand for the vari-

Stock No. 8.

Red Fir.

and Delmar avenues, today to the Legislative Investigation Committee by a 16-year-old girl who identified herself as "Irene G."

Witness was 15 years old when she went to the home, to work for her keep, medical attention and her approaching accouchment.

"I was forced to scrub floors and lift heavy trunks the day my baby was born," she declared.

She said that an overworked doctor at the home had expressed to her the fear that he would be unable to perform properly the necessary obstetrical operations when her baby was born. This proved true, she said, for one eye of the infant was punctured by an instrument.

Witness was at home nine months, she said, and she worked at scrubbing floors and waiting on table till she dropped from exhaustion. The food, she asserted, was scant and very bad, often unfit to eat.

Overwork and hardships impaired her health, she said. The girls had to attend chapel three times a day, and when they were ill they didn't feel like kneeling down and have visitors pray "at" them.

Marcia Berlyn Weinberg, who was dentist of the home for a year, testified she had criticised the practice of making girls scrub floors until the day their babies came into the world.

She asserted the head of the institution had once scored the girls in a sermon, declaring that they should "be forced to eat under the table, like dogs."

WAGE COMMISSION TO MEET.

Chairman Calls Members to Gathering in St. Louis May 15.

Michael J. Kinney, chairman of the special committee created by the Missouri Legislature at its last session to inquire into wages, working and living conditions in the State, yesterday issued a call to the committee to assemble in St. Louis May 15.

The investigation will be similar to that recently conducted by the Illinois Vice Commission.

The examination of witnesses will begin soon after May 15 and will include factory and department store owners and managers and attaches of all kinds of industrial plants where a large number of persons, especially girls, are employed.

The testimony will be submitted to the Legislature.

LOWER CALIFORNIA

Propose to Annex Possession.

April 28.—Declaration has been pledged of Lower California Government by a group of capitalists, W. J. Geary, property owner at Los Angeles, announced the deal would be concluded that annexation by

\$200,000 FOR CANCER CURE

Henry Rutherford Leaves Rockefeller Institute Special Bequest.

NEW YORK, April 28.—The Rockefeller Institute for Medical Research is left \$200,000 by the will of Henry Rutherford of Grand Isle, Vt., who died here February 26.

The will was filed here to-day. The income of the bequest, the testator says, is to be used to find a cure for cancer.

which that body will open rules were prepared and after the commission came into existence, April 5, and soon of the hands of the printer for distribution.

The synopsis of the rules

Any public utility coming under dictation of the commission must copy of the new public-service copy of the rules of the commission, and also any attorney's demand for a copy of either may request to the commission.

The rules, as adopted by the commission, will hold regular sessions at its office in Jefferson first Tuesday in each month, at 10 o'clock in the morning. Under the rules, the commission is open to the transaction of business every day of the week except legal holidays. Other sessions of the commission will be held in Jefferson elsewhere, as the business requires.

No rate of any public utility can be increased after April 15, law became effective, without notice and consent of the commission. One of the strongest features of the commission is the supervision to be exercised in the issuance of stocks, bonds and public-service corporations of the State. In addition to scrutinizing the purpose for which such bonds, notes are to be issued, the commission require an itemized statement of expenditure of such moneys, verified by some officer of the public-service, to be filed with the commission at the end of each six months, showing the position has been made of the sales of such stocks, bonds at the time.

In this way the commission fees moneys and obligations of public corporations on which the public has a return in rates should be justly and expended properly for the benefit of the public, as well as the utility.

The rules set out in full forms for complaints, applications and other matters before the commission, which will interest to lawyers practicing before the commission, and also to all utilities under the jurisdiction of the commission.

Under the rules, when a complaint is received an order of the commission that the party complained against satisfy the complaint or answer within ten days thereafter; also a copy of the complaint is sent to the party against.

If at the end of ten days the party is not satisfied, then the commission will order for a public hearing, at which the party complained against ten days of such time and place.

In this way it is hoped the business of the commission will be expedited and long drawn-out litigation.

Welfare Delegates Appoint JEFFERSON CITY, Mo., Ap

State Superintendent W. P. Egan day appointed as delegates to the nineteenth Child Welfare National Congress of Mothers and Parent Associations, which will meet in Boston, Mass., May 15—20, Miss Griffith, St. Louis; Miss Estelle Springfield, and Miss Ella V. I.

Stock No. 8.

Red Fir

throughout the col

ermosa Panamas—
98 and up.

**New Styles in
Summer Hats**
Hats in Panama, Leg-
hats are shown in this
new and clever styles
delight the little ones.
very moderate.

OR AND WIFE TO SHOP

**get Affairs of State and Visit
Downtown Stores.**

Mrs. Major will go shopping
for the brief space that lies
early shopping hours and
in the big stores, the Gov-
forget all about politics, ap-
insurance, tangles, and
gresses, while, he aids, Mrs.
ke purchases for the Exe-
nson.

Friday I will be astride a horse
time," said the Governor late
t: "and a strenuous day of
will sort of prepare me for
als. Thursday I am to appear
the Peace Congress, so, alto-
will be busy enough while in
ernor is still considering his
ats for the Public Utilities
on.

a number of men in mind,"
but I have made no decision."
used to comment on the avail-
of J. E. Allison for the fifth
that body, who is said to be
the many applicants for the

and Mrs. Major will be the
Mr. and Mrs. Fred D. Gardner

PANKHURST JEERED

**Freedom Continues, Disap-
pointing London Crowd.**

DN, April 28.—The expiration of
ted license under which Mrs.
Pankhurst, the militant suf-
frage leader, was released April 12,
olloway Jail, where she was
three years' imprisonment,
a great crowd to assemble to
the house where she has been
to recover from the effects of
finger strike.

people's expectation of seeing her
returned to jail was disap-
the authorities having in the
decided to extend her license
to her unsatisfactory health.

Mrs. Pankhurst's feminine
started off from the house
ss Sylvia Pankhurst, during the
on, a hooting crowd tried to
e car.

Miner's Dog Dies of Grief.

women's conference ac-
of the minimum wage bill, initiative
and referendum, and the limited suf-
frage bill.

The women's conference and a meet-
ing of the State Central Committee
were the only meetings scheduled for
this morning.

B. F. Harris of Champaign tendered
his resignation as chairman of the
State Committee, resigning on account
of ill health. John F. Bass of Chicago
was elected to succeed him. Fred S.
Willbur of East St. Louis was elected
to succeed Mr. Bass as vice chairman.

H. L. Fordham of Dixon, who has
been acting treasurer of the committee,
was elected treasurer.

Joel F. Longnecker of Chicago was
elected member of the committee for
the First District, to succeed Chauncey
Dewey, who resigned some time ago.

TRIES TO "DUCK" HAYWOOD

**Crowd Threatens Labor Leader When
He Is Arrested in Passaic.**

PATERSON, N. J., April 28.—William
D. Haywood, leader of the Industrial
Workers of the World, was arrested at
Passaic to-day on his way here from
New York to surrender himself under
an indictment charging him with in-
citing riots among the silk mill strik-
ers.

Ten thousand strikers had gathered
at the Erie Railroad station here this
morning to meet Haywood and to wit-
ness his arrest, and to escort him to
the jail. Fearing a disturbance if the
arrest was made here, Sheriff Radcliff
arrested Haywood at Passaic.

The strike leader accepted arrest
calmly. He was brought here from
Passaic in an automobile and was re-
leased on bail soon after his arrival.
He hurried to Turner Hall to make a
speech to a big crowd of strikers.

When the leader was taken from the
train at Passaic, he was quickly sur-
rounded by a crowd, which shouted
"duck him in the river." The demon-
stration became so threatening the
Sheriff called on several policemen to
help him escort the prisoner to an au-
tomobile.

THOUGHT TRIAL WAS HEARING

**Husband Loses Divorce When Wife
Tells Why She Didn't Contest.**

Mrs. Margaret A. Gansz, 1074 South
Kingshighway, appeared yesterday in
Circuit Judge Rassieur's court and tes-
tified in the divorce suit of her hus-
band, John J. Gansz, 1829 Market
street, although she did not contest the
case.

She said her husband has been visit-
ing her every week.

She was asked by her husband's at-
torney why she did not contest the
suit. She said her husband told her
the case was not to be tried for sixty
days and that yesterday's proceeding
was only a "hearing." She thought she
had plenty of time, she said.

Gansz denied her statements and said
he had called upon her only a few
times about business matters.

question for mature
liberation."

William K. Bixby, ac-
tive Commerce director,
the article, has stat-
since the resignation
that he thought the
tion of the bank could
ness satisfactorily.

Simmons Takes

E. C. Simmons, a
rector, who has served
took a similar stand
was no need for has-

Friends of Mr. Rans-
during the last week
several hundred letters
financial, railroad and
all sections of the co-
the hope that he will
dent of the Commerce

Mr. Randolph declar-
messages or discuss-

He owns a large
stock in several other
believe that if some-
to the Commerce vac-
the institution.

Autolists Arrested

Robert G. Kobusch,
avenue, and Wesley O.
street, were arrested
the automobile in a
riding collided with
at Bissell street and
nue. George Hentz,
who were in the bus
thrown to the street
bruises. Kobusch and
up at the Angelica
tion, charged with

Forty-Two Pass

ANNAPOLIS, Md. A
two candidates for a
Naval Academy as re-
cided to be accepta-
Academic Board thir-
lengthy session.

ONE DOSE INDIGES

All Stomach
ly ended with
Diap

You don't want
your stomach is
one—or a harmful
is too valuable; you
with drastic drug-

Pape's Diapepsi
speed in giving
ness; its certain
regulating sick, sur-
Its millions of
dyspepsia, gastrit
trouble has made
over.

Stock No. 9.

Hemlock.

Stock No. 11.

Tamarack.

SS MACKIN IS HERE

560, Who Danced With King, Attend Peace Congress.

Spottwood Mackin (Sallie) who danced with the late

ard VII when he visited St. Prince of Wales, is a guest

Jefferson and will attend the

ness Mackin is the daughter

Mayor James H. Britton of

leader of St. Louis,

the Prince of Wales, who

King Edward VII, spent sev-

in St. Louis.

ter ball was given in his

ess Sallie Britton led the

er St. Louis society belle is

ident of Paris, France.

plusive is Most Powerful.

April 28.—Prot. Arsene d'Ar-

the College of France has

a new explosive, said to be

more powerful than dynamite

black and liquidified gas. Ex-

in quarries near Paris have

markable results.

True Source

Of Beauty

must be, good health,

skin and face blemishes

usually caused by the

of impurities in the

impurities which also

gervousness and depre-

spirits. If, at times,

here is need you will use

TECHAM'S PILLS

find yourself better in

way. With purified

you will improve diges-

keep more restfully and

nerves will be built up

ng eyes, a spotless com-

rosy lips and vivacious

Good for all the fam-

echam's Pills especially

elp Women

Good Health

17th Street Broadway at Locust

the delivery had not been made.

"Ha, ha," laughed Schoenky, "I was

put wise to you fellows. You are po-

licemen and are trying to arrest me

for selling less than five gallons of

liquor at one sale without a retail

the beer, that's all."

"No, that isn't all," returned Phelan,

wasting the receipt. "Either deliver that

beer, or I will arrest you for obtaining

money under false pretense."

The beer was delivered and the liquor

license charge was placed against

A year ago Mrs. Saxe

Mrs. Bertha Newman,

follow boulevard, won

"Yippies, ind. While th

May, who is a retir

Charleston, being the

Schwab & May depa

that city.

R. T. CRANE'S WI

VICE ATTACK "PLOT" FAILS

Attorneys for Girl Witnesses Forced to

Quit Illinois Hearing.

SPRINGFIELD, Ill., April 29.—A

"plot" to attack members of the Illinois

Legislative "White-Slave" Commission

and an attempt by two Springfield at-

torneys to force themselves into the

quits by acting as volunteer counsel for

The "plot" turned out to be a hoax, a

Deputy Sheriff having told one of the

commission's officers that the Sheriff

would be on hand at the session to "run

things."

It was taken seriously, however, as

the police were on hand and were re-

quested by Lieut. Gov. O'Hara to keep

order.

The attempt by Attorneys A. M. Fitz-

Gerald and C. E. Mortimer to address

the commission was productive of much

uproar, laughter and jeering.

They were aided by the sympathy of

the crowd which attended the hearing.

Neither was permitted to make a speech

and they left the hall as O'Hara called

on the sergeant-at-arms to put them in

their seats.

The only witnesses examined were

several girls employed at the local shoe

factory. It was not announced whether

any further hearing will be held in

Springfield.

CRITICISES PIERCE'S MEMORY

Financier at \$1,500,000 Hearing Falls

to Recall Transactions.

The depositions in the suit of the Na-

tional Bank of Commerce against H.

Charles Pierce, to recover \$1,500,000, the

ward, who rooms at

Claude Pool, 2144 Elm

to their uncle's room

candy and apples, w

them were there. They

and also the whisky.

At 3 o'clock Mrs. Pe

children lying on the

of the house, uncon

for Dr. B. H. King.

The physician said

both are in a serio

recovering

representing

who is representing

Lockett Edwards,

Lockett Edwards,

Terminal Company securities provoked

sharp criticism from Attorney George

Nashville

matters pertaining to the Nashville

transactions by him and his agents in

day and his inability to remember

Mr. Pierce was on the stand yester-

cial Commissioner Hugo Muench.

o'clock to-morrow morning before Spe-

secure loans, will be resumed at 10:30

Pierce has, although it was pledged to

nal Company, which the bank claims

the o'clock in the Nashville Termi-

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the depositions in the suit of the Na-

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Holdings of City Sales Manager Estimated at More Than \$4,000,000.

Edwin A. Lemp, one of the six principal stockholders of the Lemp Brewing Company, has withdrawn from the company and disposed of his interests, following differences with his brothers over the management of the big concern.

E. A. Lemp is the second of the heirs of William J. Lemp to withdraw. Louis Lemp having sold out his interests to other members of the family about seven years ago.

Not one share of stock in the concern has been held by any but a member of the Lemp family since the brewery was founded by Adam Lemp, seventy-three years ago, and it is understood all Eddie Lemp's stock has been bought by his brothers, Charles A. and William J. Lemp Jr.

When seen last night Mr. Lemp declined to discuss his withdrawal other than to say "business differences had occasioned it."

"There is no personal feeling in this matter at all," he said, "and although my brother Charlie and I didn't get along very well, that had nothing to do with my selling out."

"My brother Louis withdrew because he wanted to live in New York and was tired of the business cares, but you can bet I'll stay right here in St. Louis. I have not made any plans, but this little old town is good enough for me or any other man on earth."

Charles A. Lemp declared his brother withdrew from the business because he was tired of working and wished to take life easy for the remainder of his days.

Eddie was manager of the city sales department and was known generally about town as a "Good fellow." He has spent a great portion of his time during the last few years at the Lemp farm on the Meramec River.

It is estimated Eddie's holdings in the brewery were worth more than \$4,000,000.

His last acts as an official of the company will be taken to-day, as he will retire permanently from the business to-morrow.

MILTED, GOES GUNNING, HELD

Frank Gurtis, 21, Crossed in Love, Threatens Storekeeper

Frank Gurtis, 21 years old, who after he had been crossed in love caused a reign of terror at Garrison and Washington avenues, yesterday afternoon was arrested charged with flourishing a deadly weapon.

Gurtis had been lavishing his attentions on Lola Blake, 17 years old, of 2961 Washington avenue, but his affection was not returned.

Lola asked her half brother, E. B. Whitworth, who owns a grocery at 2941 1/2 North St. Louis so-

tion that could be seen by the members and congressional attend the Jefferson at Forest Park and Louis on the same distinguished English-ly and bridal party, mother, Hon. Lady Misses Violet and Sir John Shelley and A. Benyon, who is man at the Peek-Lemp having sold out his interests to other members of the family about seven years ago.

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"a hurry," he replied, "us go, we are late. Thornbourg, please, was an hour late. couples were adjudged gifts will be here lady Peek and the going to stay during city?" he was asked, some hotel and re-adding. My mother the guests of Mrs. a deadly weapon.

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Not one share of stock in the concern has been held by any but a member of the Lemp family since the brewery was founded by Adam Lemp, seventy-three years ago, and it is understood all Eddie Lemp's stock has been bought by his brothers, Charles A. and William J. Lemp Jr.

When seen last night Mr. Lemp declined to discuss his withdrawal other than to say "business differences had occasioned it."

"There is no personal feeling in this matter at all," he said, "and although my brother Charlie and I didn't get along very well, that had nothing to do with my selling out."

"My brother Louis withdrew because he wanted to live in New York and was tired of the business cares, but you can bet I'll stay right here in St. Louis. I have not made any plans, but this little old town is good enough for me or any other man on earth."

Charles A. Lemp declared his brother withdrew from the business because he was tired of working and wished to take life easy for the remainder of his days.

Eddie was manager of the city sales department and was known generally about town as a "Good fellow." He has spent a great portion of his time during the last few years at the Lemp farm on the Meramec River.

It is estimated Eddie's holdings in the brewery were worth more than \$4,000,000.

His last acts as an official of the company will be taken to-day, as he will retire permanently from the business to-morrow.

THE WEATHER.

TO-DAY'S FORECAST
For St. Louis and Vicinity—Fair or to-day, Thursday, probably a

YESTERDAY'S CONDITIONS
Barometer—At 7 a. m., 30.17; 10 p. m., 30.11 inches. Temperature—At 7 p. m., east; velocity at 7 p. m., east; precipitation, none. Weather—A clear; at 7 p. m., clear.

LIGHT LAMPS, ALL VEHICLES.
Stage of the river at 7 a. m., 18 of day, 13 hours and 47 minutes. Sun rises at 5:03 and sets at 6:10 p. m.

Thermometer Reading
1 p. m., 54 degrees; 1 p. m., 54 degrees.

ing by the state of the con-

Gen. E. J. Spencer.

Francis to Call Assembly

President Francis will call to order. The exercise conducted in the open, on the of the memorial structure. Re J. Nicolls of the Second Pre Church will deliver the invocation of the statue.

The unveiling of the statue son will fall to the lot of Mr. Norton of Salisbury, Mo. Mr. Peterson of the sixth Generation immediately that the statue of President Francis will d address on the part of the building over to Mayor Henry the Mayor will respond.

the gift in behalf of the pe short address. President Mr. Th will introduce William M. Th the University of Virginia, deliver the oration of the day Mr. Thornton is a recognize ity on the life of Jefferson, an review the official acts of the Monticello, dwelling, especially Louisiana Purchase and its im the nation.

Descendant to Unveil The
The tablet commemorative event which the Exposition was to celebrate and from which the magnificent monument w velled by Mrs. Dixie Wells M 3866 De Tonty street, also a scendant of Thomas Jefferson same degree as Miss Norton, different branch.

Following the unveiling of let, Senator W. L. Jones of tion will deliver an address, a the educational and milita Francis, Govs. Dunne and Ma Kiel and the congressional d The parade will be an hour a given point. It will move on Lindell boulevard and will reach the Memorial structure

Continued on Page 11

Stock No. 12.

Tamarack.

STEEL EARNS LESS
THAN LAST QUARTER

-figures, Though, Are Higher Than

Those of Corresponding Pe-

Period of Last Year.

PROVED QUALITY
IN NATIVE BEEVES

Best Make Top of \$8.40—Cattle

Prices Generally Weak to

0c to 15c Lower.

RECEIPTS.	
Cattle	2,860
Hogs	11,000
Sheep	1,300
Horses and mules	500

NEW YORK, April 29—The financial statement of the United States Steel Corporation for the first quarter of this year, issued to-day, shows total earnings of \$34,426,801 and net income of \$25,666,509. These marked decreases of \$1,758,761

and \$68,417, respectively, compared with the quarter immediately preceded and \$67,500, respectively, for the corresponding quarter of 1912, when total earnings aggregated only \$17,826. Surplus for the quarter amounts to \$369,000, as against a deficit of \$67,184 in the same quarter last year.

The statement was under general estimates, which ran all the way from \$36,000,000 to \$40,000,000. While no official explanation was vouchsafed, it is understood that the recent floods affected the corporation's earnings to the extent of at least \$2,000,000. It is considered not improbable that this same cause may find further reflection in the current quarter.

Chairman Gary, contrary to his usual custom, did not issue any statement dealing with the outlook in the industry. But it was said that orders were sufficient to keep its plants busy for the rest of the year.

The usual quarterly dividends of 1 1/2 per cent on the preferred stock, and 1 1/2 per cent on the common, amounted

Tamarack. GRASS SEEDS, Tamarack and
Mediterranean Markets

Stock No. 12.

SORGHUM-CANE SEED—Quotable at 90c
 SWEETWATER SEED—Quotable at 75¢ @
 DRIED FRUIT—Little
 or none offering;
 prices nominal; sun-dried
 quarters apple at from 3c
 to 4¢; evaporated rings
 or ordinary to 4c for
 leaches at 5c to 5½c; cores
 ad peeled

[illegible]

Calves and Yearlings.—The supply of veals was light, with prime kinds lacking, and prices on all classes of veal were about the top was \$10.80. Most of the good grades of veals sold from \$10 to \$10.25. Common to good kinds sold from \$9.50 to \$9.75. The supply of yearlings was light, very few yearlings being sold. Meddled veals sold from \$6.00 to \$6.25. A few lots sold above and below these ranges, but they were of little consequence.

[illegible]

BISHOP JOHN JANSSEN BETTER BELLEVILLE.

Chicago. Prelate Departs for Home After Spending Day at Bedside.
Archbishop James Quigley of Chicago yesterday spent the day at the bedside of Rev. Bishop John Janssen of the Belleville diocese, who was stricken with heart failure last Thursday night on the eve of the silver jubilee of his consecration to the bishopric.
Archbishop Quigley departed last night for Chicago, where he will remain until he has recovered his illness and will return, they state they believe the Bishop has contracted his illness and will recover.

To Be Court Reporter's Bride.
Roy White, official reporter of the Clair County Probate Court in Belleville, at Miss Linda Knobloch, daughter of Mr. and Mrs. Henry Knobloch of 614 East C street, Belleville, will be married at 1 o'clock this afternoon. Mr. White is a son of Superintendent of the Belleville Water Works, Mr. White is a son of Superintendent of the Belleville Water Works, Mr. White is a son of Superintendent of the Belleville Water Works.

Brooklyn Marshal Freed.
Robert Dorsey of Brooklyn, who was under indictment on a charge of threatening to shoot Constable Walter L. Ward of Belleville six weeks ago, was acquitted in the Belleville Circuit Court yesterday. Constable Ward was one of the deputies who assisted Attorney Webb in making the raid on the gambler in East St. Louis. It was charged that when Webb rushed into a saloon which was raided by Brooklyn, Dorsey, who is Town Marshal, drew his pistol and flourished it in a threatening manner. The jury was out two hours.

Power Co. Gets \$3,000,000 Loan.
A \$3,000,000 mortgage was filed in the office of Recorder of Deeds C. A. Summerville yesterday afternoon by Southern Illinois Light and Power Company. The loan is made for improvement of the property of the company. The loan is made for improvement of the property of the company.

German Evangelical Synod Elects.
The Southern Illinois District of the German Evangelical Synod of North America elected officers as follows: President, E. G. Pissmann, Nameok, Ill.; vice president, Rev. William Riemer, Carlinville, Ill.; secretary, Rev. Daniel Buchmiller, Pocaahon, Ill.; treasurer, Rev. John Berger, Madison, Ill.

Boy on Skates Hits Mail Box.
An attempt to slide one way on the skates while looking in another direction was made by a 13-year-old son of Mr. and Mrs. Henry Wirth of Belleville, to collide with a mail box. He was knocked unconscious. He was taken to the hospital.

SUPP. POTTS IS RE-ELECTED EAST ST. LOUIS.

B. H. Canby Named President of Board of Education.
F. D. Walter Potts was re-elected superintendent of the East St. Louis public schools when the new Board of Education organized yesterday.
B. H. Canby, formerly judge of the City Court, became president of the board, succeeding Dr. R. L. Campbell, who served three terms.
The new members are Ed J. Coffey, W. H. Bray, Herman E. Mollman, Jesse Boismene, They succeeded Fred W. Kraft, Joseph H. Kuebel, Dr. G. D. Hulick and D. J. Mulcahey. The holdover members are Dr. E. W. Canaday, H. B. Carson, A. I. Cummings, Ralph McLean, J. C. Thomason, Fred Brendle, S. J. Cashel and C. C. Molla.

Fire Prevention Meeting To-Night.
The prevention of the causes of fires and how to extinguish them will be the principal topic to be discussed at the meeting of the East St. Louis Commercial Club to-night. The meeting will be held in the auditorium of the City Hall, Sidney J. Roy of Hannibal, Mo., will talk on good roads. Representatives of the Illinois Fire Prevention Bureau will address the meeting. William C. Thrasher, president of the club, will explain the object of the "Live Wire" Committee recently appointed.

Car Cartie Victim to Hospital.
After their car had run down Alfred Murphy, a 14-year-old East St. Louis schoolboy, the crew of a Belleville car picked up the boy and carried him into St. Mary's Hospital. The boy had attempted to cross the street in front of the car. He lives at 1919 Summit avenue.

NEW OFFICERS IGNORED ALTON.
Without holding election, the officers elected April 2, the old Town Board of Woodlaver Township held a meeting yesterday morning and reorganized. The newly elected members will probably organize also, there-fore, the Board contend the election was illegal, and though they were not candidates, they are holding onto their offices. The newly elected members will probably organize also, there-fore, the Board contend the election was illegal, and though they were not candidates, they are holding onto their offices.

Old Members of Town Board Reorganize Without Holding Election.
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ARGUE IT TIME

Efficulties of Credit Date.
April 29.—At their brief- ional McKern- ment upon a ntion of time After their car had run down Alfred Murphy, a 14-year-old East St. Louis schoolboy, the crew of a Belleville car picked up the boy and carried him into St. Mary's Hospital. The boy had attempted to cross the street in front of the car. He lives at 1919 Summit avenue.

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Stock No. 13.

Noble Fir.

a rush to the
restaurant
this no

Stock No. 13.

Noble Fir..

as for to-night
is that we hope the
ordered about two to
amount from the bu
After reading some
stories in the

PURE FOOD NUMBER

of

The New York Evening SATURDAY MAGAZINE

your appetite will be something fearful. We warn you not to read it if you can't afford a square

The Perpetual Potato

an attack on that time-honored starch bomb, by Henry T. Finck, author of "Food and Flavor." He commends spaghetti.

Canned Interview with a Chef.

a Foster Ware, is accompanied by other confessions telling why the kitchen lords of big hotels are proud of their baked beans.

Dining Out in New York

made of some piquant ingredients left (in the form of notes) by Samuel Ward, a 19th century gourmet, for whom they still name dishes. Incidentally it traces the history of Delmonico's.

Another Little Crucified Sisters Romance

by L. J. Beeston.

Brooklyn Bridge Maligned

Simeon Strunsky, the Post-Impressionist, experiments to explain the plausibility of

Four Famously Lovely

are the flavor of this week's portion of stage reminiscences. To wit: Adelai, Rehan, Kate Claxton, and Sara Jewell do their youth and charm full justice.

A Page of Fashions

sent direct from Paris by our own Florence H. Barkley.

Art—The Stage—Science—Fair Play's Sports—More

There are 60 pictures in this number, a piece of superb color work, the "Lilian," by Robert Henri.

This magazine accompanies the New York Evening Post on Saturdays, and the paper and magazine is only 5 cents a copy at all newsstands. (\$2.50 a year by mail)

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REV. MAXWELL GANTER

Ritchie, who becomes rector emeritus. Mr. Ganter is a son of the late Rev. Dr. R. S. Ganter, who was rector for many years of St. Paul's Episcopal Church, Akron, Ohio, where the son was born, May 31, 1883. Mr. Ganter was graduated at Kenyon College in 1904, and from Yale Graduate School in 1906. He spent the next year abroad. On returning he entered the General Theological Seminary, this city, and was graduated in 1910. He was ordained the same year in St. Thomas' Church by Bishop Sidney C. Partridge. Mr. Ganter has served as curate at St. Martin's Church, New Bedford, Mass.; Cathedral, this city; Christ Church, New Haven; St. Mark's Church, Philadelphia, and Grace Church, Newark, N. J.

Drew Methodist Theological Seminary, Madison, N. J., has established the Chair of Missions and Comparative Religions and has elected to it the Rev. Dr. Edmund Davidson Soper, professor of missions in Ohio Wesleyan University. He is the son of Dr. Julius Soper, a veteran missionary, and was born in Tokio thirty-seven years ago. The young man is a graduate of Dickinson College and of Drew Seminary. He has served as college secretary of the Pennsylvania Y. M. C. A. and as secretary of the Missionary Educational Movement.

The Rev. Frank H. Simmonds has accepted a call to Grace Episcopal Church, White Plains, N. Y., as curate to the Rev. Dr. Frederick Van Kleeck.

"GO TO CHURCH SUNDAY" HERE

West Side Churches Unite for Move-
ment and Fix Washington's
Birthday for the Date.

"Go to church Sunday" has been fixed for Washington's Birthday by forty Protestant churches of the Manhattan West side below Forty-second street, by all on Staten Island and by those of the Far Rockaway part of Long Island. In the Bronx the preceding Saturday has been included. The west side Manhattan churches adopted a resolution urging the fixing of some future date for the whole city, but voted themselves to observe February 22.

West side churches taking parts include the University Place, First, West Twenty-third Street, Greenwich and Faith Presbyterian; Metropolitan Temple and Washington Square Methodist, Ascension, Holy Communion, Holy Apostles and St. John's Episcopal; Sixteenth Baptist and Knox Memorial Reformed.

Announcement was made of the result of a canvass made in behalf of a "go-to-church Sunday" for the entire city. Dr. S. Edward Young, pastor of the Bedford Presbyterian Church, of Brooklyn, said that the vote in favor of such a Sunday had been practically unanimous and that the third Sunday in October had been the date selected.

writes—"It was a great help. I
our non-Christian children do not
clothing until they are six or eight
old. We, however, require our
children to wear clothing for the
services; hence your box was a
to many parents unable to buy clot
their little ones. We overlooked
the babies, as the material was in-
cient, and they appeared clothed
smiles."

Miss Mabel eParson Schmidt, who
the last year has been a member
deaconess staff of St. George's Ep-
iscopal Church, has resigned to become a
of English in one of the public
She will continue as a volunteer work-
the Sunday school.

Mrs. M. B. Norris, of the W
Board of Foreign Missions of the Re-
Church, who has recently returned
Japan, will address the Woman's
of the Marble Collegiate Reformed
Monday morning in the chapel, Fif-
ue and Twenty-ninth street.

The Society for Women's Work,
Broadway Tabernacle, at Fifth
street, will hear a lecture Tuesday
Lovell Murray, and February 24
Mills, of Schaeffler Institute.

The eleventh annual meeting
Young Women's Hebrew Associati-
be held at the headquarters to-
afternoon at three o'clock. The sp-
will be Mrs. Charles H. Israels, a
Rev. Dr. David de Sola Pool. G. I.
Davis, chairman of the Building Com-
tee, will report on the association's
during the year.

A retreat for the Associates of the
ters of the Holy Nativity and other
will be held Wednesday in the Ep-
Church of St. Mary the Virgin,
sixth street, east of Broadway. The
will be the Rev. Dr. Joseph G. H.
the rector.

Socialism Chan

Attorneys for Operators D
That Party Was Responsible
for Strike.

[SPECIAL DESPATCH TO THE HERALD
HAWKCOCK, Mich., Friday.—The
sional investigation of conditions
up to the copper strike in Michigan
ise to develop some stormy pas-
among the members of the Congress
committee as well as between at-
representing corporations and the W
Federation of Miners.

This was indicated this afternoon
there was a discussion of socialism
the committee. Attorneys for the
companies questioned witnesses
miners to prove the contention th
strike was born in socialism; th
ederation is backed by the socialist
and that the present industrial dis-

Stock No.14.

Alpine Fir.

references. Nunchson, 1,884 Arthur st., B'nai
 General Housework, &c.
 HOUSEWORK.—General housework; lady w
 to place at once experienced, reliable
 married colored woman, with five-year-old
 573—Montgomery.
 maid or general worker for one perfectly
 reliable. reference furnished. W. L. 216 H.
 HOUSEWORKER. English, thorough, good
 cook, highly recommended, trustworthy. A
 F. 415 West 84th.
 HOUSEWORK.—Irish girl for housework;
 plain cooking; apartment. Holland 246
 94th st.
 HOUSEWORK.—German, middle aged, w
 best reference. Care of Pass, 61 West 74

Stock No. 14
Alpine Fin
WATCH FOR IT TO-MORROW
 meet all requirements.
 will find stock offered to
 wanting a dog of any breed
 Kennel Directory. Any one
 New York Herald Sunday
 country advertise in the
 ers and exhibitions in the
 The most prominent breed-
To Dog Buyers

A desirable married couple
 in a double closet, run-
 ing parlor and base-
 ment ladies, with
 beautiful large Room,
 excellent house, neigh-
 borly, single steam
 heating, electricity,
 running water, tele-
 phone.
 Bath, BIRD.
 In modern apartment,
 time, Apt. 2 East.
 and owning modern
 Room, twin beds,
 Room, suitable for
 school; central; ref-
 erence.
 EST.
 Rooms; shower baths,
 sunny front Room;
 e southern exposed
 bath adjoining;
 all Room; heat sub-
 stantial small Room;
 reference; refer-
 ence; quiet surround-
 ings; superior accommo-
 dation; furnished, sunny
 rate bath; reference;
 St. - Furnished
 Rooms, in-
 GENTLEMEN.
 alth; two gentlemen
 in Parlor connected
 Room, MILLER.
 Lexington and Park
 Street large Parlor,
 pleasant location; Hun-
 garian.
 two adjoining Rooms;
 optional, BGAN.
 Gentlemen to share
 convenience; refer-
 ence; home comforts.
 as; large, beauti-
 ful; men preferred; ref-
 erence.
 sunny Room, facing
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 and
 (97th) - Southern
 view; elevator.
 Moon, 1899 - River-
 side, refined Jewish
 family, Mrs. Herald.
 100 weekly scale

I am freed I do not intend to marry

few months later to New York

forbids either to

months.

usually is married, so that doesn't count."

engaged two or three times before she ac-

quies of his counsel soon after Mrs. Stone-

had been in the place appeared to be

surprised.

said. "There will be no reconciliation," he

Or yesterday. He lives in West Forty-

fourth street.

that

Mr. Stonebreaker served on Lester W.

ONE BLOCK

7th Av., I

THE

NEW

HOTELS A

Special Rate

2 ROOMS AT

3 ROOMS AT

4 ROOMS AT

5 ROOMS AT

6 ROOMS AT

7 ROOMS AT

8 ROOMS AT

9 ROOMS AT

10 ROOMS AT

11 ROOMS AT

12 ROOMS AT

13 ROOMS AT

14 ROOMS AT

LOWEST RATE

ALL O

Double Rooms

with Bath

Private Bath

2 Rooms & Bath

1 Room & Bath

Rooms for Men

Connecting Rooms

Restaurant

Phone, 1890-Cole

Bonta-

BROADWAY

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THE HERALD VIA COM-
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[HERALD BUREAU,
No. 130 FLEET STREET,
London, Saturday.]

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Nine Americans at Court with Mr. and Mrs. Page

First Presentation of the Season Is Held at Buckingham Palace and Is a Very Brilliant Event—Queen Mary Ablaze with Gems, Including the Star of Africa.

Stock No. 15.

THE NEW SHOWER EMBROIDERIES ARE S

[SPECIAL DESPATCH TO THE HERALD VIA COM-
MERCIAL CABLE COMPANY'S SYSTEM.]

HERALD BUREAU,
No. 130 FLEET STREET,
London, Saturday.

The first court of the season was held by the King and Queen at Buckingham Palace last night. It was a brilliant affair, many strikingly beautiful costumes being worn, while the dazzling display of jewels made the scene one of exceptional brilliancy and splendor. The dresses and trains were enriched with the latest shower embroideries, which had a lovely effect. More than eight hundred persons were present.

King George wore the uniform of the colonel in chief of the First Life Guards. The Queen's dress was of blue and silver brocade, with a train of Honiton lace, and lined with silver tissue and trimmed with sprays of silver roses. She wore the crown pearls and diamonds and the famous Star of Africa diamond blazed on her corsage. Her other ornaments were rows and ropes of pearls and the Order of the Garter.

Mr. Walter Hines Page, the American Ambassador, presented his son, Mr. Arthur Page, and Mr. Edward Bell, Second Secretary of the Embassy, while Mrs. Page presented her daughter, Miss Page; her daughter-in-law, Mrs. Arthur Page; Mrs. Bell, mother of Mr. Edward Bell; Miss Kate Fowler, of San Francisco; Miss Sylvia Fox, of Philadelphia; Miss Harriet McCook, of New York, and Miss Elizabeth Wells, of Boston.

JUDGE CRITICISES THE WAR OFFICE SYSTEM

Says England Puts at Its Head Per-
sons Who Have Never Worn
Any Uniform.

[SPECIAL DESPATCH TO THE HERALD VIA COM-
MERCIAL CABLE COMPANY'S SYSTEM.]

HERALD BUREAU,
No. 130 FLEET STREET,
London, Saturday.

At the resumed hearing of the army
libel action yesterday Justice Darling ex-

White Fir.

which she is a successful exhibi-
Basset hounds, this afternoon, wh-
the champions were paraded before
She also saw the dogs that receive
tinction for various acts of heroism

MR. BELL'S WEDDING TO BE A QUIET

Second Secretary of American
bassy in London Will Marry
Surtees Next Week.

[SPECIAL DESPATCH TO THE HERALD V
MERCIAL CABLE COMPANY'S SYST
HERALD BUREAU
No. 130 FLEET ST
London, Saturd

In consequence of a recent bereav-
and serious illness in the bride's
the marriage between Mr. Edward
Second Secretary of the American
bassy, and Miss Etelka Surtees v-
place quietly next week in London
the Ambassador and Mrs. Page, of
of the embassy and a few near
have been invited.

MRS. LOTT DIES IN LONDON, AGE

Widow of Charles F. Lott,
Francisco, Succumbs Af-
Long Life.

[SPECIAL DESPATCH TO THE HERALD
MERCIAL CABLE COMPANY'S SYS
HERALD BUREAU
No. 130 FLEET ST
London, Saturd

The death took place on Thursd-
37 Matheson road, West Kensin-
Mrs. Jessie S. Lott, widow of C
Lott, of San Francisco, in the
ninth year of her life.

PERU'S VICE PRESI IS LEAVING FOR I

[SPECIAL DESPATCH TO THE HERALD
MERCIAL CABLE COMPANY'S SY
HERALD BUREAU

lane May n the Water

FROM THE SKETCH
E.R.N.

Planes That Can Be Un- ing Craft To Be pat.

the control is perfectly instinc- wheel being pushed forward and control the elevation of the ma- id turned from side to side to t laterally. In turning the wheel e to side the rudder handle is ith the wheel, thus giving a per- al balance, and in turns it is only to off-set the rudder handle to or the other, still controlling the sition of the machine by turning and handle together sideways. e of control was adopted after dy had been made of all existing and combines many features that ome standard in Europe, the r lateral balance by the steering r example, being the standard nt in the German army and he German Wright aeroplanes. l feature of the control is the nner in which the rudder control ad with the warping. hen known for some time that ht Company contemplated a control, and aviators have been rested to know what form this e. Expert flyers, among them Atwood, Oscar Brindley, Beck- ns and several of the army and en, have expressed admiration w system, particularly because nctiveness, which is bound to uch easier and safer to fly than

PLAY SEMI-FINAL ON TUXEDO COURTS

C. G. Osborne, of Chicago, and C. C. Pell Win Right to Meet for Gold Racquet Championship.

[SPECIAL DESPATCH TO THE HERALD.]
TUXEDO PARK, N. Y., Friday.—The semi-finals for the gold racquet championship were played on the courts of the Tuxedo Tennis and Racquet Club to-day. C. G. Osborne, of the University Club, of Chicago, defeated G. Maurice Heckscher, of the New York Tennis and Racquet Club, three games to two, and Clarence C. Pell, of the Tuxedo Tennis and Racquet Club, won from Arnold F. McCormick, of the University Club, of Chicago, three games to one. Messrs. Pell and Osborne will meet to-morrow in the final.
Mr. Osborne took the first game easily from Mr. Heckscher by 15-8, but the second was close all the way. The score was tied at thirteen all, Mr. Osborne finally winning by 18-15. The third game was also close, twelve all being called before Mr. Heckscher obtained a lead that brought him victory by 15-12.
The fourth game was all Mr. Osborne's, but the fifth and deciding one was a hard contest. Mr. Osborne in his first five hands scored fifteen aces to Mr. Heckscher's five. Mr. Heckscher, in his two hands that followed, added five more, bringing his score to 10-13. The West-érner, however, easily acquired by his effective service the two necessary aces for a 15-10 triumph.
Clever playing was witnessed in the match between Messrs. Pell and McCormick. Mr. Pell, the younger man, finally won through superior staying powers and effective returns of the long rallies.
The summary:—
Osborne vs. Heckscher.
FIRST GAME.
Osborne 6 3 1-15
Heckscher 4 1 1-6
SECOND GAME.
Osborne 0 7 0 0 0 5 0 1 0 5-18
Heckscher.... 0 2 0 2 1 1 3 0 1 1 2 2-15
THIRD GAME.
Osborne 2 0 0 5 0 2 3 0-12
Heckscher 0 6 1 0 2 4 1 1-15
FOURTH GAME.
Osborne 1 2 0 1 0 0 0 1 0-5
Heckscher 1 3 1 0 0 1 6 2 1-15
FIFTH GAME.
Osborne 1 3 1 0 8 0 0 2-15
Heckscher 0 0 0 1 4 4 1 0-10
Aces by services—Osborne, 37; Heckscher, 23.
Aces by placing—Osborne, 20; Heckscher, 22. Aces

NO NEW TENNIS

National Organ- Discussion, Mo Policy at A

Arguments over definition of an ar took up most of the meeting of the Un- Lawn Tennis Associ Waldorf-Astoria Ho ing of that body. T opposition develop offered by the orga Merrihew had drafted A vote of those pr was taken and the amendment was pass It one of the laws was necessary to hav When it came to gramme there was cussion and delay ti night before the res It seemed hardly pos be a chance of any of the American body. rat policy on the re- trol the sport in this The change in the amateur definition fa being 87 in favor and The amendment as hew was the following. Has not accepted m game in a tourname- tion, but a player, club or association tournament, match or it and sanctioned by National Lawn Tenn accept actual railroad his home to the city w is held, and such hos may provide, but sh money in lieu of hospi A player when of represent an associa world's championship petition or in a tourna auspices of the U. S. representative team c- ceive from such asso- necessary travelling a- ing expenses. Such must report the tota such player on reques Committee of the U. S. or association must of the holding of a to the secretary of the U. amounts paid by them portation and expense participated in such to- names of such players.
Robert D. Wren
Outside of the choice dent and the secretary cers was cut and dried. was again elected to t Henry W. Slocum, the

Stock No. 16.

Engelmann Spruce --- Colorado.

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Stock No. 17.

Amabilis Fir.

belts and patch pockets, nearly all with the patch
all styles.
\$6.50 to \$10 Suits & Overcoats, \$4.50
a wonderful opportunity for those who desire a
age of boys' clothing; sizes 2½ to 18. Many a prize
t.

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Suits, \$1.10 | Trousers, 50c
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sizes 6 to 17.

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Overcoats, \$6.50

one all wool, good standard quality; styles and
for young men; sizes 32 to 42.

leading makers in Amer
in medium and heavy
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Men's \$18 to

Many Overcoats fu
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garments.

Men's \$15
Chauffeur
Men's \$10 and
Men's \$4.5
Men's \$8.50
Men's \$15 M
Men's \$3

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Women's Neckwear
Leather Goods
Traveling Bags
Ribbons
Laces
Handkerchiefs
Embroideries
Infants' Outfits

Colored Petticoats
House Dresses, Ne
Corsets
Trimmed Millinery
Kid Gloves, Fabric
Colored Dress Goods
Flannels

Underwear
Men's Shoes
Men's Shoes
Men's
Jewelry
Silverware
Silverware
Articles

Men's and

Furnishings
Gloves
Hosiery
Raincoat
Leather
Shoes—
Boys' Ha

death of this brother, some forty years later, she had a square of glass let into the floor of the family pew which was directly over the family vault. In her brother's coffin she had glass placed directly over the face and, the coffin being put in place, she gazed once, but once only, upon the man who had ruined her life. Then there were less tragic figures, such as Mrs. Thorn, once a handsome fish girl, whose marriage proved exceedingly happy in spite of much opposition, and Mrs. Blackford, wife of the doctor, who considered herself scientific by marriage and had learned to know what she was supposed to see down her husband's microscope. The book is delightfully written with a distinction and simplicity of style as charming as it is unusual.

When Bret Harte opened for us the door into that magical though unreal world of California in the days of the gold seekers he also cleared the way for a host of imitators. It is impossible to read "The Twins of Suffering Creek," by Ridgwell Cullum (Jacobs), without realizing that the author is an admirer of "The Luck of Roaring Camp" and "The Outcasts of Poker Flat." It is the story of a Western mining camp, of an inadequate, amiable man whose handsome wife runs away with the good looking desperado of the vicinity, leaving her twin children to the care of their hopelessly incompetent father. The situation appeals to the compassion of the camp, and a syndicate is formed for the care of the children under the leadership of one "Wild Bill," a gambler, horse lover and general master spirit of the camp. Of course this syndicate is entirely unable to cope with the situation, and its attempts afford an opportunity for what the author evidently considers humor, but which seemed to me but a dreary succession of foolish incidents. The forsaken husband is so anxious to have his wife back, so loyal to the mother of his children, that the heart of "Wild Bill" is touched and he goes forth to kill the man who has added to his other crimes that of stealing a man's wife. The gambler succeeds, losing his own life in the act, and the repentant Jessie returns to her husband, who has found an oil well on his claim instead of the gold for which he was looking, and whose twins are further provided for by inheriting "Wild Bill's" bank account, some seventy thousand dollars. The book is poor in character drawing, dull in incident and extremely tiresome to read.

Tolstoy's Short Stories, published at a cheap price as No. 129 of the Scott Library, are very much like the stories of Russian peasant life that so many authors have given us. I have never been strong for

NEW PUBLICATIONS.

"Goddess of the Day

By MARGARET DAVIES SULLIVAN

"The Goddess of the Dawn," in the opinion of one of the editors of the time, "is the season's most delightful sentimental n

Doris, its heroine, will remain for many a day the best example of pure young womanhood in fiction.

"Fragrant and clean as the rose garden in which it opens is of the Dawn."—*New York Times*.

strongly the latter British Parliament. considers that political means in Germany would land he is much misled by its original theory of a numerical basis, the have about six hundred instead of 397, and the towns should be. What the author has the elaborate police system is interesting, though aghast at the idea of the population being of the intricate system of vision Mr. Tower thinks doubtful preventive of tends that it is of little of criminals. The chapter on municipal housing conditions in stance, are far from the streets are beautiful the apartment houses boxes seem very attractive are high, and wish something less obliged to go into rooms at the rear, looking yard which twice a week beating of innumerable are other chapters, den topics as education and intellectual life, an interesting as well as instructive.

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Lodgepole Pine. --- Montana..

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Western Yellow Pine.

Grinder Run No. 8.

Balsam Fir.

Grinder Run No. 27.

Lodgepole Pine --- California.

Grinder Run No. 1.

Red Fir.

Grinder Run No. 2.

Hemlock.

Grinder Run No. 61.

Tamarack.

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Noble Fir.

Grinder Run No. 11.

Alpine Fir.

Grinder Run No. 12.

White Fir.

Grinder Run No. 24.

Wm. H.

Granger Run No. 54

Engelmann Spruce --- Colorado.

Grinder Run No. 14.

Amabilis Fir.

Grinder Run No. 10.

Jack Pine.

Grinder Run No. 30.

White Pine.

Grinder Run No. 11.

Aspen.

Grinder Run No. 3.

Birch.

Grinder Run No. 5.

1871

George W. H. Hall

Black Gum.

Grinder Run No. 10.

Loblolly Pine --- fall cut.

Grinder Run No. 19.

Loblolly Pine --- Spring Cut.

Grinder Run No. 18.

Lowland Fir.

Grinder Run No. 2.

Engelmann Spruce --- Montana.

Grinder Run No. 10.

Western Larch.

Grinder Run No. 1.

Western Union

Chicago, Ill., Feb. 1