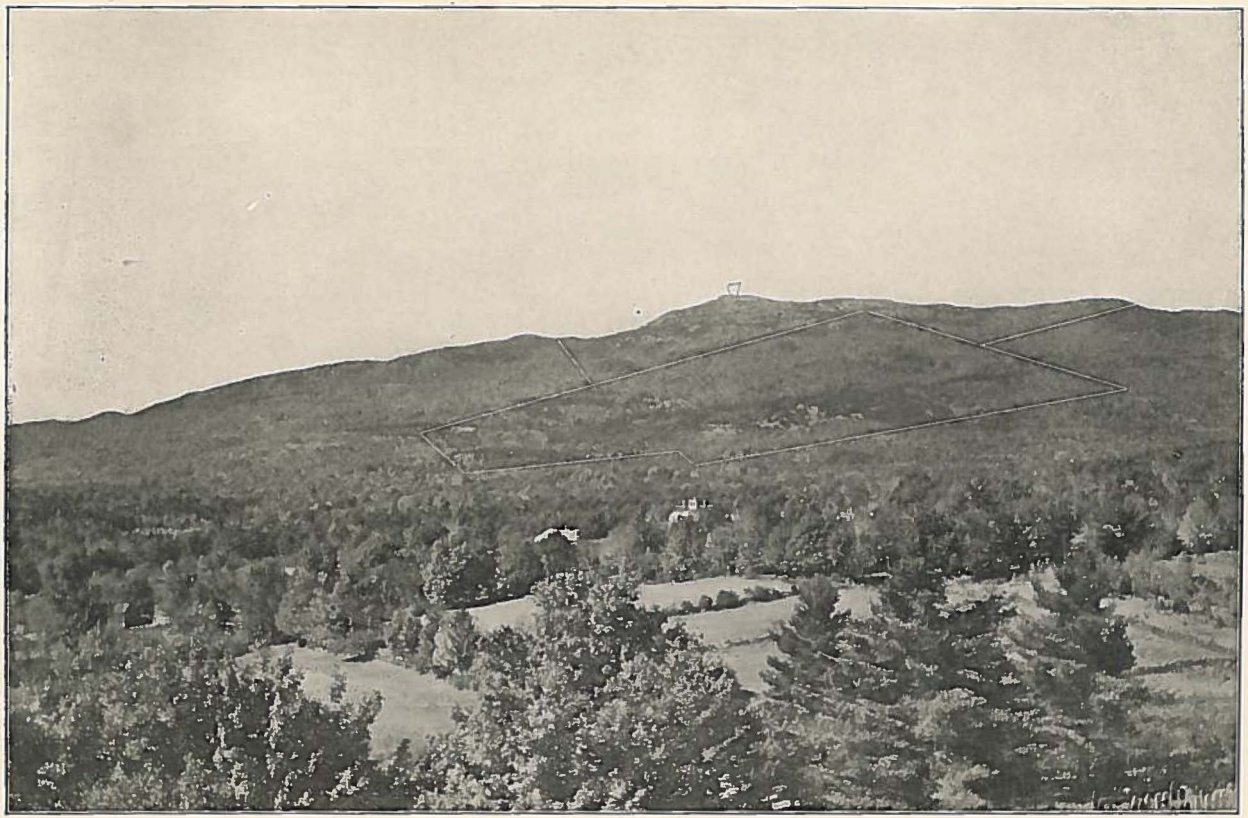


MOUNT MONADNOCK, FROM JAFFREY CENTER,

Showing the forest reservation, also the land above owned by the town of Jaffrey, N. H.

STATE OF NEW HAMPSHIRE

BIENNIAL REPORT

OF THE

FORESTRY COMMISSION

FOR THE YEARS

1905-1906

CONCORD
NOVEMBER, 1906

PRINTED AND BOUND BY
RUMFORD PRINTING COMPANY
CONCORD, N.H.

MEMBERS OF THE COMMISSION.

HENRY O. KENT, Lancaster, *President.*
GEORGE H. MOSES, Concord, *Secretary.*
JASON E. TOLLES, Nashua.
ROBERT P. BASS, Peterborough.

Forestry Commissioners.

REPORT.

To the Governor and Council:

The Forestry Commission, in presenting its report for the biennial term of 1905–'06, takes occasion to comment upon the fact that this period has been one of unusual progress in the forestry movement, both in the state and the nation.

Within this time, the forest survey of the state, undertaken under authority of the Legislature of 1903, has been completed, and the results of that work are embodied in another place in this report.

The activities in behalf of the movement to secure a national forest reserve in the White Mountains have been continued with increased zeal, and elsewhere we record the progress made in this very desirable undertaking.

The acquisition of the state forest reserve upon the slopes of Mount Monadnock, the initial steps toward which were reported in our last biennial report, has been completed, and a detailed account of the procedure will be found elsewhere.

A new forest fire law has been enacted and has had nearly two years of trial, with good results.

The general interest in forest preservation among all classes of our people has continued and increased, and there are today more organizations and individuals actively interested in forestry in New Hampshire than at any previous time since the forestry movement was begun.

In coöperation with the state board of agriculture, the Society for the Protection of New Hampshire Forests, boards of trade, commercial clubs, women's clubs and other

organizations, the propaganda for forest preservation has been carried out by the board in every possible way at its command, with the result, it is hoped, of an aroused and an enlarged interest in the subject so vital to so many of our industries and enterprises.

Forest Survey of the State.

By joint resolution of the Legislature of 1903, the sum of $5,000 was placed at the disposal of the commission for the purpose of securing a forest examination of the White Mountain region. Under the terms of the joint resolution, the field work of the examination was to be done by experts from the federal forest service; and during the summer of 1903 data were gathered for the indicated purpose. The results of this examination were published in the last biennial report of the commission, at which time it was shown that through prudent management and by means of the generous terms of coöperation offered by the federal forest service, the cost of the examination of the White Mountain region had been only little more than half the sum appropriated.

Finding themselves with $2,000 unexpended from the appropriation of 1903, the board was confronted with the alternative of expending the money under the terms of the original legislation in amplifying certain data gathered by the field party of 1903, such as statistics of tree growth, etc., or of seeking legislative authority to make use of the balance remaining in another direction.

The latter alternative being adopted, the Legislature of 1905 was applied to for authority to permit the expenditure of the unused balance in a completion of the forest survey of the entire state. Permission being thus granted, the commission effected another advantageous contract of cooperation with the federal forest service, and during the summer of 1905 a party of field workers in charge of Mr. C. A. Lyford, forest assistant in the federal forest service, made an exhaustive study of the forest growth in all that

portion of the state not covered by the examination of 1903. The summary of this work is presented in another part of the present volume, and accompanying this report will be found a complete and comprehensive forest map of the lower section of New Hampshire. This map, in connection with the one published in our last biennial report, furnishes, upon the same scale, a complete forest map of New Hampshire.

If we are not in error, New Hampshire is thus the first of all the states to have completed a forest map, and the commission takes great pride in the fact that so large an accomplishment was secured at comparatively so small an expenditure. It is proper to remark in this connection, however, that the $2,000 remaining in our hands at the conclusion of the White Mountain examination was not sufficient for the state's share of coöperative expenses under the resolution of 1905. Nevertheless, through the generous action of the forester of the federal government, Mr. Gifford Pinchot, our funds were supplemented from the federal treasury in an amount sufficient to complete the work most satisfactorily.

Accompanying the summary of Mr. Lyford's field work, he makes certain suggestions with reference to the future forest service in New Hampshire. These suggestions will be dwelt upon at a later period in this report.

Forest Fire Law.

As has been indicated, the Legislature of 1905 made material changes in the laws relating to the extinguishment of forest fires and materially altered the existing system of forest fire wardens, which had been in vogue since the passage of the original forestry law in 1893.

Several proposed measures were presented to the Legislature, and after consideration of them, which lasted nearly until the close of the session, the General Court finally put upon the statute books the following enactment:

CHAPTER 97, LAWS OF 1905.

AN ACT for the Protection of Forests from Fire.

Be it enacted by the Senate and House of Representatives in General Court convened:

SECTION 1. In cities and towns where organized fire departments are established the chief of the fire department is hereby constituted forest fire warden for such city or town. In time of drought the forest fire wardens, themselves or by some agent or agents designated by them, shall, when directed by the forestry commission, patrol the woods in their respective cities or towns, warning persons who traverse the woods, campers, hunters, fishermen and others, about lighting and extinguishing fires. They shall post extracts from the fire laws, and other notices sent to them by the forestry commission, along highways, along streams and waters frequented by tourists and others, at camp sites and in other public places. If, in woodlands thus posted, any person, other than the owner of said lands or his agents acting under his direction, shall build fires when warned not to do so by the forest fire warden, or shall fail to extinguish a fire when ordered to do so by the warden, he may be arrested by the warden without a warrant.

SECT. 2. It shall be the duty of the warden to extinguish all brush or forest fires occurring in his town, and he may call such assistance as he shall deem necessary to assist him in so doing, and may require the use of wagons, tools, horses, etc., for that purpose. If any person fails to respond to the warden's call for his assistance or the use of his property, he shall be fined not exceeding ten dollars. The city or town shall pay reasonable compensation for their services to all persons summoned to assist the warden and for the use of all property required by him in the extinguishment of a forest or brush fire. In case the warden and the persons summoned to assist him or to furnish the use of property, shall fail to agree upon the terms of compensation at the time or after the required service has been rendered, the dispute shall be referred to the commissioners of the county in which the city or town is located for final settlement.

SECT. 3. Forest fire wardens shall make reports of their doings to the forestry commission in such form and at such

times as the commission may require. If a warden has reason to believe that any brush or forest fire in his city or town was caused in violation of statute he shall report to the county solicitor all the facts coming within his knowledge and said solicitor, if the facts as so reported seem to him sufficient, shall take action to recover the penalty fixed by statute for such violation.

SECT. 4. In towns where no organized fire department exists, the forestry commission shall annually designate some member of the board of selectmen as forest fire warden, who shall perform in his town all the duties hereinbefore set forth for wardens in cities and towns having organized fire departments. All forest fire wardens hereinbefore provided for shall receive pay for their services from the city or town treasury in such sums and in such manner as they are ordinarily paid for services as members of the fire department or as selectmen.

SECT. 5. In unorganized towns, the forestry commission, on the application of the owners of forest land situated therein, are authorized to appoint a suitable number of special forest fire wardens, to define their duties and to fix their compensation. The cost of such special forest fire wardens shall be paid by the persons making application for their appointment, and, upon certificate of the forestry commission, one-half of such sum shall be repaid to the applicants by the treasurer of the county wherein said unorganized township is located.

SECT. 6. If any forest fire warden provided for in sections 1 and 4 of this act shall neglect or refuse to perform the duties prescribed for him he shall forfeit not less than $100 nor more than $500, to be recovered in an action for debt, upon complaint of the forestry commission, and all forfeitures so recovered shall be paid into the state treasury.

SECT. 7. It shall be the duty of any person who discovers a forest or brush fire not under the control or supervision of some person to extinguish it or to report it immediately to the local fire warden, and failure so to do shall be punished by a forfeiture not exceeding ten dollars, to be recovered upon complaint of the warden.

SECT. 8. All acts and parts of acts inconsistent with this act are hereby repealed, and this act shall take effect upon its passage.

Approved March 10, 1905.

This law, it will be seen, attempted to utilize existing official machinery so far as possible and to minimize the burdens of expense upon the state treasury in order to meet what appeared to be a demand in the Legislature for a reduction in proposed appropriations.

According to Mr. Lyford's report, it will be seen that the federal foresters who were actively engaged in the southern portion of our state during the time when this law was in its most experimental stages, found the law working satisfactorily. They recommend minor changes in the system, which it will be the duty of the General Court to consider.

It has often been remarked that New Hampshire has been well fortified by nature against disastrous forest fires; that her topography and the character of her soil and forests do not lend themselves as a fertile field for extensive forest conflagrations. To this, perhaps more than to any system of law, is New Hampshire to attribute her freedom from the terrific forest fires which have devastated the forest area in other states.

During the past biennial period, the forest fire loss in this state has been very slight, only one fire of any considerable area having occurred in dense matured timber, and it is satisfactory to record that in every instance the local fire wardens established by the law of 1905, without prompting from this board or from any source, attended promptly to their duties under the law.

The one fire referred to which did the greatest damage was in the month of September upon the slopes of Mount Kearsarge, where a question as to the location of the fire led to a dispute as to the jurisdiction of fire wardens in two adjoining towns. This was soon satisfactorily adjusted, however, and the forces of the two towns coöperated in checking the fire, which was not extinguished, however, until rain set in. In this connection, it should be remembered that the season of 1906 was excessively dry, the absence of rainfall being almost as great as in the previous dry season of 1903, when the fire loss in the state

amounted to hundreds of thousands of dollars under the old system of fire wardens.

In the absence of other evidence, it is safe to attribute a good share of our immunity during 1906 to the efficacy of the new forest fire warden law.

Preservation of Shade Trees.

The law of 1901 (as amended in 1903) for the preservation of shade trees along the highways was, as reported two years ago, held unconstitutional by the supreme court, and the general distribution of tree tags under the law was therefore discontinued.

There remain, however, many localities where the abutting owners are perfectly willing that the shade trees along their lands shall be placed under public ownership and care, and the demand for tree tags continues in small volume. It is unnecessary, however, to continue the present annual appropriation of $500 a year for this purpose, and we think it can safely be reduced to at least one half and possibly one fifth of this sum.

While the law was in active operation, practically half a million tags were issued and used and that number of trees along the roadsides have been saved from destruction. We are still of the opinion that the law may be amended so as to carry on the work as was at first intended, and we again suggest the wisdom of considering whether it may not be provided that the tree wardens shall continue the tagging of trees as heretofore, giving to the abutting owner a period of sixty to ninety days in which to take action in opposition; otherwise his title in the tree to pass to the community.

Monadnock Reserve.

The forest reserve upon the slope of Mount Monadnock, a petition for the condemnation of which had just come into our hands at the time of preparing our last biennial report, is now in complete possession of the state. Appeal

having been taken from the decision and award of the forestry commission, an extended series of hearings was held before the board of selectmen in Jaffrey at which the commission appeared to represent the interests of the state. Preparations were made for taking the case to its final resort in a jury trial in Cheshire County when the original donors of the funds for the acquisition of the reserve undertook a settlement with the owners of the property, which was effected; and in the fall of 1905 the state acquired complete title.

The Monadnock Reserve comprises some 600 acres of choice timberland most advantageously situated in a community where the summer boarding industry has reached large proportions and where a great sum of money has been invested in summer residences. To have swept the forests from the site occupied by the reserve would have meant immeasurable disaster to many interests, both sentimentally and materially, and it is a source of great satisfaction that public-spirited citizens and summer residents coöperated so cordially to secure a preservation of this threatened area.

Especial recognition should be made of the interest taken in the Monadnock Reserve by Messrs. Joel H. and Arthur E. Poole of Jaffrey and by Mr. Isaac Sprague of Boston, a summer resident of Jaffrey, through whose efforts the movement for the establishment of the reserve initiated and through whose generous contributions the larger part of the fund for its purchase was accumulated.

The Monadnock Reserve represents an investment of substantially $8,000, and it has been acquired practically without cost to the state, the only expense thus far incurred having been for incidental expenses of the commissioners in attending hearings, etc.

This property will continue to increase in financial value while its sentimental value can hardly be determined, and the board feels justified in pointing to this addition to the state's tangible assets as evidence of the worth of the work

laid upon the forestry commission by the Legislature of 1893.

Under the terms of the forestry act of 1893, reserves thus acquired are to be forever dedicated to the public for park purposes. Accordingly, the Monadnock Reserve has been thrown open to the public use, and regulations simple in their form have been posted upon its boundaries. These regulations apply wholly to the prohibition of the use of fire within the area of the reserve and to the restrictions under which camping parties shall occupy the ground. With these exceptions the reserve is entirely open to public use and is in the care of Mr. Arthur E. Poole, whom the board has designated as custodian.

These regulations have been prepared under authority conferred upon the board by the Legislature of 1903.

Fire Wardens.

The new legislation of 1905, to which reference has already been made, provided that chief engineers of fire departments in towns where such office existed should be forest fire wardens, *ex officio,* and that, in the absence of such officers, the forestry commission should designate some member of the board of selectmen to act as forest fire warden. These designations have been made in accordance with the law, and the list of fire wardens appointed is herewith appended:

1905–1906.

Rockingham County.

Atkinson,	John H. Smith.
Auburn,	Nathaniel D. Tilton (Route 2).
Brentwood,	E. T. Robinson (Exeter, R. 2).
Candia,	John D. Colby.
Chester,	William T. Owen.
Danville,	George M. Anderson.
Deerfield,	Arthur M. Chase (Center).
Derry,	*F. M. Gilcreast.
East Kingston,	Thomas P. Currier.

Epping,	Joseph A. Edgerly.
Exeter,	*George H. Carter.
Fremont,	James B. Martin (Epping).
Greenland,	John M. Brackett.
Hampstead,	Charles W. Garland.
Hampton,	Clarence M. Dearborn.
Hampton Falls,	Arthur W. Brown.
Kensington,	Edward J. Blodgett.
Kingston,	George M. Baker.
Londonderry,	Sidney A. Webster (North).
Newcastle,	Thaddeus Tarlton.
Newfields,	E. C. Partridge.
Newington,	Stillman A. Packart.
Newmarket,	C. A. Morse.
Newton,	Enoch H. Nichols.
North Hampton,	O. D. Brown (Little Boars Hd.).
Northwood,	Joseph E. Johnson.
Nottingham,	W. F. Watson.
Plaistow,	Harry R. Seaver.
Portsmouth,	*John D. Randall.
Raymond,	*O. N. Fellows.
Rye,	Charles M. Rand.
Salem,	*David S. Emery.
Sandown,	George M. Anderson.
Seabrook,	Emery N. Eaton (South).
South Hampton,	Frank O. Towle (Amesbury, Mass., Route 1).
Stratham,	G. M. Hall.
Windham,	William L. Emerson.

STRAFFORD COUNTY.

Barrington,	Walter H. Smith.
Dover,	*George E. Varney.
Durham,	F. E. Doe.
Farmington,	Frank J. Smith.
Lee,	Charles G. Dame.
Madbury,	H. S. Felker (Dover, R. F. D.).
Middleton,	George W. Morrill (Union).
Milton,	Haven R. Jewett (Mills).
New Durham,	Dana P. Jones.
Rochester,	*George H. Webster.
Rollinsford,	Geo. W. Nutter (Salmon Falls).
Somersworth,	*Jerry Murray.
Strafford,	Frank J. Piper.

BELKNAP COUNTY.

Alton,	Charles H. McDuffee.
Barnstead,	Miron O. Smith.
Belmont,	James C. Hill.
Center Harbor,	Orville P. Smith (Ashland, R F. D.).
Gilford,	John D. Colby.
Gilmanton,	William S. Sanderson.
Laconia,	*A. W. Spring.
Meredith,	*H. J. Jones.
New Hampton,	Charles D. Thyng.
Sanbornton,	Edwin W. Lane (Hill).
Tilton,	*O. G. Morrison (Arthur F. Cunningham).

CARROLL COUNTY.

Albany,	F. P. Piper.
Bartlett,	William Pitman (Dover).
Brookfield,	Charles Willey (Sanbornville, Route 1).
Chatham,	Charles S. Chandler.
Conway,	George V. Eastman (North).
Eaton,	Everett A. Stanley (Snowville).
Effingham,	Lemuel C. Holmes (William M. Fulton).
Freedom,	John M. Parsons.
Hart's Location,	Charles H. Morey (Bemis).
Jackson,	J. B. Hurlin.
Madison,	Ernest E. Kennett.
Moultonborough,	I. F. Moulton.
Ossipee,	C. A. White (Centreville).
Sandwich,	George W. Thompson.
Tamworth,	Frank P. Evans.
Tuftonborough,	John A. Edgerly (Mirror Lake).
Wakefield,	Fred B. Shorey.
Wolfeborough,	W. H. Gilman (East).

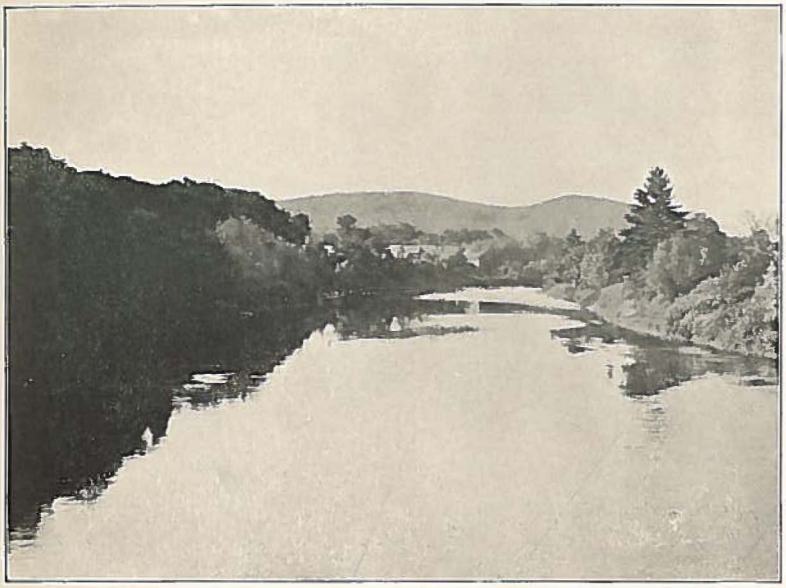
MERRIMACK COUNTY.

Allenstown,	*James E. Welch (Suncook).
Andover,	B. H. Smith (East).
Boscawen,	*George F. Brown.
Bow,	Edwin A. Colby.
Bradford,	George K. Stratton.

Canterbury,	Louis D. Morrill (Penacook, Route 11).
Chichester,	O. T. Maxfield (Pittsfield).
Concord,	David J. Adams (Agent chief fire dep't.).
Danbury,	John V. Ford.
Dunbarton,	Edward P. Paige (Concord, Route 2).
Epsom,	John A. Chesley.
Franklin,	*Fred Buntin (Falls), (Harry E. Colby).
Henniker,	Edward N. Cogswell.
Hill,	W. C. Kelley.
Hooksett,	George A. Brothers.
Hopkinton,	Stephen E. Morrill (Contoocook, Route 1).
Loudon,	E. S. Wales (Concord, Route 7).
Newbury,	Thomas J. Leach.
New London,	Frank W. Todd (No. Sutton).
Northfield,	Edwin J. Young (Tilton).
Pembroke,	*W. M. Smith.
Pittsfield,	*D. O. Sherburne (Walter H. Pierce).
Salisbury,	Baron W. Sanborn (Andover, Route 1).
Sutton,	Alvin A. Jepson.
Warner,	John P. Hill.
Webster,	Ira P. Whittier (Contoocook).
Wilmot,	John M. Tewksbury.

HILLSBOROUGH COUNTY.

Amherst,	Frank A. Holbrook.
Antrim,	J. F. Tenney.
Bedford,	Frank E. Manning.
Bennington,	James F. Griswell.
Brookline,	Alpha A. Hall.
Deering,	John E. Loveren (East).
Francestown,	Charles A. Lord.
Goffstown,	George L. Eaton (Grasmere).
Greenfield,	Franklin C. Fletcher.
Greenville,	Henry P. Girney.
Hancock,	John E. Hadley.
Hillsborough,	Charles S. Flanders.

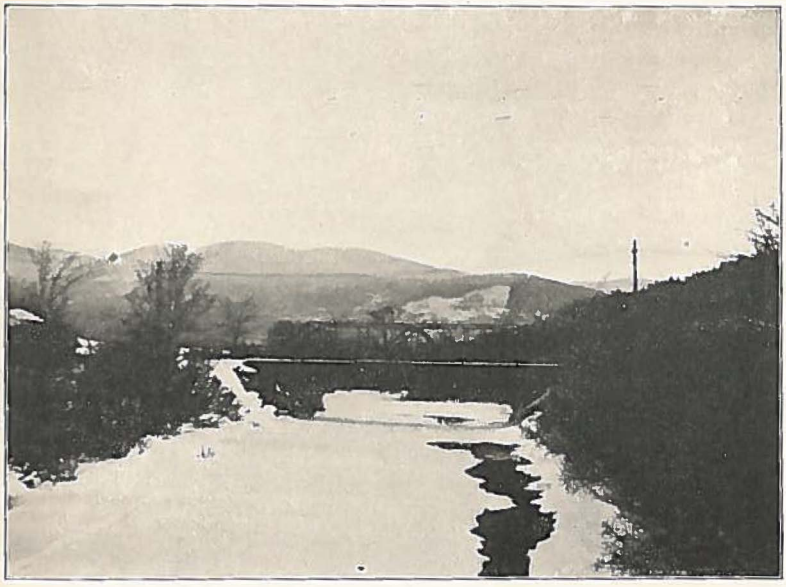


PEMIGEWASSET RIVER AT PLYMOUTH, N. H.
Looking upstream from gaging station. August 3, 1905.

GAGING STATION ON PEMIGEWASSET RIVER AT PLYMOUTH, N. H.
From upstream, right bank. August 3, 1905.

GAGING STATION ON ZEALAND RIVER AT TWIN MOUNTAIN, N. H.

Showing conditions on February 10, 1906. Chain gage is on the right. River is frozen over and covered with snow.



AMMONOOSUC RIVER AT BRETTON WOODS, N. H.

Looking upstream from foot-bridge. The open channel is shown, also the way in which the ice rests on stones, leaving a space between the water and the ice. February 9, 1906.

GAGING STATION AT PLYMOUTH, N. H., ON PEMIGEWASSET RIVER.

Showing conditions on February 7, 1906. The partly open channel at the right is shown, also ice on the banks, and the chain gage on the upstream side.

LOOKING DOWNSTREAM FROM BRIDGE AT PLYMOUTH, N. H.

Showing open channel with ice covering on the sides and ice cakes on the banks. February 8, 1906.

Hollis,	Henry A. Wilson (*C. W. Hardy.)
Hudson,	James P. Howe.
Litchfield,	Frederick L. Center (Hudson, Route 1).
Lyndeborough,	Andy Holt (South).
Manchester,	*Thomas W. Lane.
Mason,	J. O. Reed, Jr.
Merrimack,	Jerry C. Littredge (Reed's Ferry).
Milford,	*W. L. Winslow.
Mont Vernon,	Charles H. Raymond.
Nashua,	*Charles H. Whitney.
New Boston,	Charles H. Shedd.
New Ipswich,	*Joseph Silon.
Pelham,	George S. Butler (Nashua, Route 3).
Peterborough,	Daniel M. White.
Sharon,	John F. Fitzgerald (Peterborough).
Temple,	W. W. Colburn.
Weare,	H. O. Chase (North).
Wilton,	*M. R. Staunton.
Windsor,	Joseph R. Nelson (Hillsborough Upper Village).

CHESHIRE COUNTY.

Alstead,	John F. Dickey.
Chesterfield,	*John A. Joslyn.
Dublin,	John H. Mason.
Gilsum,	L. A. Guillow.
Harrisville,	*Barnard F. Bemis (Cheshire).
Hinsdale,	*F. A. Buckley.
Jaffrey,	Burt Bacon (East).
Keene,	*F. W. Towne.
Marlborough,	J. K. Southwick.
Marlow,	Amos E. Rogers.
Nelson,	Chester L. Towne (Munsonville).
Richmond,	Stephen A. Bullock (Winchester, Route 4).
Rindge,	Francis D. Converse (West).
Roxbury,	Charles W. Buckminster (East Sullivan).

Stoddard,	Cummings B. McClure (Munsonville).
Sullivan,	Winfield J. White.
Surry,	Morrison N. Scripture.
Swanzey,	*F. N. Stone.
Troy,	Alfred G. Lawrence.
Walpole,	Daniel Connors.
Westmoreland,	C. M. Scovell.
Winchester,	C. B. Mansfield.

SULLIVAN COUNTY.

Acworth,	H. A. Clark.
Charlestown,	E. M. Wingate.
Claremont,	*C. E. Sears.
Cornish,	James B. Chadbourne.
Croydon,	Edgar W. Davis.
Goshen,	Hial F. Nelson (Mill Village).
Grantham,	William H. Howard.
Langdon,	Alvin S. Cram.
Lempster,	H. S. Thompson.
Newport,	*Frank J. Lattimer (Geo. E. Lewis).
Plainfield,	Frank W. True.
Springfield,	Charles McDaniel (Enfield, Route 7).
Sunapee,	Moses F. Knowlton.
Unity,	Charles A. Newton (East).
Washington,	Sumner N. Ball.

GRAFTON COUNTY.

Alexandria,	H. F. Tilton.
Ashland,	*E. P. Harrington.
Bath,	Harry Woods.
Benton,	Labina H. Parker.
Bethlehem,	Fred D. Lewis.
Bridgewater,	A. H. Morrill.
Bristol,	J. W. Saunders.
Campton,	G. E. Pulsifer (Plymouth).
Canaan,	John Currier (Street).
Dorchester,	Wells C. Youngman (North).
Easton,	C. A. Young.
Ellsworth,	Burley O. Avery.
Enfield,	Lewis W. Currier.
Franconia,	Eugene E. Bowles.

Grafton,	Augustus F. Hoyt.
Groton,	Charlie D. Jewell.
Hanover,	Edward P. Storrs.
Haverhill,	Henry W. Keyes (Woodsville).
Hebron,	E. M. Jewell.
Holderness,	Marcus M. Sargent.
Landaff,	H. H. Cogswell.
Lebanon,	David H. Foster.
Lincoln,	George E. Henry.
Lisbon,	*Charles Pike.
Littleton,	*E. C. Young.
Livermore,	L. O. Goulding.
Lyman,	M. Ward Clough (Lisbon, Route 3).
Lyme,	Sidney A. Converse.
Monroe,	Oscar Trazer.
Orange,	Charles H. Ford (Canaan).
Orford,	Henry T. Braynard.
Piermont,	L. M. Robie.
Plymouth,	Charles W. George.
Rumney,	G. P. Cook (Depot).
Thornton,	Frank A. Barnard (West).
Warren,	Henry N. Merrill.
Waterville,	O. A. Cameron.
Wentworth,	Joshua E. Foster.
Woodstock,	M. N. Gordon (North).

Coos County.

Berlin,	*G. O. Kent.
Carroll,	John Paige (Bretton Woods).
Clarksville,	Willis A. Harriman.
Colebrook,	George Heath.
Columbia,	George D. Cleveland (Colebrook).
Dalton,	Lorenzo S. Farr (Littleton).
Dummer,	C. N. Bickford (Crystal).
Errol,	W. A. Bragg.
Gorham,	W. B. Gatis.
Jefferson,	Albert D. Howe.
Lancaster,	*Fred S. Linscott.
Milan,	A. E. Wheeler.
Northumberland,	F. G. McKellips.
Pittsburg,	James R. Blodgett (Connecticut Lake).

Randolph,	F. C. Wood.
Shelburne,	James Simpson.
Stark,	Seth Cole (Percy).
Stewartstown,	Byron Drew.
Stratford,	C. E. Clark (Coös).
Wentworth's Location,	D. A. Cameron.
Whitefield,	F. B. Lewis.

1906–1907.

ROCKINGHAM COUNTY.

Atkinson,	John H. Smith.
Auburn,	Nathaniel D. Tilton.
Brentwood,	James L. Stevens.
Candia,	John D. Colby.
Chester,	William T. Owen.
Danville,	George M. Anderson.
Deerfield,	Arthur M. Chase.
Derry,	*F. M. Gilchrist.
East Kingston,	Thomas P. Currier.
Epping,	Charles W. Sanborn.
Exeter,	*George H. Carter.
Fremont,	James B. Martin (Epping).
Greenland,	J. H. Brackett.
Hampstead,	A. M. Moulton.
Hampton,	Howell M. Lamprey.
Hampton Falls,	Joseph B. Cram.
Kensington,	Edward J. Blodgett.
Kingston,	George M. Bakie.
Londonderry,	William H. Paige (North).
Newcastle,	Robert H. Harding.
Newfields,	George L. Chase.
Newington,	Stillman A. Packard.
Newmarket,	C. A. Morse.
Newton,	Enoch H. Nichols.
North Hampton,	Otis S. Brown (Little Boars Head).
Northwood,	Joseph E. Johnson.
Nottingham,	W. F. Watson.
Plaistow,	J. W. Sleeper.
Portsmouth,	*C. D. Varrill.
Raymond	*O. N. Fellows.
Rye	Charles D. Locke.
Salem,	Benjamin R. Wheeler.

Sandown,	James F. Sargent.
Seabrook,	Emery N. Eaton (South).
South Hampton,	Frank O. Towle (Amesbury, Mass., R. F. D. No. 1).
Stratham,	John F. Emery.
Windham,	William L. Emerson.

STRAFFORD COUNTY.

Barrington,	A. B. Locke.
Dover,	George E. Varney.
Durham,	Charles A. Smart.
Farmington,	J. E. S. Hall.
Lee,	Charles G. Dame.
Madbury,	Henry L. Felker.
Middleton,	John H. Young.
Milton,	Joseph H. Avery.
New Durham,	Dana P. Jones.
Rochester,	*H. C. Hanson.
Rollinsford,	George W. Nutter (Salmon Falls).
Somersworth,	*Jerry Murray.
Strafford,	Frank J. Piper.

BELKNAP COUNTY.

Alton,	Waldo C. Varney.
Barnstead,	Fred E. Berry.
Belmont,	James C. Hill.
Center Harbor,	Orville P. Smith (Ashland, R. F. D.).
Gilmanton,	Wm. S. P. Sanderson.
Gilford,	Ansel F. Gove.
Laconia,	*A. W. Spring.
Meredith,	*H. J. Jones.
New Hampton,	Charles D. Thyng.
Sanbornton,	Robert M. Wright (Hill).
Tilton,	*O. G. Morrison (Arthur F. Cunningham).

CARROLL COUNTY.

Albany,	Frank P. Piper.
Bartlett,	William Pitman.
Brookfield,	Charles Willey.
Chatham,	Charles S. Chandler.
Conway,	George N. Eastman (North).

Eaton,	Everett A. Stanley (Snowville).
Effingham,	Lemuel C. Holmes (William M. Fulton).
Freedom,	William Watson.
Hart's Location,	Charles H. Morey (Bemis).
Jackson,	J. B. Hurlin.
Madison,	Henry Harmon (Silver Lake).
Moultonborough,	Irvin F. Moulton.
Ossipee,	N. P. Sias.
Sandwich,	George W. Thompson.
Tamworth,	A. E. Wiggin.
Tuftonborough,	Charles N. Pinkham (Melvin Village).
Wakefield,	F. J. Leavitt.
Wolfeborough.	W. H. Gilman (East).

MERRIMACK COUNTY.

Allenstown,	*James E. Welch.
Andover,	Bert H. South.
Boscawen,	*George F. Brown.
Bow,	Edwin A. Colby.
Bradford,	George K. Stratton.
Canterbury,	Lowell T. Mason.
Chichester,	C. A. Langmaid.
Concord,	*William C. Green (David J. Adams).
Danbury,	John V. Ford.
Dunbarton,	Aaron E. Barnard.
Epsom,	Benjamin M. Towle (Gossville.)
Franklin,	*F. D. Buntin.
Henniker,	Harry A. Tucker.
Hill,	Oscar F. Ackerman.
Hooksett,	George A. Brothers.
Hopkinton,	Albert S. Eaton (Contoocook).
Loudon,	Daniel S. Green (Concord, Route 7).
Newbury,	Thomas J. Leach.
New London,	
Northfield,	Edwin J. Young (Tilton).
Pembroke,	*N. M. Smith.
Pittsfield,	*D. O. Sherburne.
Salisbury,	Ernest C. Currier (Warren, Route 1).

Sutton,	John H. Keyser.
Warner,	Fred A. Clark.
Webster,	Senter M. Goodhue.
Wilmot,	Thomas Graney.

HILLSBOROUGH COUNTY.

Amherst,	Rodney H. Prince.
Antrim,	W. W. Merrill.
Bradford,	Perham Parker.
Bennington,	Allen Gerrard.
Brookline,	Clarence R. Russell.
Deering,	Arthur O. Ellsworth.
Francestown,	Walter P. Holt.
Goffstown,	William P. Hadley.
Greenfield,	E. J. Fletcher.
Greenville,	Henry P. Gainey.
Hancock,	John E. Hadley.
Hillsborough,	Charles S. Flanders.
Hollis,	C. M. Hardy.
Hudson,	James P. Howe.
Litchfield,	Norris C. Griffin.
Lyndeborough,	Andy Holt.
Manchester,	*Thomas W. Lane.
Mason,	E. H. Russell.
Merrimack,	George Watkins, Jr.
Milford,	*N. S. Winslow.
Mont Vernon,	Charles H. Raymond.
Nashua,	Charles H. Whitney.
New Boston,	Richard B. Taylor.
New Ipswich,	Edwin F. Blanchard.
Pelham,	Charles L. Seavey.
Peterborough,	Daniel M. White.
Temple,	J. W. Edwards.
Weare,	Horace O. Chase (North).
Wilton,	*M. R. Stanton.
Windsor,	Joseph R. Nelson (Hillsborough Upper Village).

CHESHIRE COUNTY.

Alstead,	M. E. Knight.
Chesterfield,	*John A. Joslyn.
Dublin,	Almon A. Baldwin.
Fitzwilliam,	David H. Firmin.
Gilsum,	F. P. Craine.

Harrisville,	Bernard F. Bemis.
Hinsdale,	F. A. Buckley.
Jaffrey,	Myron L. Cutler (East).
Keene,	*F. W. Towne.
Marlborough,	Warren M. Davis.
Nelson,	Wilmer C. Tolman (Munsonville).
Richmond,	Leason A. Martin (North).
Rindge,	Francis D. Converse (West).
Roxbury,	Charles W. Buckminster (East Sullivan).
Stoddard,	Cummings B. McClure (Munsonville).
Sullivan,	L. F. Davis.
Surry,	Harrison N. Scripture.
Swanzey,	*F. N. Stone.
Troy,	Alfred T. Lawrence.
Walpole,	Daniel Connors.
Westmoreland,	Charles M. Scovell.
Winchester,	C. B. Mansfield.

SULLIVAN COUNTY.

Acworth,	A. E. Clark (East).
Charlestown,	G. L. Richardson.
Claremont,	*C. E. Sears.
Cornish,	James B Chadbourne.
Croydon,	Edgar W. Davis.
Goshen,	Eben A. Purington.
Grantham,	William H. Howard.
Langdon,	Charles A. Jefts.
Lempster,	Fred A. Barton.
Newport,	*Frank J. Latimer (George E. Lewis).
Plainfield,	Edward J. Wingate.
Springfield,	Horace W. Stevens (West).
Sunapee,	Charles O. Bailey.
Unity,	Charles A. Newton (Newport).
Washington,	Sumner N. Ball.

GRAFTON COUNTY.

Ashland,	*E. P. Harrington.
Bath,	John D. Child.
Benton,	Labina H. Parker.
Bethlehem,	Henry A. Hildreth.

Bridgewater,	A. H. Carpenter.
Bristol,	J. W. Saunders.
Campton,	George E. Pulsifer (Plymouth, R. F. D.).
Canaan,	John Currier (Street).
Dorchester,	George W. Rowen.
Eaton,	C. A. Young.
Ellsworth,	Burley O. Avery.
Enfield,	Henry E. Lennon.
Franconia,	Eugene E. Bowles.
Grafton,	Augustus F. Hoyt.
Groton,	Charles D. Jewell.
Hanover,	Edward P. Storrs.
Haverhill,	Henry W. Keyes (Woodsville).
Hebron,	E. M. Jewell.
Holderness,	Charles A. Haskell.
Landaff,	C. M. Gale.
Lebanon,	George E. Henry.
Lisbon,	John B. Noyes.
Littleton,	E. C. Young.
Livermore,	L. D. Goulding.
Lyman,	J. B. Clough.
Lyme,	Sidney A. Converse.
Monroe,	Oscar Frazer.
Orange,	Charles H. Ford (Canaan).
Orford,	Harvey T. Braynard.
Piermont,	William H. Horton.
Plymouth,	E. A. Chase.
Rumney,	G. P. Cook (Depot).
Thornton,	W. P. Van Housen (West).
Warren,	Henry E. Weeks.
Waterville,	Oscar A. Cameron.
Wentworth,	Joshua B. Foster.
Woodstock,	Charles A. Hunt.

Coos County.

Berlin,	*G. O. Kent.
Carroll,	John Paige (Fabyans).
Clarksville,	H. Wells (Beecher Falls, Vt.)
Colebrook,	John G. Hurlbert.
Columbia,	Charles S. Jordan (Colebrook).
Dalton,	Lorenzo S. Farr (Littleton).
Dummer,	Charles N. Bickford (Crystal).
Errol,	A. L. Davis.

Gorham,	W. B. Gatis.
Jefferson,	L. T. McIntyre.
Lancaster,	F. E. Richardson.
Milan,	A. C. Wright.
Northumberland,	George A. Cummings (Gorham).
Pittsburg,	James R. Blodgett (Connecticut Lake).
Randolph,	Francis C. Wood.
Shelburne,	James Simpson.
Stark,	Seth Cole (Percy).
Stewartstown,	Byron Drew.
Stratford,	William H. Kimball (Coös).
Wentworth's Location,	D. A. Cameron.
Whitefield,	John N. Burns.

*Designate chief of fire department.

White Mountain Reserve.

By far the most important and interesting of all the work done by the board during the last biennial term has related to the advancement of the proposition to establish a national forest reserve in the White Mountains. This measure first took concrete shape at the instance of the forestry commission, at whose initiative the Legislature of 1903 memorialized Congress in behalf of the project. In the Fifty-eighth Congress a bill establishing a forest reserve in the White Mountains and appropriating a sufficient sum of money therefor, was introduced in the Senate by Senator Gallinger. Upon the urgent personal appearance of members of this commission before the Senate committee having the bill in charge, it was favorably reported to the Senate at the close of the first session of the Fifty-eighth Congress.

A comprehensive report upon the measure was presented to the Senate by Senator Burnham at the opening of the second session of the Fifty-eighth Congress, but the bill was not brought to vote before final adjournment.

At the same time there was pending in Congress a bill for the establishment of a national forest reserve in the Southern Appalachians, for which a much larger sum of

money was asked and behind which there had previously been a much larger body of public sentiment than that secured for the White Mountain measure. The Appalachian bill was favorably reported in the Senate in the Fifty-eighth Congress, but, like the White Mountain measure, failed to come to a vote.

At the opening of the Fifty-ninth Congress, a conference of the friends of both the White Mountain and Appalachian reserves was secured, and it was determined that for the success of both measures a joint effort should be made to secure congressional action. Accordingly a bill was drawn to establish under single authority both the White Mountain and the Southern Appalachian reserves at a total cost of three million dollars. This bill was introduced in the Senate by Senator Gallinger and in the House by Congressman Currier.

It was referred to the Senate committee on forest reserves and preservation of game, of which Senator Burnham is a member, and his efforts in securing a favorable report speedily are deserving of the commendation of all who are interested in the White Mountain Reserve. The bill was reported favorably to the Senate by unanimous action of the committee, and Senator Brandegee of Connecticut, who had the measure in charge, filed in its favor a most logical and interesting report. Early in the winter of 1906 the bill was called up for passage by Senator Brandegee and passed the Senate.

Progress in the House was not so rapid, and in the spring of 1906 it became apparent that if anything were to be accomplished before the adjournment of the first session of the Fifty-ninth Congress, some concerted action in favor of the measure should be taken. Accordingly, at the initiative of Governor Glenn of North Carolina, a numerous and influential group of citizens from all the states interested in the establishment of the two reserves, North and South, secured a two days' hearing before the House committee on agriculture, to whom the forest reserve bill had been referred.

New Hampshire was represented upon this occasion by His Excellency Governor McLane, the secretary of state, a majority of the governor's council, three members of the forestry commission, and officers and members of the Society for the Protection of New Hampshire Forests. At the hearing before the committee, Governor McLane was the opening speaker, and he cogently outlined the general basis upon which the demand for the establishment of the White Mountain reserve is formulated. Governor McLane's address to the committee is deserving of preservation other than in inaccessible committee files at Washington, and we take pleasure in presenting herewith his remarks in favor of the bill.

GOVERNOR MCLANE'S ADDRESS.

Mr. Chairman and Gentlemen of the Committee:

We appreciate your courtesy in permitting us to be present to present our case today.

Speaking for New Hampshire particularly, I desire to say that our interests are the same as those of the numerous states to the south of us, and whatever we say applies to them with equal force. There are, gentlemen, thirteen states represented here, which are interested in this measure, and you will remember that thirteen was never an unlucky number as applied to the states of this Union.

On account of the shortness of time, and knowing that you can only give us a very few minutes, and that other gentlemen desire to be heard, I will state very briefly what I have to say.

Twelve hundred and fifty square miles, which is the total area comprised in the territory designated as the proposed White Mountain Forest Reserve, is an insignificant portion of our country's expanse. It may be blotted from even our largest maps with the breadth of the hand. Yet within that hand's breadth nature has stored immeasurable riches and beneficence for mankind. I do not refer to the strength of body, the refreshment of mind, and the uplift of soul which flow from nature as revealed in mountain scenery, for we now are dealing with more tangible things. I mean that here, within this limited area nature has placed the sources and the reservoirs

of five of America's most important waterways, whose equable flow maintains the largest number of productive water powers, in the utilization of which five states have become rich and populous, and in the perpetuation of which these five states must place their greatest reliance for future prosperity. New England has no coal, but New England has water power. Without the White Mountain forests New England would have neither.

These forests are now the object of desperate assault with the ax—an assault which, if continued, means not only the denudation of the noble hills, with its consequent loss to the one state for which I most especially speak—but unspeakable, immeasurable and irreparable disaster to the thriving population of a score of great cities which lie without our borders, but which look constantly toward our hills from whence cometh their strength. And for this reason, gentlemen, because the benefits of forest preservation in the White Mountains of New Hampshire mean a hundred times more of benefit to other states than to New Hampshire, we come here to submit that none less than the Federal power should attempt the task.

New Hampshire is not poor, nor yet is she rich. She is self-respecting and self-supporting. The various Federal appropriations now made in such endless number and with such generosity of sum and wide variety of purpose are practically free from selfish pressure by us; and if we believed that it was our duty to take measures in this matter, which so much more concerns other states than our own, we would not be here today, but our 400,000 people —scarcely more than are gathered in this capital city—would cheerfully take up the burden alone. I emphasize the fact, therefore, that this is not a state question, but an interstate question, and therefore a national question. A more authoritative voice than mine has said so, and I venture to ask you to listen to this argument from a distinguished member of the national administration:

"This is a national problem. The people of a number of states are directly interested. The dangers growing out of the policy now in force are national in their character, as are also the benefits to be obtained by the policy now advised. This proposal for a national forest reserve has already been discussed and commended by our ablest men of science, by practical lumbermen, by the forestry associations, by many of the business organizations of the

country and by both the technical and general press. . . .

"Congress has wisely provided for the setting aside out of the public domain, and this withdrawing from sale, many thousands of square miles of valuable forest lands, with view to protecting the streams and perpetuating the timber supply about the mountains in our Western states and territories. And while the measure now proposed involves a purchase the principle and purpose are the same. In both cases, even if judged simply, will ultimately prove a good one."

And surely, Mr. Chairman, the time is now ripe for action. Congress should move to take the initial steps in the inauguration of a new policy looking toward bringing under Federal guardianship the unprotected danger spots, although I speak today for only one.

Here are all the conditions which impel to Federal action. Here are high peaks and large mountain masses. Here are regions of heavy rainfall. Here are slopes which are rapidly disintegrated when despoiled of their forest cover. Here are the sources of great rivers which bear the most intimate relations to the agriculture, the manufacturing and the commerce of several states. Here are rich forests, capable under Federal ownership and management, of producing a constant and increasing supply of valuable and necessary timber, fuel and paper supplies; but which, under private ownership and control, are slowly but surely being converted into centers of widespread disaster.

And here also arises an argument for the "square deal."

The government has already established, by proclamation, the Yellowstone Park, containing over 2,000,000 acres, in Wyoming; the Sequoia, containing over 161,280 acres, in California, and the Mount Rainier Park, of 207,360 acres in the state of Washington, with many others in other western states. None of these parks or reservations are east of western Dakota; they are west of the 103d meridian, yet the population west of the meridian is approximately 4,000,000, as against 71,000,000 east of it. The increase west has been but 980,000 since the census of 1890, while the increase west has been over 12,000,000, thus 95 per cent. of the population of the country is east of the meridian, west of which the present parks and reservations are located. The question at once arises, why

should not the eastern section of the country contain such a reservation, either in the form of a national park or of areas set apart under such restrictions as would preserve and foster the forest growth now rapidly disappearing?

I have said, Mr. Chairman, that the time is now ripe. I say further that delay is dangerous. While we wait waste continues. Like the Sybilline books, the half is already destroyed.

I am aware, gentlemen of the committee, that some will urge the postponement of this measure now, because the Federal expenditure made necessary by the loss of government property at San Francisco compels retrenchment elsewhere. Not so, say I. On the contrary, the disaster at San Francisco furnishes a potent and a pertinent argument in our behalf. Turning our eyes to the Pacific slope we see a proud city desolate and a great Commonwealth in sadness. To lighten their distress you, gentlemen of Congress, have voted millions of the public moneys, and a generous and sympathetic people have multiplied your gifts. San Francisco today sits in waste because of the unrestrained, unrestrainable and unforeseen working of great natural forces; and how promptly and how generously have you hastened to her assistance! We ask you now to act with like promptness to forestall the workings of other natural forces, which, unlike those which wrought such havoc one week ago this very hour, may be foreseen and restrained. For it is sure that if the forests of the White Mountains are leveled—if these hills are exposed to the elements—if the springs and reservoirs are left without the protection of their natural forest cover—in short, if those things take place which only Federal action can avert, we shall see the gradual and certain desolation, not of one city, but of twenty; not of one state, but of five, and no human kindness can then come quickly to our aid, but New England will be alone in the hands of nature's slow and toilsome process, creeping back through the centuries to the beneficent conditions which she now shares with all the states of the Union, and which we ask you, gentlemen, through this measure, to guarantee to us and to the nation.

Other speakers presented various phases of the argument for the establishment of the White Mountain Reserve and in contra-distinction to the practical grounds urged by Governor McLane, Mr. Harvey N. Shepard of the Appa-

lachian Mountain Club, most eloquently presented the claims of the White Mountain forests to preservation as a source of physical enjoyment to the people. Mr. Shepard's presentation of this most appealing phase of the argument for the White Mountain forests is also presented herewith as a fitting addendum to the logical and eloquent address made by the governor.

Mr. Shepard's Address.

Mr. Chairman and Gentlemen:

I have the honor to be here this morning, in part as the representative of the Commonwealth of Massachusetts, and also as representing the Appalachian Mountain Club of Boston.

This matter has been presented to you from a business and commercial standpoint. I beg leave briefly to present it in another aspect, which is not to be measured in dollars and cents, but which is yet of great and important value.

Permit me to occupy a few minutes in speaking of the Appalachian Mountain Club. This club was organized thirty years ago, with Professor Pickering of Harvard University, the eminent astronomer, as its first president. Among his successors was a gentleman who is present here this morning, another representative of the Commonwealth and of the Appalachian Mountain Club, and also the chaplain of the Senate, our much beloved Reverend Doctor Hale. The other associates were other professors and scientists in Harvard University and the Massachusetts Institute of Technology.

That club now numbers 1,600 members, mainly from Massachusetts, of course, but also from other New England states, and from every part of our country. It is a scientific and geographical club, and is affiliated with the principal geographical and mountain exploring clubs of the world. When it started in, the only peak of the White Mountains which was easily accessible was Mount Washington. Today, through its efforts mainly, and partly by its example, there have been provided paths, so that every peak of the White Mountains and Franconia Range are easily accessible. From one point on the northern slope of the Presidential Range there are more than fifty miles of mountain paths radiating from that center.

These paths are among the best in the world. There are none in Switzerland better than these paths that have been provided. What is the result? Thousands of people every year, every season, traverse these mountain peaks. There are men, women and children, clerks from stores, school teachers, professional men, and it is only because of these paths that these mountains are made accessible to them.

In addition the club has provided in suitable places camps and shelters. Among them is a stone hut between two of these mountains, Mount Adams and Mount Madison. In that hut was used blankets, a stove, fuel, clothing and so forth, and that hut was used by more than 800 people last season.

Besides this, about ten years ago the club entered upon the enterprise of seeing how far it could preserve some of the places of historic interest and scenic beauty. It owns today, mainly by gift, fourteen reservations, two in Massachusetts and twelve in New Hampshire. These reservations are small, the largest only containing about 200 acres of woodland, but all of these, as well as the paths and camps, are open for the use of the whole community. The members of the club have no privileges of this public service that the states of Massachusetts and New Hampshire have exempted our holdings from taxation, because we hold them simply as reservations.

While the club is mainly interested in the White Mountains, we have what is perhaps a selfish interest in this matter of the Southern Appalachian Reservation, for when that measure was agitated the club petitioned Congress for favorable consideration, though the White Mountains were not mentioned at that time at all.

These two resorts are the nation's recreation grounds for the people who live in this section of the country. Within easy reach of the White Mountains there are more than 10,000,000 people, who can get there very readily, and if you take in both resorts there are 60,000,000 people who, within twenty-four hours, can get to the Southern Appalachian Mountains and the White Mountains; and I know of no higher form of physical enjoyment than to climb mountains. Then the exhilaration that comes from it is of some value in itself—a value not to be measured, as I said before, in dollars and cents, and that appeals to us from other than commercial reasons.

In addition to all these people who climb the mountains, there are thousands of people who come into the White Mountains and stay at the hotels who do not undertake to climb the peaks at all, but who come there because they can enjoy the prospect of these mountains, and these people leave some $8,000,000 a year in the White Mountain region because of their going there for the enjoyment of these mountains.

I need not say anything to you as to how valuable they are as health resorts for the people. Doctor Bowditch and other eminent physicians of our land, and Dr. W. J. Hirdman of the University of Michigan have spoken of these things of value that come from the cool, dry and bracing air of the mountains, in words far stronger than any I could use.

The value of these mountains is, in part, because of the forests with which they are clothed. In the White Mountains there are some 80,000 acres yet remaining of virgin forests that would be included in the limits of this reserve.

We believe these 80,000 acres ought to be saved to us, and not simply the denuded tracts and deforested tracts. If it is proper for the nation to keep a herd of bison so that the people may see the animal that used to roam the prairies, and to keep a magnificent zoölogical park here where the people can go and see the animals of our country, it is equally proper for the nation to preserve the forests, where the people can go and enjoy the trees as they used to stand, and as they stand today. But that will not be possible unless something is done at once. The wood-pulp men combined with the lumbermen are sweeping it away. It would make your heart sad to go into some of those mountain regions now and see where the fire has swept over, taking away the material left by the foes of the trees, and which had been allowed to accumulate there, sweeping away the entire soil, so that you have left nothing but the rocks.

We want to enjoy these mountains, not bare, not ugly, but as nature provided them, clothed with trees. I speak to you as a mountain lover, and it may be said that this is merely a matter of sentiment, but sentiment is not without value in our community. Sentiment it is that leads such men as Lucius Tuttle, president of the Boston and Maine Railroad, to join with us cordially in all our labors in trying to preserve our forests, and he has authorized me to

use his name as one of the persons who hopes for the favorable consideration of this bill. It is sentiment that inspires devotion to our flag; it is sentiment that has led you to make a large appropriation for the suffering people of San Francisco, and that has led the people of our land to join you in giving aid to these sufferers. It is sentiment that leads us to appeal to you to do something to save the mountains to us, clothed in beauty, that they may be places of resort, not merely for pleasure, but also for health.

As a result of these hearings, supplemented by a two-days' active canvass among the members of the House of Representatives, a majority of the House committee on agriculture voted favorably to report the measure, and it now lies upon the speaker's table in the House of Representatives at Washington.

The parliamentary situation of the White Mountain Reserve bill is most fortunate. It has passed the Senate and is before the House of Representatives. It has been favorably reported from the House committee, and is therefore in position to go immediately upon its passage at any time when, under the rules, it can be brought before Congress. The determination of this time apparently lies entirely with the speaker under the rules of Congress, and it is to be hoped that that officer may become so convinced of the pressing necessity for the enactment of this bill that it may be put to a vote before the adjournment of the Fifty-ninth Congress. The members of the board, personally and in cooperation with others, have used every effort within their power to impress the speaker of the national House of Representatives with the necessity of permitting the White Mountain Reserve bill to come to vote in the present Congress. These labors may properly and helpfully be supplemented by the individual efforts of all who are interested in the measure; and we hope that such action will be taken, and with successful results. In such event, we feel certain, from investigations already made at Washington, that it will receive the assent of the majority of Congress and will go to the president, who has already said he would gladly sign it.

Field Work.

The field work of the board in the past biennial term has not differed from that which has occupied its attention since the enactment of the forestry law in 1893. Under the terms of this measure, the forestry commission is clothed with no affirmative power. Their duties consist in informing themselves and others as to forest conditions of the state; to advise and to counsel timberland owners with reference to the conduct of their property, and to hold public meetings from time to time for the discussion of forestry questions. All these duties as imposed by the law upon the board have been fulfilled during the past biennial term, as in previous years. The forests of the great North Country, where are located the larger lumbering, pulp and paper industries, have been visited frequently and the board has kept itself informed of the progress of forest removal, where such has taken place. It is a pleasure to record that those of the large lumber companies previously reported as having adopted forestry restrictions in the conduct of their lumber operations and as having employed trained foresters to superintend their work in the woods, still continue to carry on their business under such enlightened procedure.

Recommendations.

The recommendations of the field party engaged in the forest survey of the state and to be found elsewhere in this volume, may be classified generally under the heads of forest service and taxation.

For a state containing as extensive a forest area as New Hampshire, a complete and comprehensive forest service with sufficient appropriation to carry on the work and with an increase of power to effectuate the recommendations of the service would be ideal.

There is now a wider general interest in the forestry movement among the people than at any previous period since the first temporary forestry commission was author-

ized in 1881. That was the first action of the kind taken by the Legislature in any state; and from time to time the General Court has enacted further legislation designed to accomplish the purposes of forest preservation. These enactments have been fully approved by public opinion, and the only criticism has been in the form of expressed disappointment that more progressive action had not been secured. The present time, when New Hampshire is seeking congressional action to establish a federal forest reserve wholly within our borders, seems opportune for action by the Legislature which will put the forestry movement under state auspices upon a more effective footing. Such action can probably be most simply secured by providing changes from the present manner of conducting the forestry department in the state government.

In our last biennial report we called attention to the cumbersome number of the present board, the attendant difficulty of securing a quorum to act in cases of condemnation, etc. We then recommended the substitution of a smaller board with enlarged powers and authority to employ a forester. This recommendation we repeat.

Upon the head of taxation, it may be said that no entirely satisfactory method of taxing timber growth has yet been devised, though Mr. Lyford's report suggests that method of dealing with the subject which foresters everywhere have most generally endorsed. It is evident, however, that the entire subject of taxation in New Hampshire is soon to be taken up by a special commission to be created for the purpose and to this special board may safely be remitted the question of forest taxation.

HENRY O. KENT, *President,*
GEORGE H. MOSES, *Secretary,*
JASON E. TOLLES,
ROBERT P. BASS,
Forestry Commissioners.

APPENDIX.

HYDROGRAPHY OF THE WHITE MOUNTAIN REGION.

Second Report Covering the Period from September, 1903, to October, 1906.

BY

H. K. BARROWS.

HYDROGRAPHY OF THE WHITE MOUNTAIN REGION.

In the first report upon the Hydrography of the White Mountain Region, accompanying the report of the New Hampshire Forestry Commission, for the years 1903–'04, were given data obtained during 1903–'04, and also a general description of the hydrographic conditions in the White Mountain Region, the purpose governing the measurements made and the methods employed. These will be but briefly touched upon in the present report, as it is intended to be merely a continuation of the previous one.

The White Mountain Region is a collecting basin for four large rivers of New England, namely, Connecticut, Merrimack, Saco and Androscoggin, all of which are extensively used for water power. The lakes and small rivers in this mountainous district are not of sufficient size to be of any great importance for power purposes, although a few small mills have been placed upon them. The slopes are steep, but practically no storage of water is possible under natural conditions, and the time has not yet, as a rule, arrived when artificial reservoirs for storage purposes can be profitably constructed.

The importance of these streams for the present, then, consists simply in their effect on the flow of the large rivers to which they are tributary.

There is a well-founded popular belief that forests act naturally as great regulators of rivers, and one has only to observe and compare conditions within and without their borders in the springtime, to convince himself that their influence on snow storage, and consequently on spring freshets, is very material. The magnitude of this effect, and its value as a regulator of flow of streams, as well as the effect of forests under the control of water which falls as rain, is still uncertain.

In connection with the special appropriation for the investigation of forest conditions in New Hampshire, made during the legislative session of 1902–'03, the United States Geological Survey was asked to assist by studying the effect of the deforestation on streams, and to obtain, if possible, some quantitative data bearing upon this question.

This work has been carried on by the United States Geological Survey since that time, a small appropriation being also made from the funds of the State Forestry Commission during the last two seasons.

In making this investigation the method for determining the daily flow of the rivers has been that usually followed by the Survey. A gage for observing the stage of the river is established at a bridge, or other place, where the record of flow is to be made. This gage is a vertical staff, or some device by which the height of water may be observed, and is read usually twice each day by a person living nearby. The average of the gage readings in any day is used as the mean gage height for that day. At various stages of the river the station is visited by one of the hydrographers of the Survey, who measures the amount of water flowing, by means of a current meter. When several measurements, covering a considerable range of gage height, have been made, they are plotted on coördinate paper with gage heights for ordinates and discharges for abscissas, and a smooth curve, called the rating curve, is drawn through the several points. From this curve, for convenience, a rating table is computed, and by applying this rating table to the daily gage heights, estimates of the mean daily discharge are made, and from this the table of mean monthly discharge and other dependent data are determined. (For more detailed explanation of methods, with example of a typical rating curve, see first report on Hydrography of the White Mountain Region, previously alluded to.)

In interpreting the data obtained, the following definitions should be kept in mind:

The term "second-feet" (Sec.-ft.) is an abbreviation for "Cubic feet per second." It is the number of cubic feet of water flowing by the gaging station every second. The col-

umn headed "Maximum" gives the mean flow for the day when the mean gage height was the highest and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "mean" is the average flow for each second during the month. Upon this the computations for the three remaining columns in the table are based. The expression "second feet per square mile" means the number of cubic feet of water flowing each second from every square mile of drainage area. "Depth in inches" means the depth of water in inches that would have covered the drainage area, uniformly distributed, if all the water could have accumulated on the surface. This quantity is used for comparing run-off with rainfall, which quantity is usually given in depth in inches.

The river stations established in 1903 were at the following places:

1. Saco River at Conway Center.
2. Pemigewasset River at Plymouth.
3. Israel (above South Branch) River at Randolph.
4. Israel (below South Branch) River at Jefferson Highlands.
5. Ammonoosuc River at Bretton Woods.
6. Zealand River at Twin Mountain.
7. Little River at Twin Mountain.

These have all been maintained up to the present time, with the exception of that on Little River at Twin Mountain, which was discontinued September 15, 1905. Descriptions of these several stations, together with a statement of work done and the results obtained at each are given on the following pages.

The rainfall records have been continued at Bartlett, Bretton Woods, Jefferson Highlands and North Woodstock.

The river basins in the White Mountain Region do not differ from each other materially in their topographic and geologic features. Granite prevails throughout the whole

region and the topography is broken and rocky, cut by narrow valleys, gradually changing to the lower hills and broader valleys of the large river basins, and as the slopes of all streams are great, there is little or no pondage or natural storage. The mountain summits are bare and considerable areas are composed of naked rock. The condition of vegetation and forest cover ranges from barren mountain tops to dense spruce growth. The natural conditions have been largely modified by the lumbermen and a great proportion of the total area has been cut over to some extent. From some sections the forest cover has been entirely stripped, while from others certain portions of the growth only have been removed. These conditions have been examined in detail and accurately reported by the Bureau of Forestry. In the following table is a concise statement of the forestation of each basin whose hydrography has been studied by the United States Geological Survey:

TABLE SHOWING FOREST CONDITIONS ON DRAINAGE AREAS.

Classification.*	Per Cent. of Drainage-Area.					
	Pemigewasset at Plymouth.	Israel (above South Branch).	Israel (below South Branch).	Ammonoosuc at Bretton Woods.	Zealand at mouth.	Little at mouth.
Soft Woods (evergreens).						
Over 2 M. ft. per acre	25.4	27.3	21.8	51.3	13.2	21.5
Under 2 M. ft. per acre	20.9	6.2	14.1	11.6	0.5	.....
Total	46.3	33.5	35.9	62.9	13.7	.....
Hard Woods (deciduous)	9.7	37.5	29.6	6.1	2.4	20.1
Waste and barren land	9.3	18.0	12.3	15.2	2.7	13.7
Agricultural, clean cut and burns	13.4	11.0	22.2	15.8	81.2	42.6
Water	0.3	.....	.....	.....	.....	.....
Not classified	21.0	.....	.....	.....	.....	.....
Total per cent.	100.00	100.00	100.00	100.00	100.00	100.00

* Field work done by the Bureau of Forestry in 1903.

SACO RIVER DRAINAGE BASIN.

Description of Basin.

Saco River receives its headwaters from the valleys and slopes of the White Mountains, at elevations of 4,000 to 5,000 feet. It drains an area of 1,720 square miles, of which 900 square miles lie in New Hampshire and the remainder in Maine. The slopes at the headwaters are very steep with no lake storage. In the lower river are many good water powers, part of which are in use. The upper portions of the basin are generally in forest, but much of the large growth has been cut, and over large areas the evergreen trees have been entirely removed. In the lower basin are many farms and villages. The underlying rock is generally granite, appearing at the surface in many mountain summits.

SACO RIVER NEAR CENTER CONWAY, N. H.

This station was established August 26, 1903, by N. C. Grover. It is located at the wooden highway bridge between Center Conway and Redstone, about two miles from each place.

The channel is straight for 2,000 feet above and 300 feet below the station, and is about 200 feet wide at ordinary stages, broken by one pier. The banks are high and are not liable to overflow, except in very extreme freshets. The bed is sand and gravel and is permanent. The current is medium at high and sluggish at low stages.

Discharge measurements are usually made by wading about 400 feet above the bridge.

A standard chain gage, which is read twice each day by Albert P. Davidson, is fastened to the floor of the bridge. The length of the chain is 30.47 feet. The gage is referred to bench marks as follows: (1) Marked point on lower chord of bridge near gage; elevation, 27.76 feet. (2) South end of top of west abutment; elevation, 25.14 feet. Elevations refer to datum of gage.

DISCHARGE MEASUREMENTS OF SACO RIVER NEAR CENTER CONWAY, N. H.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. pr sec.*	*Feet.*	*Sec.-ft.*
1903 Aug. 28	H. K. Barrows.....	167	429	1.18	4.81	504
Aug. 27*a*	H. K. Barrows.....	277	294	1.30	4.18	382
Sept. 19*a*	H. K. Barrows.....	275	295	1.22	3.92	359
1904 April 19	N. C. Grover.....	227	738	2.20	5.87	1,623
May 2	S. K. Clapp.....	251	1,477	3.88	9.00	5,730
May 18	S. K. Clapp.....	235	986	2.68	7.00	2,786
May 26	N. C. Grover.....	224	740	2.12	5.76	1,567
June 14	S. K. Clapp.....	144	417	1.17	4.11	488
July 21*a*	S. K. Clapp.....	230	119	1.27	3.39	151
Aug. 9	S. K. Clapp.....	200	141	1.31	3.45	185
Oct. 11*a*	T. W. Norcross.....	260	320	1.14	3.88	365
Oct. 11*a*	T. W. Norcross.....	260	321	1.14	3.92	366
1905 May 6	T. W. Norcross.....	228	786	1.91	5.71	1,500
July 5*b*	Murphy and Barrows....	160	517	1.44	4.53	742
Aug. 26*c*	T. W. Norcross.....	136	177	1.49	3.69	263
1906 May 3	T. W. Norcross.....	226	896	2.35	6.28	2,110
Aug. 20*b*	George M. Butt.....	122	153	1.21	3.80	185
Oct. 2*b*	F. E. Pressey.....	125	134	1.07	3.27	144

a At wading section.
b Right channel, by wading a short distance below bridge.
c By wading 250 feet below gage; meter on rod.

DAILY GAGE HEIGHT, IN FEET, OF SACO RIVER NEAR CENTER CONWAY, N. H.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1903						1903					
1	.....	3.94	3.54	4.01	a	17	.....	3.62	4.0	3.78	a
2	.....	3.94	3.5	4.0	.....	18	.....	4.06	6.52	4.18	.....
3	.....	3.93	3.5	4.02	.....	19	.....	3.52	5.3	4.0	4.5
4	.....	3.9	3.51	3.9	.....	20	.....	3.71	4.7	3.78	.....
5	.....	3.92	3.52	3.92	.....	21	.....	3.6	4.45	3.79	.....
6	.....	3.91	3.55	4.05	3.9	22	.....	3.6	4.25	3.61	.....
7	.....	3.8	3.53	3.96	.....	23	.....	3.5	4.22	3.88	.....
8	.....	3.67	3.62	3.95	.....	24	.....	3.48	4.3	3.72	.....
9	.....	3.68	5.12	3.88	.....	25	.....	3.5	4.22	3.9	.....
10	.....	3.67	5.65	3.85	.....	26	4.31	3.5	4.23	4.1	.....
11	.....	3.7	4.32	3.85	.....	27	4.1	3.52	4.22	a	.....
12	.....	3 65	4.4	3.8	4.0	28	3.93	3.55	4.0	.....	.....
13	.....	3.65	4.32	3.78	.....	29	3.92	3.53	4.0	.....	.....
14	.....	3.62	4.22	3.72	.....	30	3.95	3.55	3.93	.....	.....
15	.....	3.55	4.05	3.75	.....	31	3.95	.....	4.03	.....	.....
16	.....	3.54	4.02	3.8	.....						

a River frozen November 27 to December 31, 1903. Readings are to the surface of the water in a hole cut in the ice.

DAILY GAGE HEIGHT, IN FEET, OF SACO RIVER NEAR CENTER CONWAY, N. H.—*Continued.*

Day	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1904 1	.....	.....	.....	5.75	9.9	4.7	4.1	3 45	3.88	5.46	4.86	.....
2	.....	.....	.....	5.5	9.22	4.65	4.88	3.46	3.37	4.94	4.62	.....
3	7.1	.....	.....	5.55	8.6	4.58	4.18	3.56	3.37	4.68	4.8	.....
4	.....	.....	.....	5.3	8.82	4.52	3.98	3.67	3.82	4.5	4.25	.....
5	.....	.....	.....	5.28	9.02	4.52	3.84	3.6	3.76	4.26	4.14	.....
6	.....	.....	e7.5	5.75	8.48	4.68	3.78	3.54	3.54	4.19	4.15	.....
7	6.1	.....	. .....	6.18	7.72	4.72	3.74	3.52	8.45	4.26	4.15	.....
8	.....	.....	.....	5.98	7.72	4.61	3.66	3.45	3.41	3.98	4.1	.....
9	.....	.....	.....	7.1	7.58	4.47	3.62	3.42	8.37	3.94	4.0	.....
10	a7.0	.....	.....	9.7	8.85	4.38	3.58	3.42	3.41	3.98	3 95	.....
11	.....	.....	.....	8.68	9.1	4.28	3.57	3.44	3.86	4.04	3.95	*f*
12	.....	.....	.....	7.75	7.68	4.2	3.6	3.48	3.82	3.89	3.9	.....
13	.....	.....	*f*	7.08	7.04	4.15	3.7	3.46	3.32	3.89	3.85	.....
14	.....	d6.4	.....	6.6	6.68	4.12	3.62	3.47	3.26	3.57	4.05	.....
15	.....	.....	.....	6.2	7.1	4.07	3.58	3.44	5.34	3.86	4.65	.....
16	.....	.....	.....	6.05	8 94	4.05	3.54	3.44	5.43	3.85	4.0	.....
17	b7.0	.....	.....	5.7	8.06	3.58	3.45	3.42	4.41	3.92	3.95	.....
18	.....	.....	.....	5.7	7.58	3.92	3.46	3.42	4.05	3.92	3.75	h4.25
19	.....	.....	.....	5.82	9.24	3.84	3.42	3.35	3.9	3.83	.....	.....
20	.....	.....	*f*	6.2	9.58	3.83	3.42	3.54	3.86	3.88	.....	.....
21	.....	d6.2	.....	5.88	7.78	3.75	3.4	6.18	3.92	3.13	4.1	.....
22	.....	.....	.....	5.72	6.98	3.88	3.38	4.48	4.05	5.86	4.2	.....
23	.....	.....	.....	5.94	6.16	3.95	3.38	4.04	3.68	5.86	4.1	.....
24	c7.0	.....	.....	6.35	6.28	3.83	3.4	3.62	3.76	5.25	4.1	.....
25	.....	.....	.....	7.2	6.01	3.75	3.46	3.72	4.75	4.92	4.0	i4.8
26	.....	.....	... .	7.9	5.78	3.7	3.52	3.63	4.34	5.12	3.9	.....
27	.....	.....	*f*	7.75	5.58	3.7	3.56	3.56	4.2	4.9	4.0	.....
28	.....	d6.7	.....	7.78	5.35	3.65	3.74	3.54	4.42	4.56	4.1	.....
29	.....	.....	.....	10.20	5.01	3.71	3.58	3.48	4.0	4.49	.....	.....
30	.....	.....	.....	10.82	4.91	3.7	3.51	3.44	5.88	4.45	.....	.....
31	c6.75	.....	{ g7.15 6.52	....	4.75	.....	3.48	3.42	.....	4.46	.....	.....

See note on next page.

NOTE.—River frozen January 1 to March 30, November 19 and 20, and November 29 to December 31, 1904. Readings are to the surface of the water in a hole cut in the ice. The following additional data was obtained during 1904:

a January 10, ice 1.25 feet thick.
b January 17, ice 1.35 feet thick.
c January 24 and 31, ice 1.5 feet thick.
d February 14, 21 and 28, ice 2.0 feet thick.
e March 6, ice 2.5 feet thick.
f March 13, 20 and 27 and December 11, ice unsafe to go upon.
g March 31, morning and evening readings.
h December 18, ice 1.15 feet thick. Gage height to top of ice 4.5 feet.
i December 25, ice 1.13 feet thick. Gage height to top of ice 4.8 feet.

DAILY GAGE HEIGHT, IN FEET, OF SACO RIVER NEAR CENTER CONWAY, N. H.—*Continued.*

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905												
1	*a*4.5	.....	.....	7.65	6.8	4.45	4.35	3.5	4.35	4.25	4.2	6.0
2	.....	.....	.....	6.5	5.75	4.45	4.35	6.4	4.45	4.2	4.2	*p*
3	.....	.....	.....	6.1	5.55	4.45	5.35	5.3	7.7	4.15	4.2	7.05
4	.....	.....	.....	6.0	6.15	4.2	4.75	5.35	9.4	4.15	4.2	7.15
5	.....	*f*4.9	*j*4.3	5.75	6.15	4.25	4.5	4.7	7.5	4.1	4.3	6.9
6	.....	.....	.....	6.55	5.9	4.35	4.35	4.65	5.3	4.1	4.3	6.15
7	.....	.....	.....	7.05	6.4	4.95	4.25	4.55	5.3	3.95	4.3	5.7
8	*b*5.05	.....	.....	6.35	6.0	4.6	4.05	4.45	5.5	3.95	4.4	5.15
9	.....	.....	.....	5.95	5.7	4.4	4.0	4.55	5.2	3.85	4.45	4.85
10	.....	.....	.....	6.0	5.7	4.4	3.95	4.35	4.95	3.85	4.4	4.65
11	.....	.....	.....	6.75	5.85	4.15	4.0	4.15	4.3	3.9	4.4	4.9
12	.....	*g*4.95	*k*4.85	6.65	5.2	4.25	3.9	4.1	5.1	6.1	4.15	5.3
13	.....	.....	.....	6.55	5.4	6.35	3.95	4.05	6.25	5.3	4.2	5.1
14	.....	.....	.....	6.4	4.9	5.35	3.3	4.05	5.6	5.0	4.5	5.05
15	*c*4.5	.....	.....	6.45	4.95	5.35	3.35	4.0	5.05	4.65	4.35	.....
16	.....	.....	.....	6.25	5.6	4.55	3.75	4.55	4.85	4.5	4.4	.....
17	.....	.....	.....	5.75	5.35	4.45	3.7	5.3	4.75	4.5	4.3	.....
18	.....	.....	.....	5.55	5.55	4.35	3.3	4.5	6.15	4.6	4.3	.....
19	.....	*h*5.05	*l*5.0	5.35	5.3	4.25	3.7	4.25	7.2	4.9	3.95	.....
20	.....	.....	*m*7.45	5.35	5.4	4.3	3.35	4.1	6.05	4.9	4.2	.....
21	.....	.....	*m*6.65	6.0	5.0	4.25	3.35	3.95	5.65	4.7	4.2	.....
22	*d*5.05	.....	*m*6.1	7.75	4.95	4.45	3.7	3.35	5.4	4.45	4.1	.....
23	.....	.....	.....	6.3	4.35	4.4	3.6	3.3	5.25	4.45	4.1	.....
24	.....	.....	.....	6.05	4.7	4.2	3.55	3.75	4.9	4.35	4.15	*q*
25	.....	.....	.....	6.25	4.6	4.0	3.55	3.3	4.75	4.3	4.25	.....
26	.....	*i*5.05	*n*11.15	5.9	4.5	4.1	3.55	3.7	5.2	4.2	4.5	.....
27	.....	.....	*o*8.1	6.3	4.5	6.5	3.55	3.95	5.0	4.2	4.25	.....
28	.....	.....	7.75	6.3	4.45	5.3	3.55	3.35	4.45	4.2	4.3	.....
29	*e*4.9	.....	7.45	6.4	4.3	4.55	3.55	3.9	4.25	4.2	4.45	.....
30	.....	.....	8.0	6.3	4.3	4.55	3.6	3.95	4.25	4.2	5.9	.....
31	.....	.....	8.05	.....	4.3	.....	12.55	4.3	.....	4.2	.....	*r*4.95

See note on next page.

NOTE.—River frozen January 1 to March 26 and December 15-31, 1905. Readings are to the surface of the water in a hole cut in the ice. The following comparative readings were taken during 1905:

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Water surface.	Top of ice.	Thickness of ice.
1905	*Feet.*	*Feet.*	*Feet.*	1905.	*Feet.*	*Feet.*	*Feet.*
a January 1...	4.5	4.55	1.2	*g* February 12.	4.95	4.9	2.2
b January 8...	5.05	*	.....	*h* February 19.	5.05	5.35	2.35
c January 15..	4.5	5.15	2.1	*i* February 26.	5.05	5.3	2.4
d January 22..	5.05	5.2	2.0	*j* March 5.....	4.8	4.85	2.45
e January 29..	4.9	5.05	2.0	*k* March 12....	4.85	5.0	2.5
f February 5..	4.9	4.95	2.2	.....	.....	.....	.....

l March 19, unsafe; gage height read to top of ice.
m March 20-22, water flowing over surface of ice.
n March 26, ice breaking up.
o March 27, river clear of ice.
p December 2, ice under gage 2 inches thick, but river not frozen across.
q December 24, gage height to top of ice, 5.1 feet.
r December 31, gage height to top of ice, 5.05; thickness of ice, 0.85 foot at gage, but river not frozen across in left span.
* Below water surface.

DAILY GAGE HEIGHT, IN FEET, OF SACO RIVER, NEAR CENTER CONWAY, N. H.—*Concluded.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1906 1	.....	6.5	....	4.35	6.2	6.2	4.9	4.3	3.4	.....	.....	.....
2	.....	5.7	.....	4.2	6.3	6.45	4.3	4.05	3.55	.....	.....	.....
3	.....	.....	.....	4.15	6.3	6.3	4.65	3.9	3.5	.....	.....	.....
4	.....	.....	.....	4.3	6.45	5.25	4.65	3.3	3.5	.....	.....	.....
5	.....	.....	.....	4.35	6.55	5.05	4.4	3.75	3.45	.....	.....	.....
6	.....	.....	.....	5.25	6.55	5.3	4.35	3.7	3.4	.....	.....	.....
7	4.95	.....	.....	5.45	6.25	6.6	4.3	3.7	3.4	.....	.....	.....
8	.....	.....	.....	4.7	6.7	6.2	4.3	3.7	3.35	.....	.....	.....
9	.....	.....	.....	4.7	7.85	5.85	4.2	3.7	3.35	.....	.....	.....
10	.....	.....	.....	4.65	6.35	5.3	4.2	3.7	3.3	.....	.....	.....
11	.....	5.5	.....	4.65	5.95	5.1	4.15	3.55	3.35	.....	.....	.....
12	.....	.....	.....	4.3	6.1	4.95	4.1	3.6	3.45	.....	.....	.....
13	.....	.....	.....	5.25	6.45	4.85	4.0	3.55	3.4	.....	.....	.....
14	5.3	.....	.....	5.4	6.4	4.65	3.95	3.5	3.45	.....	.....	.....
15	.....	.....	.....	7.5	6.3	4.6	3.9	3.4	3.35	.....	.....	.....
16	.....	.....	.....	9.25	6.55	4.5	3.9	3.4	3.3	.....	.....	.....
17	.....	.....	.....	7.3	6.6	4.5	3.35	3.35	3.3	.....	.....	.....
18	.....	5.1	.....	7.65	6.65	6.65	3.9	3.4	3.2	.....	.....	.....
19	.....	.....	.....	7.6	6.75	5.65	3.35	3.35	3.2	.....	.....	.....
20	.....	.....	.....	7.75	6.65	5.05	3.75	3.3	3.15	.....	.....	.....
21	5.1	.....	.....	7.8	5.05	4.9	3.9	3.3	3.1	.....	.....	.....
22	.....	.....	.....	6.2	4.9	4.6	5.1	3.35	3.05	.....	.....	.....
23	.....	.....	.....	6.0	4.35	5.0	4.3	3.4	3.2	.....	.....	.....
24	.....	.....	.....	6.0	4.3	6.65	4.25	3.45	3.2	.....	.....	.....
25	9.0	.....	.....	6.05	5.05	5.9	4.1	3.5	3.2	.....	.....	.....
26	6.65	.....	.....	6.25	5.4	5.35	3.85	3.4	3.15	.....	.....	.....
27	6.25	.....	.....	6.55	5.75	4.9	3.7	3.45	3.2	.....	.....	.....
28	6.2	.....	.....	6.55	7.45	4.75	3.75	4.5	3.2	.....	.....	.....
29	6.35	.....	4.85	6.55	3.7	5.05	3.65	4.05	3.2	.....	.....	.....
30	6.3	.....	4.65	6.5	7.0	5.3	4.6	3.7	a3.2	.....	.....	.....
31	6.75	.....	4.05	.....	6.6	.....	4.95	3.45	.....	.....	.....	.....

a Interpolated, September 30.

See note on next page.

NOTE.—The following ice conditions prevailed during 1906: River frozen January 1-25, except for small open water area in left span and just above gage. During frozen season gage heights are to surface of water in hole cut in ice. Ice went out January 25. River frozen over again February 4, when gage height to top of ice was 6.1 feet. Narrow stretches of open water remained in left channel near gage for rest of winter and the ice was thin and weak. Ice went out during the morning of March 29. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Top of ice.
1906	*Feet.*	*Feet.*	*Feet.*	1906	*Feet.*
January 7	4.95	5.15	1.1	February 25	4.95
January 14	5.8	5.45	1.5	March 4	4.8
January 21	5.1	5.2	1.0	March 11	4.25
February 4	.....	6.1	(thin)	March 18	4.75
February 11	5.5	5.55	0.65	March 25	4.5
February 18	5.1	5.15	0.8	.....	.....

RATING TABLE FOR SACO RIVER NEAR CENTER CONWAY, N. H., FROM AUGUST 26, 1903, TO DECEMBER 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
8.25	117	4.20	475	5.90	1,675	8.20	4,420
8.30	138	4.30	525	6.00	1,765	8.40	4,740
.....	.....	4.40	575	6.10	1,855	8.60	5,060
8.40	166	4.50	625	6.20	1,950	8.80	5,390
.....	.....	4.60	675	6.30	2,050	9.00	5,730
8.50	200	4.70	730	6.40	2,150	9.20	6,080
.....	.....	4.80	795	6.50	2,250	9.40	6,440
8.60	235	4.90	865	6.60	2,350	9.60	6,800
.....	.....	5.00	935	6.70	2,460	9.80	7,175
8.70	271	5.10	1,005	6.80	2,570	10.00	7,555
.....	.....	5.20	1,080	6.90	2,680	10.20	7,935
8.80	307	5.30	1,160	7.00	2,790	10.40	8,315
.....	.....	5.40	1,240	7.20	3,030	10.60	8,710
8.90	348	5.50	1,320	7.40	3,280	10.80	9,110
.....	.....	5.60	1,405	7.60	3,545	.....	.....
4.00	380	5.70	1,495	7.80	3,825	.....	.....
4.10	425	5.80	1,585	8.00	4,120	.....	.....

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1903 and 1904. It is well defined between gage heights 8.4 feet and 9.0 feet.

RATING TABLE FOR SACO RIVER NEAR CENTER CONWAY, N. H., FROM JANUARY 1 TO DECEMBER 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.50	197	4.90	917	6.80	2,050	.....	.....	9.2	6,090
3.60	284	5.00	984	6.40	2,150	7.80	3,835	9.4	6,450
3.70	278	5.10	1,053	6.50	2,250	.....	.....	.....	.....
3.80	314	5.20	1,124	6.60	2,355	8.00	4,120	.....	.....
3.90	358	5.30	1,197	6.70	2,460	.....	.....	.....	.....
4.00	404	5.40	1,272	6.80	2,570	8.20	4,425	.....	.....
4.10	453	5.50	1,349	6.90	2,680	.....	.....	.....	.....
4.20	504	5.60	1,428	7.00	2,795	8.40	4,740	.....	.....
4.30	557	5.70	1,509	.....	.....	.....	.....	.....	.....
4.40	612	5.80	1,592	7.20	3,030	8.60	5,060	.....	.....
4.50	669	5.90	1,677	.....	.....	.....	.....	.....	.....
4.60	728	6.00	1,764	7.40	3,285	8.80	5,395	.....	.....
4.70	789	6.10	1,855	.....	.....	.....	.....	.....	.....
4.80	852	6.20	1,950	7.60	3,555	9.00	5,735	.....	.....

The above table is applicable only for open-channel conditions. It is based on 14 discharge measurements made during 1903-'05. It is well defined between gage heights 3.4 feet and 9.0 feet.

RATING TABLE FOR SACO RIVER NEAR CENTER CONWAY, N. H., FROM JANUARY 1, TO DECEMBER 31, 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.00	100	.25	....	.50	208	.75	.....
.05	.....	.30	154	.55	.....	.80	314
.10	115	.35	....	.60	238	.85	.....
.15	....	.40	178	.65	.....	.90	.....
.20	133	.45	.....	.70	274	.95	.....

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-'06. It is well defined between gage heights 3.25 feet and 9.0 feet. Above gage height 3.80 feet use 1905 rating table.

ESTIMATED MONTHLY DISCHARGE OF SACO RIVER NEAR CENTER CONWAY, N. H.

[Drainage area, 885 square miles.]

MONTH.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1903.							
August 26-31....	580	350	402	1.04	0.23	.....	.....
September.....	405	198	264	.69	.77	.54	1.43
October.....	2,270	200	550	1.43	1.65	.51	3.26
November 1-26..	465	289	389	.88	.85	.....	*1.20
December.....	.....	.....	.....	.....	.....	.....	5.09
Total.....	.....	.....	.....	.....	.....	.....	10.98
1904.							
January.....	.....	.....	.....	.....	.....	.....	3.72
February.....	.....	.....	.....	.....	.....	.....	2.75
March.....	.....	.....	.....	.....	.....	.....	4.16
April.....	9,110	1,160	2,315	7.81	8.16	2.10	3.95
May.....	7,385	760	3,682	9.56	11.02	2.20	5.05
June.....	742	228	451	1.17	1.31	.74	1.78
July.....	565	159	250	.65	.75	.38	1.99
August.....	1,930	149	276	.72	.83	.20	4.05
September.....	1,657	120	411	1.07	1.19	.22	5.58
October.....	4,345	224	754	1.96	2.26	.78	3.11
November 1-18..	385	289	424	1.10	.78	.....	*0.65
December.....	.....	.....	.....	.....	.....	.....	1.27
The year.....	.....	.....	.....	.....	.....	.....	38.01
1905.							
January.....	.....	.....	.....	.....	.....	.....	3.40
February.....	.....	.....	.....	.....	.....	.....	1.75
March 26-31.....	10,200	3,352	4,984	12.95	2.39	.....	*3.79
April.....	3,765	1,234	2,088	5.42	6.05	2.39	2.60
May.....	2,150	557	1,214	3.15	3.63	1.99	1.32
June.....	2,625	404	321	2.18	2.38	.55	4.29
July.....	13,600	216	385	2.17	2.50	.26	9.49

* Rainfall for complete month.

ESTIMATED MONTHLY DISCHARGE OF SACO RIVER NEAR CENTER CONWAY, N. H.—*Concluded.*

MONTH.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1905.							
August	4,900	278	774	2.01	2.32	.43	5.34
September	6,450	530	1,581	8.98	4.44	.65	6.88
October	1,855	836	646	1.68	1.94	.88	2.20
November	1,677	881	583	1.51	1.68	.59	2.84
December	...	...	...	...	...	...	4.05
The year	...	...	...	...	...	...	48.40
1906.							
January	...	...	...	...	...	...	2.67
February	...	...	...	...	...	...	2.87
March	...	...	...	...	...	...	4.08
April	6,180	479	1,951	5.07	5.66	8.09	1.88
May	5,225	852	2,146	5.57	6.42	1.25	5.18
June	2,408	669	1,820	3.43	8.83	.59	6.50
July	1,053	256	521	1.35	1.56	.50	8.09
August	669	154	261	.678	.782	.28	2.78
September	222	108	157	.408	.455	.24	1.91
Total	...	...	...	...	...	...	30.36

MERRIMACK RIVER DRAINAGE BASIN.

This basin, which has a total drainage area of 5,015 square miles, lies in the states of New Hampshire and Massachusetts; of this 3,815 square miles are in the former state and 1,200 square miles in the latter. Merrimack River is formed at Franklin by the junction of Pemigewasset and Winnepesaukee rivers. The headwaters of the Pemigewasset lie in the White Mountain region at elevations of approximately 2,000 feet; thence they flow southerly through New Hampshire with very steep slopes. On this branch of the Merrimack there is very little lake storage. Squam and Newfound lakes, aggregating about 20 square miles of surface area, are the only bodies of water of any importance. Above Plymouth probably 85 per cent. of the basin is in heavy forest. A very insignificant amount of water power is utilized.

The total drainage area of Pemigewasset River is 1,085 square miles.

Pemigewasset River at Plymouth, N. H.

This station was established September 5, 1903, by N. C. Grover. It is located at the wooden highway bridge below the mouth of Baker's River, in the town of Plymouth. The drainage area at this point is about 615 square miles. The headwaters of the river lie in the mountainous country to the west of Mount Washington, at elevations of more than 2,000 feet. At North Woodstock Pemigewasset River is formed by the junction of East Branch, Middle Branch and Moosilauke Brook, at an elevation of about 700 feet. Thence the waters flow south, receiving Mad River from the east and Baker's River from the west, until at Plymouth, about 20 miles below North Woodstock, the elevation is between 400 and 500 feet. The underlying rock in this basin is usually granite, exposed in the mountain summits. The basin contains some of the best spruce standing in New England. Large areas in the basin of East Branch are still in virgin forest; other areas have been practically stripped, especially on Hancock Brook, a tributary of East Branch, and in the basin of Middle Branch.

The height of water at Plymouth has been recorded daily since January 1, 1886, during which time extensive deforestation in the basin above has taken place. This record of gage height has been given to the United States Geological Survey by the Locks and Canals Company of Lowell, Mass. From these figures the monthly discharge of the river since that date was estimated from measurements of flow at the station during 1903 and 1904.

The channel is straight for 1,000 feet above and below the bridge, and is about 180 feet wide at ordinary stages, broken by one pier. The banks are high and rocky. The bed is fairly permanent near the gage, but evidences of change in conditions below and consequent change in control as regards velocity have been observed during 1905. The bed is rocky in the right half and gravelly in the left. The velocity is rapid in the right and sluggish in the left half.

Discharge measurements at ordinary and high stages are made from the bridge. The initial point for soundings is at the top of the face of the right abutment on the upstream side. At low water the discharge of the left channel is measured by wading.

A standard chain gage, which is read twice each day by Frank Morton, is attached to the guard rail of the sidewalk of the bridge on the upstream side. The length of the chain is 34.69 feet. The gage is referred to bench marks as follows: (1) Marked point on rail of bridge near gage; elevation 33.96 feet. (2) North corner of intermediate cast-iron gage set by the Locks and Canals Company of Lowell, Mass.; elevation 13.27 feet. (3) North corner of lowest cast-iron gage set by same company; elevation 7.11 feet. All elevations refer to the datum of the gage.

DISCHARGE MEASUREMENTS OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft pr. sec.*	*Feet.*	*Sec.-ft.*
1903						
Sept. 5	N. C. Grover	108	250	1.08	1.85	270
Sept. 22	H. K. Barrows	102	238	1.00	1.74	288
Oct. 9	N. C. Grover	79	248	1.17	1.98	285
1904						
April 14	N. C. Grover	215	931	2.88	4.75	2,680
April 14	N. C. Grover	215	920	2.80	4.70	2,580
April 20	S. K. Clapp	210	886	2.70	4.34	2,257
April 80	S. K. Clapp	234	2,048	5.65	10.86	12,800
May 21	S. K. Clapp	220	1,360	4.17	6.75	5,675
May 25	N. C. Grover	208	782	2.55	4.06	2,000
June 9	N. C. Grover	190	559	1.86	3.02	1,042
July 5	S. K. Clapp	135	288	1.45	2 12	419
July 26	S. K. Clapp	85	197	.91	1.55	179
Aug. 5	S. K. Clapp	135	278	1.61	2.11	448
Aug. 23	H. K. Barrows	190	630	2.03	8.15	1,280
Sept. 28	S. K. Clapp	146	850	1.84	2.47	642
Oct. 14	T. W. Norcross	166	399	1.81	2.65	722
Nov. 22	T. W. Norcross	155	856	1.73	2.54	616
1905						
July 4	Murphy and Barrows	202	777	2.65	8.94	2,060
Aug. 8*a*	H. K. Barrows	178	887	2.14	2.75	826
Aug. 23*b*	T. W. Norcross	124	257	1.44	1.80	370
Sept 5	T. W. Norcross	224	1,400	4.17	6.88	5,840
Oct. 7*a*	T. W. Norcross	142	282	1.65	2.01	466
Oct. 28*a*	T. W. Norcross	113	208	1.15	1.51	240
Oct. 28*a*	T. W. Norcross	113	208	1.81	1.57	272
1906						
April 17	C. R. Adams	228	1,770	4.83	8.36	8,550
April 17	C. R. Adams	228	1,590	4.62	7.56	7,350
April 28	T. W. Norcross	212	818	2.63	4.00	2,140
July 21	G. M. Brett	168	312	1.05	1.69	328
Aug. 24	G. M. Brett	106	181	1.10	1.42	199
Sept. 29	F. E. Pressey	102	174	1.22	1.42	212

a Left channel by wading.
b Left channel by wading; meter fastened to rod.

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1866 1	5.6	4.85	6.1	9.77	4.6	8.68	2.48	2.1	2.77	3.85	5.85	4.02
2	9.1	4.1	5.98	17.1	4.6	8.43	2.48	2.1	2.48	2.98	4.1	4.68
3	7.27	3.98	5.77	6.6	4.52	8.27	2.48	2.68	2.85	2.72	3.52	3.6
4	6.48	4.98	5.77	6.1	4.48	4.48	2.48	2.48	2.02	2.52	3.27	4.27
5	8.77	4.77	5.77	5.85	4.6	3.68	2.48	2.27	1.95	2.43	3.1	.....
6	15.27	4.6	5.77	5.85	4.93	3.48	2.1	2.1	1.85	2.43	2.93	4.27
7	8.52	4.85	5.67	5.68	4.43	3.18	2.1	2.1	1.77	2.27	4.25	4.77
8	6.1	4.1	5.77	4.93	4.1	3.1	2.1	2.1	1.77	2.27	5.6	4.93
9	5.85	3.98	5.68	4.6	6.85	3.1	2.1	2.1	1.68	2.18	4.27	4.77
10	5.1	3.98	5.6	5.43	4.98	3.1	2.1	2.1	1.6	2.15	4.02	4.6
11	4.6	3.98	5.6	5.27	4.43	2.98	2.1	2.1	1.68	2.1	3.77	4.48
12	5.6	3.98	5.6	5.85	4.27	2.77	2.1	2.1	1.68	2.1	3.52	.....
13	5.6	4.27	5.6	4.85	4.1	2.77	2.1	2.1	1.68	2.1	3.35	4.1
14	5.6	16.85	5.6	6.6	4.02	2.77	2.1	2.1	1.68	2.18	3.35	4.1
15	5.6	13.98	5.6	3.6	3.85	3.93	2.1	2.1	1.77	2.18	3.22	3.93
16	5.6	12.27	5.6	9.27	4.52	3.68	2.1	2.1	1.77	2.77	3.1	3.65
17	5.52	11.6	5.48	7.48	5.98	3.27	3.77	2.52	1.98	2.48	3.02	3.6
18	5.48	9.77	5.27	9.35	4.43	3.1	3.25	3.48	2.6	2.18	2.68	3.6
19	5.27	9.27	5.18	10.6	4.02	2.93	2.68	2.68	2.45	2.18	4.43	.....
20	5.1	8.1	5.1	10.43	3.85	2.72	2.6	2.35	2.27	2.1	11.77	3.77
21	5.1	7.27	4.93	9.68	3.85	2.52	2.48	2.1	2.35	2.1	6.27	3.77
22	5.1	7.1	4.93	9.43	3 6	2.52	2.43	2.1	2.35	2.1	.....	3.77
23	4.93	7.1	5.02	6.77	3.5	2.48	2.27	2.1	2.1	2.1	4.52	3.77
24	4.85	6.93	4.77	6.77	3.35	2.43	2.1	2.1	2.02	2.05	4.18	3.77
25	4.77	6.27	4.6	6.27	3.18	2.48	2.1	2.1	2.02	2.02	5.02	4.1
26	4.6	6.27	4.6	5.77	4.6	2.52	2.1	2.1	2.02	2.02	5.18	.....
27	4.27	6.1	4.93	5.27	4.77	2.35	2.1	2.1	2.02	2.18	.....	4.85
28	4.27	6.1	5.18	5.02	4.77	3.18	2.43	2.1	2.27	3.52	4.27	4.52
29	4.48	.....	5.1	4.85	4.6	2.68	2.43	2.02	4.93	3.43	3.85	4.1
30	4.6	.....	5.48	4.85	4.2	2.55	2.27	1.93	4.48	2.93	3.68	3 85
31	4.48	.....	6.6	.....	3.85	.....	2.1	1.93	.....	4.15	.....	3.85

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER, AT PLYMOUTH, N. H.—*Continued.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1887												
1	4.02	6.18	4.43	4.43	9.43	4.68	3.43	3.68	2.6	2.02	2.1	4.27
2	.....	5.6	4.43	4.43	9.02	5 43	3.27	3.85	2.6	2.05	2.1	4.27
3	5.02	5.27	4.52	4.43	9.6	5.1	3.15	3.1	2.52	2.1	2.02	5.1
4	4.48	5.27	4.52	4.48	9.85	7.35	3.02	2.93	2.48	2.1	2.02	4.98
5	4.02	5.1	4.52	5.1	12.1	5.52	2.93	2.85	2.48	2.27	2.1	4.6
6	4.02	.....	.....	6.1	9.98	4.93	2.85	3.2	2.85	2.52	2.1	4.6
7	4.02	4.77	4.52	5.85	9.1	4.52	4.68	3.25	2.85	2.27	2.1	3.93
8	3.85	4.77	4.6	5.85	7.77	4.27	3.77	3.6	2.52	2.1	2.1	3.77
9	.....	4.6	4.77	4.27	9.85	3.93	3.43	3.1	2.52	2.05	2.1	3.48
10	3.68	4.48	4.77	5.68	9.68	3.77	3.52	2.93	2.52	2.02	2.1	.....
11	3.68	4.48	4.77	9.6	9.68	3.85	3.6	2.77	2.4	2.1	2.1	6.1
12	3.6	4.48	4.68	18.1	7.52	3.43	5.48	3.43	2.27	2.27	2.27	3.02
13	3.6	.....	.....	12.1	6.18	3.18	4.1	3.1	2.68	2.1	2.27	6.18
14	3.6	4.27	4.85	9.1	5.6	3.18	3.18	2.85	2.68	2.1	2.27	5.02
15	3.6	4.27	4.93	7.68	5.35	3.02	3.1	2.6	2.85	2.1	2.18	4.43
16	.....	4.27	4.93	6.48	5.77	2.93	2.93	2.52	2.68	2.05	5.18	4.1
17	3.6	4.48	4.85	6.1	6.18	3.35	2.77	2.43	2.6	2.02	3.85	3.6
18	3.6	4.6	4.77	5.85	6.02	3.35	2.68	2.48	2.45	2.02	3.27	3.35
19	3.6	4.6	4.77	4.98	5.85	2.98	3.1	3.27	2.27	2.02	.....	3.48
20	3.6	.....	.....	4.77	5.35	2.77	2.93	2.98	2.85	2.02	4.18	3.48
21	3.6	4.6	4.98	5.68	5.85	2.68	2.77	2.68	2.27	2.02	4.43	3.43
22	3.6	4.6	5.1	6.77	4.68	2.77	2.68	2.43	2.18	3.27	3.6	3.85
23	.....	4.6	5.85	7.77	4.6	4.18	3.35	2 6	2.18	2.9	3.1	3.93
24	3.77	4.6	4.85	10.1	4.52	14.02	6.18	3.68	2.14	2.52	3.02	4.1
25	5.27	4.6	4.85	10.1	4.27	9.1	6.6	4.1	2.1	2.48	2.85	4.27
26	6.1	4.48	4.77	3.68	7.52	5.85	3.52	3.6	2.08	2.35	2.85	4.18
27	4.93	.....	.....	7.52	3.6	5.02	5.52	3.02	2.02	2.27	3.85	4.1
28	4.77	4.48	4.6	7.1	6.1	4.48	4.6	2.8	2.02	2.18	5.27	4.02
29	5.1	.....	4.68	7.68	7.1	4.02	4.1	2.6	2.02	2.18	5.93	4.52
30	.....	.....	.....	11.77	6.6	3.77	4.1	2.52	2.02	2.15	4.43	4.77
31	7.1	.....	.....	.....	5.27	.....	3.9	2.52	.....	2.1	.....	4.68

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER, AT PLYMOUTH, N. H.—*Continued.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1888												
1	.....	8.93	4.68	.....	12.93	5.85	3.22	2.1	2.27	3.6	4.35	4.52
2	5.1	8.98	4.85	7.27	10.6	5.68	3.1	2.43	2.85	4.1	4.35	8.98
3	6.02	8.98	4.77	7.1	8.18	5.15	2.93	2.1	2.52	4.27	4.27	3.93
4	5.77	3.93	.....	6.77	3.1	4.6	2.85	2.02	2.27	3.85	5.48	3.77
5	5.48	.....	4.6	6.6	6.85	4.27	2.6	2.02	2.18	3.52	4.6	3.6
6	5.27	3.98	4.52	6.43	3.05	4.18	2.52	2.02	2.18	3.35	4.27	3.52
7	5.1	3.93	4.6	3.85	9.27	4.27	2.43	2.02	2.1	7.1	4.1	3.27
8	.....	4.02	4.52	.....	9.02	4.02	2.85	1.98	2.02	6.77	3.93	3.27
9	4.93	4.02	4.48	5.98	9.1	3.68	2.27	2.1	4.68	5.18	4.18	3.18
10	4.77	3.93	4.52	5.6	11.68	3.48	2.27	2.48	3.85	4.6	7.52	3.1
11	4.68	3.93	.....	4.68	11.27	3.27	2 27	2.1	3.1	4.18	7.1	3.1
12	4.43	.....	4.48	4.1	11.85	3.18	2.6	2.05	2.85	4.02	5.85	3.1
13	4.27	3.93	4.43	4.6	18.85	3.1	3.6	2.02	2.68	3.93	4.98	2.6
14	4.1	3.93	4.27	4.18	12.43	2.93	3.68	4.1	2.68	4.35	4.52	2.77
15	.....	4.1	4.68	.....	9.68	2.93	3.22	3.85	2.52	4.18	4.27	2.93
16	4.48	4.1	4.77	3.98	3.1	3.18	2.77	2.77	2.48	4.02	5.85	3.35
17	4.27	4.1	4.77	4.18	7.27	3.0	2.6	2.52	2.85	3.85	5.18	4.27
18	4.27	4.1	.....	4.6	6.43	2.85	2.52	3.6	4.02	5.27	4.85	7.1
19	4.1	.....	4.68	4.27	5.98	2.52	2.43	3.1	6.18	4.52	4.1	5.35
20	4.1	4.1	4.68	4.93	6.85	2.52	2.48	2.6	4.85	4.35	5.6	4.1
21	4.1	4.85	4.85	4.6	7.02	2.52	2.52	2.35	4.02	4.6	4.27	3.52
22	.....	4.77	7.27	4.72	5.77	2.85	2.4	2.52	7.1	4.27	4.1	6.48
23	4.02	6.27	11.02	4.85	5.68	2.02	2.27	3.6	5.27	4.02	3.52	5.6
24	4.02	5.77	7.52	4.93	6.85	4.8	2.18	2.93	4.35	3.77	3.77	5.43
25	4.02	5.85	.....	4.48	6.48	6.6	2.18	2.6	3.85	5.52	3.85	5.85
26	4.02	.....	7.1	4.98	6.85	5.77	2.1	2.5	3.52	4.6	3.6	5.52
27	4.85	5.27	6.77	5.77	6.1	5.1	2.1	2.48	7.85	4.18	4.93	6.1
28	4.85	5.1	6.85	3.1	5.85	4.1	2.1	2.52	5.02	6.6	6.85	3.77
29	.....	4.98	7.85	12.35	6.98	3.6	2.1	2.35	4.18	6.85	5.68	5.85
30	4.85	.....	10.85	15.1	6.77	3.35	2.1	2.27	3.85	5.68	4.85	4.48
31	4.65	.....	8.27	.....	5.98	.....	2.02	2.18	.....	4.77	.....	4.85

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER, AT PLYMOUTH, N. H.—*Continued.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1889												
1	3.35	4.6	3.52	3.35	5.6	2.35	2.68	4.35	1.98	3.1	3.43	.....
2	3.35	4.52	3.52	3.1	4.93	9.6	2.52	7.98	1.93	6.6	3.1	3.43
3	3.52	.....	.....	3.18	4.43	6.02	2.43	5.27	2.02	5.52	3.65	3.27
4	3.27	4.27	3.52	3.18	4.35	4.43	4.52	4.93	1.77	4.43	3.65	3.1
5	3.18	4.27	3.77	3.93	4.22	4.18	5.1	4.27	1.77	4.02	3.7	3.1
6	3.43	4.52	4.68	3.77	4.1	4.27	3.68	4.27	1.77	5.22	3.7	3.43
7	3.35	4.77	6.77	.....	4.43	4.27	3.22	3.77	2.27	6.43	4.27	3.6
8	5.77	4.43	5.93	4 77	4.43	3.93	2.77	3.27	2.27	3.35	3.93	.....
9	4.27	4.43	5.27	.....	4.43	4.77	2.77	3.18	2.27	5.6	3.77	5.1
10	3.93	3.27	.....	5.18	4.35	5.43	2.68	3.1	2.1	4.52	3.65	3.6
11	5.52	4.1	4.6	4.93	4.27	6.6	2.6	3.2	2.02	4.27	3.52	5.6
12	4.6	4.1	4.27	5.35	3.35	4.93	2.77	3.27	1.85	3.93	3.35	6.68
13	3.68	4.1	4.27	6.27	3.43	4.35	2.68	3.02	1.85	3.72	3.27	5.27
14	3.52	3.35	4.27	... ..	3.43	3.35	2.68	2.93	1.85	3.52	3.35	4.52
15	3.1	3.35	4.1	4.35	3.77	3.6	2.68	3.1	2.0	3.35	3.43	.....
16	3.1	3.35	4.1	4 6	3.52	3 6	2.52	3.35	2.18	3.18	3.1	4.1
17	3.68	.....	.....	5.18	3.35	3.6	2.43	3.1	2.27	3.1	.....	3.35
18	6.35	3.35	4.6	5.93	3.27	3.35	2.43	2.9	3.6	3.02	2.93	3.68
19	4.1	3.35	5.18	7.6	3.1	3.6	2.35	2.68	3.6	2.93	2.93	4.1
20	3.6	3.35	4.35	3.43	2.93	3.27	5.18	2.6	7.52	2.3	3.02	5.77
21	3.27	3.68	4.02	7.35	4.02	3.1	7.77	2.52	4.6	2.68	4.43	5.1
22	6.68	3.6	3.35	7.77	7.68	2.35	4.35	2.52	4.0	2.68	4.52	.....
23	5.35	3.6	4.18	5.43	5.6	2.72	3.93	2.43	3.35	2.6	5.35	4.27
24	5.35	.....	.....	4.68	4.43	2.6	3.68	2.35	3 6	2.6	.....	4.1
25	5.35	3.6	4.93	4.43	4.02	2.6	3.35	2.27	3.18	2.6	3.93	3.93
26	5.35	3.52	4.43	5.77	3.77	2.52	3.02	2.18	3.02	2.52	3.6	3.77
27	5.27	3.52	3.77	6.93	3.52	2.6	2.35	2.1	4.43	2.6	3.43	3.77
28	5.1	3.52	3.52	7.43	3.35	3.68	3.1	2.1	3.77	3.27	3.43	3.43
29	4.93	.....	3.77	3.27	3.43	3.6	2.93	2.1	3.43	4.27	4.6	.....
30	4.6	.....	3.77	6.6	3.1	4.15	7.1	2.02	3.1	4.1	3.93	2.93
31	4.6	.....	.....	.....	2.93	.....	6.35	2.02	.....	2.6	.....	3.68

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER, AT PLYMOUTH, N. H.—*Continued.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1890												
1	4.27	4.85	6.68	4.43	6.93	4.5	2.6	2.43	5.52	8.18	3.52	2.77
2	4.77	.....	.....	4.18	8.27	4.18	2.52	2.6	4.6	3.02	8.55	4.1
3	6.1	4.6	5.6	3.98	6.68	8.98	2.6	2.4	4.02	2.98	8.6	8.77
4	5.93	4.6	5.6	8.85	8.48	3.77	7.77	2.18	3.6	2.93	3.6	8.6
5	.....	4.6	5.6	6.6	10.27	4.43	4.77	2.1	3.35	3.15	8.35	4.1
6	6.1	5.27	4.98	.....	10.1	5.6	4.05	2.02	3.18	8.35	8.18	4.1
7	6.6	5.1	4.6	5.27	12.6	5.18	3.35	2.93	3.1	3.1	3.1	.....
8	6.48	4.68	4.48	5.6	8.27	4.6	8.18	2 35	3.02	3.27	3.1	3.77
9	7.1	.....	.....	5.18	6.6	4.6	3.02	2.18	2.55	4.27	8.25	3.6
10	6.6	5.77	4.43	4.98	5.93	4.02	8.02	2.15	8.6	8.85	8.43	8.52
11	6.68	5.1	4.43	5.68	7.68	8.77	2.77	2.1	8.18	8.6	3.93	3.52
12	.....	4.85	4.48	4.93	6.77	3.77	2.6	2.02	3.27	3.47	8.43	8.43
13	6.93	4.85	4.77	.....	5.77	8.68	2.5	1.98	8.85	3.35	8.35	3.27
14	6.68	4.6	7.27	8.27	6.27	4.35	2.43	1.98	11.6	8.18	8.18	.....
15	6.43	4.68	7.02	10.35	7.1	4.2	2.85	1.85	6.68	8.52	8.1	3.27
16	6.6	.....	.....	8.1	6.6	4.02	3.43	1.85	5.85	8.93	.....	3.27
17	6.43	5.85	5.43	7.1	6.18	3.6	2.85	1.85	10.68	3.6	8.85	3.27
18	6.85	5.27	5.48	6.68	5.55	3.48	2.52	1 85	10.02	5.6	5.85	3.85
19	.....	4.85	5.1	5.52	4.98	3.18	2.85	2.1	7.85	5.6	5.68	3.52
20	6.27	4.6	4.77	6.22	7.43	3.1	2.35	2.27	5.6	7.6	4.77	8.1
21	6.02	4.27	5.1	6.93	12.1	2.98	2.35	2.85	4.93	6.77	4.18	.....
22	6.02	4.27	5.52	6.02	6.77	2.85	2.27	2.52	4.27	5.35	8.85	3.1
23	5.77	.....	....	6.6	5.6	2.77	2.18	3.6	3.93	4.77	.....	3.1
24	5.35	4.27	5.6	8.27	5.1	2.77	2.1	8.27	3.77	4.48	3.6	8.1
25	5.1	4.6	5.1	8.52	4.72	3.1	2.1	5.85	3.6	4.43	8.43	8.1
26	.....	5.48	5.1	6.77	4.85	3.85	4.6	4.02	3.85	4.15	8.85	8.1
27	5.27	.....	5.1	6.45	8.5	3.02	8.85	7.15	3.85	8.85	8.1	8.1
28	4.93	7.02	4.85	6.1	8.68	3.02	3.1	9.85	3.6	3.77	2.77	.....
29	4.98	.....	4.43	6.1	6.43	2.8	2.6	5.52	8.35	3.6	2.77	8.1
30	5.1	.....	.....	5.85	5.52	2.6	2.43	4.52	8.85	3.77	.....	8.1
31	4.85	.....	4.48	.....	4.85	.....	2.85	5.00	.....	8.68	.....	8.1

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.—*Continued.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1891 1	8.18	.....	.....	5.48	4.93	4.05	2.35	3.02	2.85	1.6	1.65	3.77
2	8.18	5.27	5.6	5.35	5.65	3.6	2.85	8.15	3.02	1.52	1.68	8.6
3	8.35	4.98	5.48	5.1	6.0	3.48	2.27	8.27	2.98	1.52	1.77	3.48
4	.....	4.93	5.85	4.77	6.1	3.77	2.18	2.18	2.68	1.55	1.6	2.85
5	8.52	4.27	5.18	.....	5.18	4.43	2.5	2.1	2.52	1.6	1.48	7.1
6	8.52	4.27	5.1	4.18	4.6	3.6	2.85	2.02	2.93	1.52	1.43	.....
7	8.43	4.43	5.02	4.1	4.18	3.2	2.77	2.85	3.85	1.52	1.48	4.1
8	8.48	.....	....	3.93	5.02	3.2	2.77	2.27	3.02	1.68	1.5	3.6
9	8.43	4.35	5.02	3.85	3.85	3.15	3.52	2.15	2.68	2.18	1.6	3.1
10	3.43	4.35	5.85	3.27	4.72	2.77	2.77	2.02	2.48	1.85	1.6	3.1
11	.....	4.43	6.68	4.6	5.6	2.68	2.52	1.93	2.35	1.72	1.68	2.85
12	3.85	.....	6.1	10.6	5.77	2.6	2.4	1.85	2.27	1.6	4.02	2.6
13	7.68	.....	5.98	3.6	5.02	2 6	2.27	1.98	2.18	1.6	3.1	.....
14	6.6	4.18	7.35	7.1	4.68	2.5	2.1	2.02	2.1	1.68	2.6	2.6
15	5.77	.....	.....	3.6	4.6	2.43	2.02	1.85	2.1	1.77	2.35	2.35
16	5.27	4.1	6.48	3.43	4.27	2.35	2.02	2.05	2.02	1.68	2.1	3.52
17	4.93	4.85	5.68	7.85	4.1	2.27	2.02	2.27	2.02	1.68	2.1	3.27
18	.....	5.18	5.43	3.77	5.52	4.18	1.98	2.18	1.98	1.65	5.6	3.6
19	4.98	5.1	5.27	10.6	4.6	4.1	5.35	2.02	2.02	1.6	3.35	3.43
20	4.77	4.85	5.02	11.6	4.18	3.85	4.02	2.02	1.98	1.6	2.77	.....
21	4.52	4.43	4.85	9.1	4.18	3.05	2.93	1.85	1.98	2.02	2.77	3.35
22	4.52	.....	.....	8.1	5.68	2.77	2.85	4.02	1.98	2.43	.....	3.18
23	7.48	4.6	10.68	10.1	5.1	4.48	2.35	3.6	1.85	2.1	2.68	3.1
24	3.6	4.6	18.52	10.68	4.5	3.52	2.18	3.18	1.85	1.85	3.27	5.27
25	.....	4.68	12.1	7.48	3.93	3.85	3.35	3.02	1.85	1.75	5.85	3.27
26	6.43	3.6	6.77	6.4	3.93	3.02	3.05	2.77	1.77	1.68	3.93	6.35
27	6.1	9.4	5.6	5.85	3.77	2.77	2.77	2.48	1.72	1.77	3.52	.....
28	5.6	7.35	5.35	5.6	3.52	2.6	2.48	3.35	1.68	1.68	3.27	4.6
29	5.35	.....	.....	6.1	3.85	2.43	2.27	5.1	1.68	1.68	.....	3.6
30	5.18	.....	6.1	5.1	4.52	2.43	2.35	4.15	1.6	1.68	3.85	3.1
31	5.1	.....	5.6	.....	4.05	.....	2.85	3.18	.....	1.6	.....	6 85

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.—*Continued.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1892 1	4.6	4.6	2.85	2.85	3.8	4.93	6.85	2.02	3.35	2.18	2.48	2.77
2	4.52	4.43	2.85	3.52	3.43	4.52	4.93	2.0	3.18	2.1	2.85	2.85
3	14.1	4.27	2.85	.....	3.98	4.18	6.7	1.95	2.85	2.02	2.52	2.85
4	7.48	4.02	2.6	7.1	5.85	3.93	3.85	1.93	2.68	2.1	4.48	.....
5	5.85	3.85	2.52	7.27	6.6	4.18	6.85	2.02	2.52	2.48	2.85	2.45
6	4.35	3.52	.....	7.1	4.68	4.48	5.02	2.27	2.48	2.27	3.0	2.1
7	4.27	.....	2.27	3.85	4.1	4.18	4.48	1.98	2.6	2.1	3.1	2.6
8	3.85	3.35	2.27	5.77	3.75	4.1	4.85	1.6	2.48	2.18	3.1	2.52
9	3.43	3.35	2.35	5.35	3.48	3.6	3.68	1.77	2.85	2.23	5.68	2.48
10	.....	3.35	2.85	.....	3.48	3.35	3.5	2.02	2.18	2.27	4.1	2.68
11	4.6	3.27	3.93	4.27	3.48	3.1	3.85	2.02	2.1	2.18	3.85	.....
12	4.77	3.27	3.52	3.85	5.1	3.0	3.1	2.35	2.02	2.1	3.35	2.85
13	4.88	3.1	.....	3.43	6.02	2.85	2.93	4.43	2.02	2.1	3.22	2.27
14	9.52	.....	3.48	3.35	5.1	2.68	2.68	3.93	2.02	2.1	3.1	2.1
15	11.1	3.27	3.1	3.18	5.6	2.6	2.6	3.48	3.35	2.1	3.1	2.35
16	5.6	3.1	2.6	3.1	6.1	2.6	2.52	2.85	3.52	2.22	3.6	2.18
17	.....	3.27	2.85	3.0	6.35	2.52	2.4	2.52	3.52	2.35	11.35	2.1
18	4.27	3.1	2.85	2.98	4.6	2.27	2.27	2.27	3.15	2.85	7.1	.....
19	4.27	3.1	2.18	2.85	4.1	2.48	2.85	2.1	2.77	2 85	9.1	2.1
20	4.48	.....	.....	2.85	3.77	2.68	2.27	3.1	2.6	2.85	.....	2.02
21	3.77	.....	1.85	2.85	4.15	3.85	2.1	3.0	2.6	2.48	4.85	1.85
22	3.6	3.1	2.1	3.27	6.1	3.85	2.1	2.85	2.52	2.48	4.48	1.77
23	3.6	3.1	1.98	4.6	6.43	2.98	2.02	2 43	2.85	2.22	4.02	1.68
24	.....	3.43	2.02	4.22	7.52	2.68	2.02	2.18	2.27	2.02	3.48	.....
25	3.48	3.35	2.1	3.85	5.85	3.85	2.02	2.1	2.22	1.98	3.39	1.68
26	4.77	3.27	1.85	3.52	5.6	7.52	2.02	5.85	2.18	2.18	.....	1.52
27	4.6	.....	.....	3.18	5.1	6.1	2.02	5.85	3.02	2.18	.....	.....
28	4.6	.....	2.43	3.1	6.85	9.1	1.85	7.1	2.85	2.18	3.02	1.48
29	4.85	3.02	2.6	4.68	5.72	3.52	1.85	4.85	2.48	2.1	2.85	1.85
30	5.1	.....	2.52	4.18	4.6	5.27	2.1	3.85	2.27	2.85	2.85	1.85
31	.....	.....	2.6	.....	5.85	.....	2.05	3.85	.....	2.6	.....	1.85

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.—*Continued.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1893												
1	.....	1.43	2.02	3.6	7.1	3.18	2.1	1.6	3.18	2.05	3.85	3.52
2	2.6	1.6	2.02	.....	6.85	3.1	2.1	1.85	2.85	2.02	3.43	2.85
3	3.18	1.52	1.85	4.1	6.85	3.02	2.1	1.77	2.6	1.93	3.27	.....
4	3.1	1.43	1.85	4.02	7.43	3.02	2.02	1.68	2 35	1.93	3.1	3.85
5	3.1	.....	.....	4.1	12.43	3.02	1.93	1.6	2.27	1.85	2.98	4.1
6	2.6	1.43	1.85	4.85	8.43	2.85	2.02	1.6	2.18	1.93	2.85	4.6
7	2.27	1.43	1.85	4.85	7.75	2.85	1.93	1.6	2.1	1.85	2.77	4.6
8	.....	1.43	1.85	4.6	7.1	2.6	1.93	2.93	2.35	2.15	2.6	4.35
9	1.85	1.43	1.85	.....	7.1	2.6	1.85	2.52	2.93	2.43	2.43	4.1
10	1.68	1.43	2.02	6.85	7.43	3.7	1.77	2.02	2.55	2.27	2.43	.....
11	1.68	2.35	1.85	6.1	9.85	3.75	1.77	1.68	2.18	2.1	2.43	3.85
12	1.52	.....	.....	6.6	10.6	4.85	1.77	1.6	2.02	2.02	2.4	3.6
13	1.52	4.1	4.27	7.43	10.68	3.85	1.77	1.6	1.93	1.85	2.35	3.6
14	1.52	8.85	6.43	6.85	9.6	3.18	1.6	1.6	1.85	2.02	2.27	3.35
15	.....	3.85	6.1	6.68	8.52	2.85	1.52	1.52	1.85	7.1	2.35	3.1
16	1.43	4.1	5.27	5.65	7.43	3.18	1.52	1.52	2.43	4.43	2.1	3.43
17	1.43	3.77	5.27	4.6	10.98	2.85	1.52	1.52	3.0	3.35	2.1	.....
18	1.43	3.6	5.27	4.27	10.35	2.68	1.6	1.52	3.6	3.02	2.1	3.85
19	1.43	.....	.....	4.1	7.68	2.52	1.68	1.93	3.1	2.85	.....	3.6
20	1.43	3.52	4.85	4.27	6.85	2.85	1.52	1.93	2.85	2.60	2.18	3.52
21	1.43	2.85	4.6	4.43	6.85	2.52	1.52	1.93	2.52	2.52	2.02	3.43
22	.....	3.1	4.43	4.1	6.85	2.18	1.52	1.85	2.35	2.48	2.1	3.43
23	1.43	2.68	4.27	4.4	6.02	2.1	1.68	2.18	2.35	2.43	2.85	3.85
24	1.43	2.43	4.02	4.68	6.6	2.6	1.85	2.02	2.22	5.48	2.6	.....
25	1.43	2.1	4.1	5.52	5.35	2.65	1.77	4.1	2.1	6.6	2.27	3.1
26	1.43	.....	.....	4.85	4.85	2.68	1.6	3.6	2.1	4.43	.....	3.6
27	1.43	2.1	4.6	5.35	4.35	2.43	1.6	3.0	2.43	3.6	2.1	3.35
28	1.43	2.1	4.43	4.6	4.1	2.35	1.68	2.43	2.27	7.27	2.35	3.35
29	.....	.....	4.02	5.85	3.85	2.18	1.68	2.27	2.1	7.43	5.85	3.18
30	1.43	.....	4.1	6.48	3.6	2.1	1.65	7.43	2.1	5.1	4.85	3.1
31	1.43	.....	3.85	.....	3.52	.....	1 6	4.1	.....	4.1	.....	.....

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.—*Continued.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1894												
1	3.1	3.1	8.18	.....	4.68	4.68	2.48	1.52	1.48	1.68	8.6	2.85
2	3.1	3.1	3.1	4.6	5.6	4.6	2.43	1.52	1.43	1.68	8.43	.....
3	3.1	3.1	3.35	3.68	6.1	7.1	2.48	1.6	1.43	1.68	2.85	2.68
4	3.02	.....	.....	3.6	5.18	5.85	2.68	1.85	1.48	1.68	6.1	2.68
5	3.1	3.1	3.5	3.43	4.52	4.43	2.52	1.68	1.43	1.85	4.48	2.68
6	3.43	3.1	3.35	3.68	4.6	4.18	2.52	1.52	1.48	1.85	3.85	2.68
7	.....	3.1	5.1	3.6	4.68	3.93	2.68	1.52	1.43	1.75	3.27	2.68
8	3.85	3.1	7.52	.....	4.68	3.6	2.6	1 43	1.43	1.68	3.1	2.43
9	3.27	3.1	7.43	3.35	4.6	3.35	2.52	1.48	1.48	1.68	2.85	.....
10	3.1	3.1	6.6	3.35	3.68	3.1	2.48	1.43	1.48	1.85	2.77	2.27
11	3.1	.....	.....	3.35	3.27	2.85	2.27	1.48	5.98	3.6	2.68	2.35
12	3.02	3.1	6.68	3.1	3.18	2.52	2.18	1.5	2.93	3.18	2.6	2.85
13	2.85	3.1	7.1	3.48	3.0	2.6	2.10	1.6	2.18	2.85	2.35	5.6
14	.....	3.1	6.35	3.68	2.85	2.52	2.35	1.52	1.93	4.6	2.6	6.18
15	2.85	3.1	5.85	.....	2.85	2.48	2.3	1.52	1.68	3.85	2.52	4.85
16	3.1	3.1	5.18	4.85	2.68	2.85	2.27	1.6	1.65	3.1	2.35	.....
17	3.1	3.1	5.02	5.43	2.6	2.3	2.1	1.6	1.6	2.85	2.43	4.1
18	3.1	.....	.....	6.1	2.52	2.27	2.02	1.6	1.52	3.1	.....	3.6
19	3.1	3.48	4.02	6.43	2.77	3.1	1.85	1.65	1.48	2.77	2.6	3.48
20	3.1	3.6	7.02	7.1	3.1	4.43	1.77	1.68	1.52	2.52	2.1	3.6
21	.....	3.6	5.6	3.48	3.43	3.18	1.68	1.68	6.02	2.42	2.27	3.85
22	3.1	3.43	4.85	18.1	3.1	3.18	1.68	1.6	3.6	2.35	2.48	3.68
23	3.1	3.48	5.18	10.1	2.85	2.85	1.68	1.52	3.0	2.27	2.35	.....
24	3.1	3.1	4.52	3.6	2.85	2.65	1.68	1.52	2.35	2.18	2.48	2.02
25	3.27	.....	.....	7.35	3.1	2.43	1.85	1.43	2.18	2.18	.....	3.1
26	3.77	2.98	3.85	6.43	4.18	2.27	1.77	1.43	2.02	2 1	2.35	3.1
27	3.77	3.1	3.48	5.85	3.75	2.52	1.68	1.48	1.98	2.1	2.1	3.02
28	.....	3.27	3.35	6.1	3.35	2.43	1.6	1.43	1.85	2.1	2.27	3.02
29	3.35	.....	3.1	5.0	11.27	2.6	1.55	1.43	1.85	2.1	2.6	2.85
30	3.35	.....	3.1	4.93	9.6	2.52	1.52	1.43	1.75	2.02	2.68	.....
31	.....	.....	3.1	.....	5.6	.....	1.52	1.43	.....	2.02	.....	3.1

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.—*Continued.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1895 1	8.1	2.77	2.48	2.1	6.02	8.18	2.52	2.85	2.35	4.18	2.35	.....
2	3.1	2.68	2.43	2.1	5.27	8.0	2.35	2.1	2.35	2.93	3.85	3.43
3	3.1	.....	.....	2.1	5.18	2.85	2.35	2.1	2.1	2.43	3.25	7.35
4	2.85	2.68	2.52	2.18	6.1	2.27	2.27	2.47	1.93	2 27	2.68	4.6
5	2.85	2.68	2.52	2.1	5.7	3.02	2.1	2.85	1.85	2.18	2.52	4.18
6	.....	2.6	2.43	2.1	5.35	8.1	2.02	2.52	1.85	2.1	2.6	3.85
7	2.85	2.6	2.43	.....	5.48	3.85	2.15	2.18	1.77	2 02	2.6	3.52
8	2.85	2.48	2.48	2.85	4.85	3.27	2.27	2.1	1.77	2.02	2.93	.....
9	2.85	2.43	2.43	5.68	4.93	3.0	2.1	2.1	1.77	2.1	8.1	3.35
10	2.85	.....	.....	13.52	4.48	2.77	2.18	1.93	1.77	2.02	6.6	3.6
11	2.85	2.43	2.43	8 35	8.1	2.6	2.18	1.9	1.68	1.93	5.18	4.35
12	3.18	2.52	2.43	5.85	5.1	2.52	2.02	1.85	1.93	1.93	4.02	4.85
13	.....	2.52	2.43	5.85	7.1	2.48	1.93	8.18	2.6	3.1	2.43	4.85
14	3.6	2.52	2.43	20.1	4.85	8.18	2.05	2.85	2.02	4.27	8.18	4.48
15	8.43	2.52	2.27	25.1	4 27	3.1	2.18	2.18	1.9	4.02	3.02	....
16	3.27	2.52	2.27	10.81	4.02	2.8	2.1	2.02	1.77	3.1	5.85	4.18
17	3.18	.....	.....	7.85	4.02	2.52	2.1	1.85	1.85	2.77	.....	3.68
18	8.1	2.52	2.1	7.85	3.6	2.85	2.02	2.5	1.85	2.68	8.85	3.48
19	2.02	2.52	2.1	7.85	3.45	2.27	1.98	8.1	1.77	2.52	8.43	3.48
20	.....	2.52	2.1	7.85	3.27	2.27	1.85	2.48	1.77	2.45	8.43	8.6
21	2.85	2.52	2.1	7.6	8.1	2.1	1.8	2.18	1.77	2.85	5.18	8.6
22	2.85	2.52	2.1	7.85	8.02	2.85	1.77	2.02	1.72	2.27	4.1	10.1
23	2.85	2.43	2.1	7.1	2.85	2.65	1.85	1.93	1.68	2.27	8.6	6.6
24	2.85	.....	.....	6.6	2.77	2.93	1.68	1.85	1.68	2.18	.....	4.68
25	2.85	2.43	2.1	6.1	2.68	2.98	1.68	1.8	1.68	2.18	8.85	4.1
26	2.68	2.48	2.1	7.1	2.65	2.48	1.68	1.77	1.68	2.1	3.68	8.68
27	.....	2.48	2.1	6.1	2.6	2.6	1.68	1.77	1.6	2.05	11.1	7.64
28	2.85	2 35	2.1	5.75	8.85	2.6	2.15	1.77	1.6	2.02	6.6	6.85
29	2.85	.....	2.1	5.43	4.6	2.98	2.6	1.85	1.9	2.1	5.1	.....
30	2.85	.....	2.1	5.85	8.93	2.72	2.27	2.52	2.18	2.1	4.43	4.1
31	2.85	.....	.....	.....	3.43	.....	2.18	2.35	.....	2.1	.....	10.02

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.—*Continued.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1896 1	7.94	2.85	21.1	5.18	4.35	3.27	1.77	2.1	1.85	3.43	3 4	4.52
2	5.35	.....	15.85	4.85	4.18	2.93	1.77	2.05	1.85	2.85	3.18	3.85
3	4.77	2.85	7.43	4.1	4.4	2.77	1.63	2.02	1.85	3.1	3.1	3.35
4	4.18	2.85	5.35	3.85	4.6	2.6	1.6	2.02	1.93	2.85	2.85	3.1
5	.....	2.85	5.6	.....	4.6	2.43	2.15	1.85	2.43	2.6	2.93	3.43
6	4.6	2.85	6.6	3.35	4.68	2.35	2.68	2.52	4.75	2.43	13.6	.....
7	4.52	5.98	6.35	3.35	4.1	2.48	2.18	2.93	7.1	2.35	7.85	3.35
8	4.35	5.77	.....	3.1	3.35	2.6	2.1	2.63	4.1	2.68	6.7	3.1
9	4.35	.....	5.35	3.35	3.6	3.1	2.18	2.4	3.18	3.02	5.52	2.93
10	4.35	3.6	4.35	4.35	3.7	3.68	2.02	2.1	2.85	2.63	4.52	3.1
11	4.35	4.1	3.85	4.43	3.35	3.68	1.85	2.02	2.68	2.55	4.1	3.1
12	.....	3.85	3.85	.....	3.85	3.18	1.75	1.93	2.43	2.43	3.85	3.18
13	3.68	3.85	3.6	6.6	3.43	3.1	1.68	1.85	3.25	2.35	3.85	.....
14	3.85	3.85	3 6	10.68	3.18	3.35	1.63	1.77	4.1	2.93	3.85	2.85
15	3.35	3.6	.....	8.85	3.1	2.6	1.68	2.52	3.18	5.77	3.6	2.85
16	3.68	.....	3.43	12.1	2.93	2.68	1.68	2.3	2.77	4.1	3.35	2.43
17	3.68	3.35	3.43	13.1	2.35	2.52	1.68	2.1	2.52	3.43	3.27	2.6
18	3.52	3.35	3.35	11.85	2.77	2.43	1.68	2.6	2.85	3.25	3.1	2.52
19	.....	3.18	3.27	11.0	2.77	2.43	1.65	2.13	3.02	3.1	3.18	2.52
20	3.35	3.18	3.68	10.1	2.77	2.43	1.6	2.1	6.6	3.1	3.1	.....
21	3.35	3.18	7.1	9.02	2.77	2.25	5.27	1.93	4.43	3.1	3.1	2.35
22	3.18	3.1	.....	7.1	2.6	2.1	3.77	1.85	3.43	9.6	.....	2.6
23	3.1	.....	4.43	6.6	2.6	2.18	2.85	2.6	3.1	5.6	3.1	2.6
24	3.1	3.1	3.85	5.52	2.5	2.02	2.52	3.35	2.85	4.68	3.02	2.52
25	2.85	3.1	3.6	5.35	2.43	1.93	2 35	2.85	2.68	4.48	3.1	2.27
26	.....	3.1	3.52	5.0	2.43	2.02	2.18	2.43	2.6	4.27	3.1	2.27
27	3.1	3.1	4.35	4.68	2.85	1.85	2.02	2.1	2.48	4.02	3.35	.....
28	3.1	3.1	5.52	4.85	2.63	1.8	2.1	2.1	2.35	3.68	3.5	2.35
29	2.93	3.1	.....	4.6	2.6	1.77	2.27	2.1	2.35	3.43	.....	2.35
30	2.85	.....	3.85	4.85	3.35	1.77	2.1	2.0	2.35	3.68	5.6	2.35
31	2.85	.....	4.6	.....	3.3	.....	2.1	1.85	.....	3.6	.....	2.35

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.—*Continued.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1897												
1	2.35	2.85	2.85	4.48	7.1	3.85	5.1	3.22	2.02	1.68	1.68	8.6
2	2.85	2.85	2.85	4.85	6.75	3.43	3.85	8.1	1.93	1.68	2.18	3.48
3	.....	2.85	8.02	5.6	6.43	8.35	8.35	2.93	1.85	1.6	6 85	8.18
4	2.1	2.85	8.1	... ..	6.85	8.43	3.1	2.68	1.85	1.52	4.43	8.1
5	2.52	2.85	3.1	4.6	6.6	4.1	2.85	2.68	1.85	1.6	8.52	.....
6	6.48	2.85	8 85	5.85	6.02	4.0	2.68	2.6	1.85	1.6	8.1	5.6
7	7.1	.....	.....	7.1	5.85	3.85	4.43	2.6	1.77	1.6	3.0	4.35
8	6.1	5.35	3.52	7.1	4.52	3.48	3 85	2.48	1.77	1.52	2.85	4.1
9	5.1	6.27	3.52	6.43	4.8	8.35	8.1	2.35	1.68	1.52	2.68	4.1
10	.....	4.85	8.48	5.85	4.1	10.64	2.52	2.6	1.77	1.52	4.6	3.85
11	4.85	4.27	8.52	.....	4.85	10.1	2.52	2 48	1.6	1.52	8.68	8.6
12	4.68	3.85	4.1	4.18	4.52	6.6	2.52	2.6	1.65	1.6	8.18	.....
13	4.27	8.6	4.52	4.68	6.68	5.85	8.85	2.52	1.68	4.6	8.18	6.1
14	3.48	.....	.....	4.68	14.85	5.1	14.1	2.43	1.68	2.85	2.95	4.35
15	8.18	3.52	8.85	5.93	8.1	4.85	18.85	2.25	1.68	2.85	2.68	8.85
16	3.35	8.35	8.6	9.6	6.65	4.85	8.68	2.1	1.68	2.18	2.77	12.1
17	.....	3.35	8.85	9.1	5.18	3.85	6.48	2.6	1.68	2.3	4.52	7.1
18	8.85	3.1	3.43	8.2	4.6	3.6	5.5	8.85	1.68	2.43	4.1	5.43
19	8.85	3.18	3.43	7.35	4.42	3.85	4.6	2.85	1.68	2.85	8.48	.....
20	2.85	8.1	3.85	7.1	8.85	8.9	4.1	2.6	1.68	2.02	8.27	3.48
21	2.6	.....	.....	5.68	8.6	4.43	8.85	2.68	2.02	2.02	.....	5.85
22	2.6	3.1	8.77	5.18	8.85	8.68	8.85	2.5	2.18	1.85	8.85	5.6
23	2.85	8.1	4.1	5.85	8.6	8.35	4.93	2.35	2.02	1.85	2.85	5.6
24	.....	3.1	5.85	8.6	8.35	3.1	6.02	2.1	1.85	1.8	2.6	5.48
25	2.85	3.18	5.35	9.7	8.85	5.85	6.05	2.85	1.85	1.77	2.48	5.1
26	2.85	8.18	4.85	10.85	6.1	8.68	6.1	2.68	1.85	1.77	2.85	.....
27	2.85	8.18	4.35	8.85	4.6	3.25	4.68	2.85	1.85	1.68	6.44	5.1
28	2.85	.....	.....	6.6	4.85	2.85	4.02	2.43	2.02	1.68	.....	4.85
29	2.85	.....	8.6	6.1	5.68	2.85	3.85	2.25	1.85	1.68	4.6	4.68
30	2.85	.....	3.77	5.98	5.05	2.85	3.6	2.1	1.68	1.68	4.27	4.85
31	.....	. ....	4.85	.....	4.48	.....	8.35	2.1	.....	1.68	.....	4.85

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER, AT PLYMOUTH, N. H.—*Continued.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1898												
1	4.1	2.68	2.68	5.85	5.2	3.85	2.52	1.43	1.6	2.02	3.18	2.85
2	.....	2.68	2.68	5.1	5.27	8.6	2.43	1.68	1.52	1.95	3.02	8.02
3	3.68	2.52	2.68	.....	5.18	3.43	2.4	2.1	1.52	1.85	2.85	2.85
4	8.48	2.52	2.68	3.93	4.93	8.18	2.85	1.85	1.6	1.85	2.68	.....
5	8.1	2.52	2.68	4.1	4.85	3.1	2.1	1.85	1.68	1.93	2.6	2.6
6	8.1	.....	.....	3.85	5 18	3.02	2.1	2.52	1.77	2.1	2.7	2.98
7	8.1	2.52	2.68	3.77	5.02	2.85	2.1	2.2	1.68	2.27	2.85	2.85
8	8.1	2.52	2.68	8.6	4.8	2.85	1.93	1.85	1.93	2.1	2.85	2.77
9	.....	2.6	2.85	8.85	4.6	2.85	1.93	1.85	2.02	2.15	2.6	2.43
10	8.1	2.6	2.85	.....	4.85	8.18	1.9	1.85	1.77	2.18	2.52	2.85
11	8.1	2.85	2.85	4.68	4.85	2.77	1.85	1.68	1.65	2.02	4.1	.....
12	3.1	2.85	8.48	5.6	5.52	8.2	1.85	1.68	1.52	1.98	4.42	2.6
13	4.43	.....	.....	6.68	11.1	8.68	1.77	1.6	1.52	2.02	8.85	2.43
14	4.6	8.1	7.85	6.85	6.85	8.85	1.77	1.55	1.52	2.02	3.27	2.48
15	4.52	8.85	7.1	6.85	6.1	5.85	1.68	1.52	1.43	2.1	3.27	2.43
16	.....	3.1	6.1	6.85	5.85	8.35	1.68	1.52	1.48	2.45	8.1	2.6
17	8.85	2 85	4.68	7.0	4.85	3.85	1.65	1.52	1.43	2.77	3.18	2.6
18	8.6	2.68	4.85	7.1	4.85	3.27	1.6	1.52	1.48	2.48	3.18	.....
19	8.35	2.68	5.1	6.6	4.6	4.55	1.6	1.6	1.48	2.35	3.68	2.6
20	8.85	.. ..	.....	5.68	5.1	5.85	1 6	2.68	1.48	2.52	.....	2.6
21	8.35	2.68	9.1	5.48	5.35	4.43	1.77	2.25	1.48	8.18	5.18	2.6
22	3.35	2.68	6.43	5.85	4.9	4.02	2.1	1.85	1.48	8.1	4.27	2.6
23	.....	2.68	5.35	5.1	4.48	4.68	1 85	1.93	1.52	8.75	8.68	2.85
24	8.1	2.68	6.1	7.4	4.48	8.85	1.7	2.02	3.18	4.43	8.43	4.6
25	8.1	2.68	5.85	9.68	5.6	3.85	1.6	2.27	3.15	3.02	3.35	.....
26	3.1	2.68	5.52	8.52	5.85	3.2	1.6	2.35	8.1	2.85	8.1	8.85
27	8.1	.....	.....	6.6	5.18	8.02	1.6	2.1	2.6	7.85	.....	2.85
28	2.85	2.68	6.85	5.85	5.35	2.85	1.6	1.95	2.68	6.1	2.85	2.85
29	2.85	.....	6.6	5.35	4.9	2.68	1.52	1.77	2.43	4.48	2.85	2.85
30	.....	.....	7.68	5.1	4.43	2.6	1.52	1.6	2.18	8.93	2.85	2.85
31	2.68	.....	7.1	.....	4.1	.....	1.48	1.6	.....	8.48	.....	2.85

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.—*Continued.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1899 1	.....	2.6	3.1	4.85	11.1	2.85	1.77	1.68	1.43	1.85	2.68	2.02
2	3.1	2.6	3.43	. ....	11.93	2.68	1.7	1.68	1.35	1.85	5.18	1.93
3	3.1	2.6	3.43	4.27	11.1	2.52	1.6	2.27	1.48	1.77	3.6	.....
4	2.85	2.6	3.35	3.85	8.6	2.45	1.6	2.27	1.6	1.6	2.94	2.6
5	2.85	.....	.....	3.85	6.68	2.35	1.6	1.35	1.43	1.6	2.8	2.35
6	2.85	2.6	3.85	3.85	6.1	2.35	1.6	1.8	1.43	1.6	2.68	2.43
7	2.85	2.6	4.43	4.27	6.15	2.18	1.6	1.77	1.27	1.52	2.6	2.43
8	.....	2.6	3.52	4.6	6.18	2.18	2.1	1.6	1.27	1.52	2.43	2.35
9	2.85	2.6	3.93	.....	5.43	2.18	2.45	1.6	1.27	1.52	2.28	2.35
10	2.85	2.6	3.77	5.68	5.43	2.1	2.77	1.52	1.27	1.52	2.18	.....
11	2.6	2.43	3.6	5.43	4.81	2.0	2.52	1.6	1.27	1.43	2.18	2.27
12	2.6	.....	.....	4.85	4.84	1.85	2.1	1.68	1.27	1.43	1.9	2.27
13	2.6	2.43	4.1	4.18	4.84	1.85	1.93	1.75	1.27	1.43	1.6	8.27
14	2.6	2.27	5.85	4.68	4.5	1.85	1.85	1.77	1.27	1.43	1.68	4.6
15	.....	2.43	5.35	6.43	4.18	1.85	1.68	1.68	1.27	1.40	1.93	3.6
16	3.35	2.43	4.6	7.1	3.84	3.18	1.7	1.52	1.27	1.35	2.1	3.1
17	3.1	2.43	4.27	6.27	3.27	2.93	1.77	1.43	1.27	1.35	2.1	.....
18	3.1	2.43	3.85	6.6	3.27	2.5	2.1	1.43	1.27	1.43	2.1	2.93
19	2.85	.....	.....	7.35	3.35	2.1	1.93	1.43	1.27	1.6	.....	2.93
20	2.85	2.6	4.1	8 85	3.85	2.02	1.77	1.43	1.35	1.86	2.27	4.85
21	2.6	2.6	3.85	6.85	3.6	2.27	1.77	1.43	1.43	1.77	2.68	4.1
22	.....	2.77	3.85	7.1	3.35	2.02	1.77	1.35	1.68	1.7	2.43	3.6
23	2.6	2.85	3.85	8.43	3.27	1.93	1.9	1.43	1.6	1.6	2.43	3.18
24	2.6	2.85	3.85	10.6	3.18	1.35	2.02	1.43	1.55	1.6	2.43	.....
25	2.6	2.85	3.68	10.1	3.02	1.85	1.85	1.43	1.52	1.52	2.35	2.93
26	2.6	.....	.....	10.43	3.02	1.85	1.77	1.43	1.52	1.52	.....	2.93
27	2.6	2.85	3.68	11.35	2.93	1.85	2.35	1.43	2.77	1.52	2.1	2.6
28	2.6	3.1	3.68	9.68	3.18	1.77	2.18	1.43	2.52	1.77	2.1	2.43
29	.....	.....	3.93	9.85	3.43	1.85	1.85	1.43	2.1	3.05	2.1	2.43
30	2.6	.....	5.6	9.6	3.1	1.93	1.8	1.43	1.85	4.35	2.02	2.43
31	2.6	.....	5.43	.....	3.02	.....	1.77	1.43	.....	3.02	....	.....

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.—*Continued.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1900												
1	2.1	3.35	9.1	.....	8.02	3.69	1.8	1.6	1.44	1.94	1.86	3.43
2	2.1	3.43	9.93	8.02	6.1	3.52	1.85	1.6	1.43	1.85	1.85	.....
3	2.1	3.43	11.1	8.27	5.85	3.55	1.77	1.6	1.43	1.77	1.85	3.1
4	2.1	.....	.....	8.35	8.52	3.6	1.77	1.6	1.43	1.68	1.85	8.02
5	2.85	3.43	9.52	8.1	6.18	3.35	1.68	1.55	1.43	1.68	1.85	4.1
6	2.35	3.85	8.85	7.52	5.48	7.18	1.68	1.52	1.44	1.77	1.78	3.1
7	.....	4.1	8.35	7.52	4.78	3.02	1.6	1.52	1.44	1.85	1.77	8.27
8	2.1	3.93	8.35	.....	4.52	2.86	1 65	1.6	1.43	1.93	2.18	2.94
9	2.1	3.93	8.27	5.27	4.85	2.94	1.68	1.68	1.43	3.68	7.43	.....
10	2.1	4.18	8.27	4.85	5.6	2.72	1.68	1.68	1.43	2.77	7.85	2.68
11	2.1	.....	.....	4.18	4.52	2.6	1.68	1.6	1.52	5.6	6.0	2.6
12	2.1	3.94	7.93	4.94	4.27	2.6	1.6	1.65	1.44	4.18	4.18	2.77
13	2.18	4.1	7.93	4.52	4.65	2.43	1.77	1.68	1.43	8.27	3.85	2.77
14	... ..	19.1	7.85	4.98	5.02	2.44	1.94	1.6	1.86	3.0	8.6	2.68
15	2.27	10.1	7.77	.....	6.85	3.02	1.85	2.85	1.43	2.77	3.27	2.35
16	2.27	8.27	7.68	5.94	8.27	2.6	1.77	2.02	1.4	8.02	8.1	.....
17	2.27	7.6	7.6	7.1	5.68	2.42	1.77	2.27	1.86	2.85	2.85	2.48
18	2.27	.....	.....	8.52	5.27	2.27	1.78	2.27	1.36	2.77	.....	2.43
19	2.27	8.77	7.35	11.43	4.94	2.1	1.68	2.1	1.86	2.6	2.77	2.6
20	2.27	8.77	7.52	18.6	10.48	2.27	1.68	1.93	1.43	2.52	4.18	2.6
21	7.1	8.6	7.52	11.68	6.93	2.02	1.68	1.85	1.44	2.4	6.1	2.52
22	5.68	8.6	7.43	11.15	5.68	1.93	1.68	1.77	2.6	2.27	6.93	2.52
23	5.02	8.6	7.43	10.6	5.1	2.1	1.68	1.68	2.22	2.18	4.85	.....
24	4.1	8.44	8.1	10.68	4.93	2.0	1.6	1.68	1.85	2.1	4.27	2.68
25	3 85	.....	.....	9.85	4.86	1.98	1.6	1.68	1.78	2.52	.....	5.93
26	3.77	11.35	7.93	7.77	4.6	1.98	8.1	1.68	1.68	2.35	4.68	4.85
27	3.6	9.85	7.93	6.93	4.42	1.85	2.27	1.68	1.68	2.27	5.77	4.68
28	.....	9.35	7.93	5.77	4.27	1.68	1.94	1.52	2.43	2.15	4.85	4.68
29	3.35	.....	7.93	5.9	3.85	1.77	1.8	1.52	2.1	2.02	4.1	4.52
30	3.27	.....	7.6	6.02	3.68	1.77	1.68	1.52	2.0	1.93	3.77	.....
31	3.43	.....	7.6	.....	3.6	.....	1.68	1.44	.....	1.93	.....	3.48

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER, AT PLYMOUTH, N. H.—*Continued.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1901												
1	3.27	2.27	2.35	4.1	5.77	4.93	2.1	3.1	1.85	1.93	2.1	.....
2	8.48	2.35	2.35	4.1	5.52	4.65	2.02	2.85	1.85	1.85	2 02	2.1
3	3.43	.....	.....	4.85	5.18	4.85	2.02	2.52	1.77	1.77	2 0	2.02
4	8.44	2.35	2.1	8.1	4.85	4.68	1 93	2.65	1.85	1.85	1.93	1.93
5	8.48	2.27	2.27	7.43	4.47	4.18	1.93	2.77	1.78	1.85	1.93	1.93
6	.....	2.1	2.18	6.18	4.1	3.85	2.02	2.27	1.77	1.8	1.93	1.86
7	3.1	2.1	2.18	9.1	8.85	8.52	2.8	2.6	1.68	1.77	1.85	1.85
	2.98	2.18	2.27	11.06	4.85	8.77	2.6	7.1	1.65	1.68	1.85	.....
9	2.85	2.18	2.27	8.78	4.68	3.8	2.27	4.27	1.6	1.85	1.93	2.1
10	2.77	.....	.....	7.52	4.52	8.85	2.27	8.93	1.6	1.78	1.85	2.6
11	2.68	2.18	2.85	7.18	6.55	8.6	2.1	3.5	1.6	1.68	1.77	4.85
12	2.68	2.27	8.85	6.85	6.83	8.27	2.1	8.1	1 6	1.68	1.93	4.43
18	.....	2.27	8.18	6.68	6.1	3.1	2.02	2.93	1.68	1.9	2.6	3.85
14	2.77	2.85	8.1	.....	5.52	2.85	1.98	2.85	1.85	2.1	2.85	8.35
15	2.68	2.35	8.1	7.85	4.77	2.77	1.94	2.68	1.95	5.6	2.27	.....
16	2.6	2.35	3.1	6.85	4.35	2.65	1.93	8.85	2.02	4.52	2.18	15.6
17	2.77	.....	.....	6.27	8.85	2.52	1.93	3.77	2.1	3.68	.....	6.6
18	2.85	2.27	3.02	7.85	3.77	2.85	2.6	8.2	2.1	3.1	2.02	4.1
19	8.48	2.27	2.98	6.6	6.95	2.27	3.02	2.68	2.02	2.77	1.94	4.1
20	.....	2.27	2.93	6.52	10.1	2.85	2.52	2.43	1.94	2.7	2.1	8.93
21	8.52	2.18	8.1	8.0	7.27	2.27	2.85	2.85	1.93	2.68	2.1	8.85
22	8.43	2.18	5.22	9.43	5.85	2.27	2.18	2.27	1.9	2.6	2.02	.....
23	8.27	2.18	7.1	10.85	4.77	2 45	2.02	2.27	1.85	2.35	2.02	4.02
24	3.1	.....	.....	8.68	4.77	2.6	1.93	2.18	1.78	2.27	.....	4.02
25	2.85	2 27	5.6	7.52	5.85	2.77	1.93	2.15	1.77	2.6	2.27	4.27
26	2.85	2.27	5.68	6.93	5.85	2.85	1.85	2.1	1.77	2.52	2.68	4.18
27	.....	2.43	7.48	6.1	6.6	2.85	1.85	2.1	1.68	2.4	2.85	3.93
28	2.68	2.43	9.52	6.0	6.6	2.18	2.7	2.02	1.68	2.27	2.18	8.6
29	2.6	.....	7.1	5.85	6.98	2.1	8.6	1.93	1.75	2.18	2.18	.....
30	2.6	.....	6.18	6.6	6.1	2.1	8.27	1.93	1.85	2 18	2.1	5.6
31	2.85	.....	.....	.....	5.18	.....	4.6	1.85	.....	2 1	.....	4.85

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER, AT PLYMOUTH, N. H.—*Continued.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902												
1	4.27	4.98	8.6	7.85	10.1	4.1	8.43	2.48	2.02	8.6	4.48	2.77
2	8.93	.....	.....	6.85	7.77	3.1	8.85	2.27	2.02	3.52	4.8	2.77
3	8.6	4.48	18.1	6.68	6.27	4.18	8.68	2.27	2.02	8.85	4.18	2.78
4	3.68	3.85	11.27	5.27	5.9	4.02	5.18	2.27	1.93	8 1	3.93	2.77
5	.....	3.77	6.1	4.77	5.52	4.1	4.43	2.48	2.48	3.1	8.85	2.68
6	3.77	3.6	5.35	.....	6.1	3.85	4.0	2.27	2.85	3.1	3.68	2.68
7	3.77	3.6	4.6	4.27	5.93	3.68	3.6	2.6	2.45	4.77	3.6	.....
8	3.68	3.52	4.18	4.18	5.6	4.35	3.85	2.52	2.52	3.77	3.52	2.68
9	3.68	.....	.....	4.1	5.1	5.02	3.1	2.68	2.52	3.85	3.35	2.6
10	3.68	3.48	3.02	7.1	4.43	4 27	3.02	2.55	6.1	3.18	3.18	2.6
11	3.68	3.27	3.85	5.68	4.1	3.93	3.35	2.48	4.6	3.18	3.18	2.6
12	.....	3.18	3.6	5.18	3.77	3.6	3.18	3.1	3.18	3.1	3.1	2.52
13	3.52	3.18	6.48	.....	3.1	3.52	3.05	3.35	2.85	3.02	3.18	2.52
14	3.43	3.18	7.6	4.85	3.1	3.52	2.98	3.02	3.4	3.02	3.77	.....
15	3.86	3.1	5.93	4.43	2.98	3.5	3.85	3.18	3.93	2.93	3.6	2.52
16	3.85	.....	.....	4.1	2.77	3.48	3.6	2.68	3.85	2.98	.....	2.44
17	3.27	3.1	7.27	4.1	2.27	7.1	3.35	2.55	3.18	2.85	3.48	4.68
18	3.18	3.1	9.68	4.1	2.1	4.85	3.18	2.48	2.85	2.68	3.65	7.1
19	.....	3.1	6.02	4.02	1.93	4.27	3.1	3.35	2.52	4.05	3.27	5.02
20	3.02	3.02	5.18	4.2	3.1	3.68	3.4	3.35	3.93	5.43	3.18	4.6
21	3.02	2.98	5.18	4.35	3.1	3.43	3.68	2.27	3.68	4.6	3.18	.....
22	3.48	2.93	6.1	4.52	3.02	3.65	3.52	2.77	3.48	4.1	3.18	5.18
23	9.52	.....	.....	5.18	2.77	3.85	3.85	2.6	2.93	3.68	.....	4.85
24	6.1	2.98	6.48	6.27	2.68	3.85	3.77	2.45	2.77	3.48	3.1	7.43
25	4.6	2.85	5.85	5.1	3.65	3.18	3.77	2.27	2.6	3.85	2.93	5.93
26	.....	2.77	5.02	5.68	4.6	4.1	3.27	2.18	2 48	3.25	2.94	.....
27	4.85	2.77	4.98	6.4	7.1	6.02	3.1	2.18	2.35	3.18	2.98	6.02
28	5 1	4 1	4.98	7.1	10.1	4.52	2.93	2.1	2.95	9.1	2.98	.....
29	5.02	.....	6.43	5.6	3.6	4.0	2.85	2.1	3.52	18.1	2.85	5.77
30	5.18	.....	.....	5.77	6.6	3.43	2.77	2.1	4.02	7.52	....	5.85
31	5.18	.....	3.52	.....	5.1	.....	2.6	2.05	.....	5.85	.....	5.27

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER, AT PLYMOUTH, N. H.—*Continued.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908 1	5.02	.....	.....	7.52	5.52	2.18	2.85	2.48	2.27	1.75	2.2	1.8
2	4.85	4.85	8.48	5.35	4.85	2.1	2.68	2.85	2.18	1.62	2.1	1.75
3	4.77	4.77	6.6	5.27	4.35	2.1	2.6	2.27	2.18	1.52	2.1	1.7
4	....	4.77	6.02	6.85	8.85	2.1	2.48	2.18	1.9	1.45	2.05	1.72
5	4.85	4.68	5.98	.....	4.02	2.02	2.35	2.18	1.92	1.62	2 0	1.7
6	4.77	4.6	5.77	5.68	8.77	2.02	2 27	2.18	1.9	1.78	2.85	1.75
7	4.6	4.43	5.68	5.35	3.68	2 02	2.27	2.85	2.02	1.98	2.52	1.78
8	4.52	.....	.....	5.35	3.68	2.02	2.18	2.27	2.05	1.82	2.85	1.8
9	4.43	4.48	8.6	6.02	8.98	2.48	2.18	2.2	1.9	2.2	2.15	1.75
10	4.43	4.85	11.52	6.1	8.9	2.52	2.1	2.18	1.9	2.78	2.05	1.8
11	.....	4.27	12.1	5.18	3.85	2.85	2.1	2.18	1.78	2.4	2.1	1.82
12	4.27	4.1	16.6	.....	8.6	2.86	2.1	3.52	1.82	2.2	2.0	1.8
13	4.18	4.27	9.1	4.93	3.6	9.43	2.1	8.35	1.6	2.1	1.98	1.9
14	4.18	5.27	8.52	4.77	3.85	7.5	2.1	3.18	1.62	2.1	1.9	2.42
15	4.1	.....	.....	4.68	8.27	5.52	2.02	2.93	1.6	2.0	1.95	2.55
16	4.1	4.85	6.68	4.6	8.27	4.85	1.94	2.8	1.52	1.88	1.9	2.48
17	4.1	4.77	5.85	4.6	8.1	8.85	1.94	2.68	1.42	1.88	2.02	2.4
18	.....	4.77	6.27	4.48	2.93	8.85	2.18	2.52	1.72	8.65	2.42	2.22
19	4.02	4.68	6.18	8.2	2.85	3.85	2.15	2.43	2.1	8.65	2.6	2.28
20	3.93	4.6	8.48	2.02	2.85	3.1	2.1	2.43	2.0	2.78	2.45	2.9
21	4.6	4.43	12.18	8.85	2.77	5.85	4.93	4.27	1.82	2.58	2.1	a 6.4
22	4.35	.....	.....	8.77	2.6	8.6	4.02	8.18	1.72	2.48	2.1	7.18
23	4.1	4.35	8.52	3.68	2.52	5.68	8.52	2.85	1.65	2.3	2.05	6.52
24	4.1	3.93	10.27	3.6	2.5	4.52	8.18	2.52	1.62	2.38	2.15	6.48
25	.....	3.77	10.93	8.48	2.48	3.68	2.93	2.43	1.58	2.3	2.38	6.82
26	4.18	3.68	8.68	8.5	2.35	4.02	2.75	2.35	1.52	2.12	2.3	6.0
27	4.18	8.6	6.6	8.52	2.1	8.52	2.6	2.85	1.45	2.15	1.9	5.9
28	4.1	4.1	6.27	8.52	2.1	8.25	2.52	2.27	1.5	2.05	1.78	5.8
29	4.1	.....	.....	3.35	2.1	8.18	2.35	2.85	1.82	1.95	1.7	5.65
30	4.27	.....	4.98	5.1	2.27	2.98	2.52	2.55	1.78	2.1	1.8	5.4
31	4.52	.....	4.68	.....	2.2	.....	2.52	2.25	.....	2.1	.....	5.2

a River frozen December 21 to 31, 1903.

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.—*Continued.*

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904												
1	5.2	*e*3.9	.....	.....	8.85	2.85	2.05	1.78	1.82	5.55	2.82	2.2
2	5.15	.....	.....	6.7	7.85	2.8	3.0	1.88	1.9	4.55	2.72	2.2
3	.....	.....	.....	.....	6.88	2.62	3.0	1.98	1.72	8.9	2.7	2.2
4	*a*4.75	.....	*f*4.65	.....	7.12	2.48	2.55	2.48	2.2	3.5	2.62	1.75
5	.....	*e*8.65	.....	*k*6.12	7.8	2.4	2.1	1.98	2.35	8.2	2.55	2.2
6	.....	.....	.....	8.42	6.75	2.72	2.06	1.98	1.9	3.05	2.5	1.9
7	.....	.....	*g*4.6	5.8	5.8	2.98	2.01	1.8	1.9	2.9	2.5	2.0
8	*b*8.9	*e*4.25	.....	5.5	6.0	8.2	1.85	1.82	1.98	2.88	2.4	2.0
9	.....	.....	*g*8.6	7.2	5.68	3.15	1.88	1.72	1.8	2.7	2.85	1.95
10	.....	.....	.....	9.4	6.45	2.78	1.8	1.7	1.8	2.75	2.2	2.05
11	*c*4.2	.... .	.....	7.88	8.25	2.55	1.78	1.7	1.45	2.82	2.15	1.95
12	.....	*f*3.3	*h*6.7	6.45	6.45	2.85	1.72	2.1	1.8	2.95	2.2	2.0
13	.....	.....	.....	5.55	5.28	2.82	1.82	2.05	1.62	2.82	2.1	1.8
14	.....	.....	*h*6.65	4.78	4.82	2.25	1.92	1.65	1.62	2.88	2.4	2.0
15	*d*4.4	*f*4.1	..... .	4.48	4.7	2.15	1.82	1.8	4.65	2.72	2.1	1.9
16	.....	.....	.....	4.18	8.02	2.0	1.72	2.0	4.82	2.6	2.2	1.9
17	.....	.....	.....	3.95	9.9	1.88	1.7	1.98	8.4	2.5	2.0	2.0
18	*d*4.8	.....	.....	8.8	6.28	1.95	1.62	1.92	2.95	2.85	2.15	1.9
19	.....	*f*4.15	*i*4.8	4.05	6.82	1.9	1.68	1 9	2.6	2.5	2.15	2.1
20	.....	.....	.....	4.28	9.5	1.9	1.6	2.3	2 5	2.85	2.2	2.05
21	.....	.....	.....	3.92	6.62	1.95	1.62	6.62	2.8	8.2	2.85	2.05
22	*d*4.1	*g*4.2	*j*5.1	3.92	5.4	2.0	1.58	8.8	2.85	7.88	2.6	1.9
23	.....	.....	.....	4.32	4.75	2.12	1.52	3.22	2.48	5.6	2.4	1.9
24	.....	.....	.....	5.25	4.35	2.0	1.45	2.85	2.4	3.88	2.2	2.05
25	*d*4.2	..... .	.....	6.7	3.98	1.98	1.58	2.5	5.3	3.42	2.2	2.2
26	.....	.....	8.3	7.52	3.8	1.95	1.58	2.32	8.75	3.35	2.3	2.1
27	.....	*g*4.5	12.45	7.28	8.48	1.9	1.98	2.2	3.72	4.28	2.45	2.15
28	.....	.....	.....	7.82	3.42	1.88	2.5	2.0	8.2	3.62	2.45	2.8
29	*d*4.8	*f*4.55	10.0	8.88	3.3	1.92	2.05	1.9	3.0	8.25	2.4	2.3
30	.....	.....	.....	9.68	3.08	1.98	2.32	1.85	7.22	3.15	2.3	2.8
31	.....	.....	8.4	.....	2.95	.....	1.85	1.85	.....	2.98	.....	2.25

See note on next page.

NOTE.—River frozen January 1 to April 4, 1904. Readings are to the surface of the water in a hole cut in the ice. The following additional data was obtained during 1904:

Date.	Thickness of ice.	Date.	Thickness of ice.
1904.	*Feet.*	1905.	*Feet.*
a January 4	1.4	*i* March 19	2.3
b January 8	1.5	*j* March 22	2.2
c January 11	1.55	*k* April 5 ice went out.	
d January 15, 18, 22, 25 and 29	1.6		
e February 1, 5 and 8	1.65		
f February 12, 15, 19 and 29, and March 4	1.7		
g February 22 and 27 and March 7 and 9	1.8		
h March 12 and 14	2.8		

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.—*Continued.*

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905 1	2.2	.....	.....	7.55	4.4	2.6	2.3	4.85	3.6	2.35	2.0	2.65
2	2.22	*e*3.1	*i*3.1	5.6	3.9	2.4	2.3	3.3	3.3	2.2	2.2	2.3
3	2.32	.....	.....	4.6	3.6	2 35	6.0	2.3	4.3	2.3	2.0	3.6
4	2.42	.....	.....	4.4	4.2	2.4	4.05	2.5	3.3	2.25	2.15	6.3
5	2.5	.....	.....	4.2	4.3	2.35	3.3	2.3	7.15	2.2	2.4	4.15
6	.....	.....	.....	5.7	4.0	3.3	2.95	2.15	5.2	2.15	2.45	3.75
7	.....	.....	.....	6.3	5.15	3.6	2.8	2.1	4.25	2.0	2.5	3.3
8	*a*3.4	.....	.....	5.05	4.75	3.05	2.6	2.1	3.6	2.0	2.6	3.1
9	4.1	*f*2.35	*j*2.35	4.6	4.1	2.9	2.4	2.0	3.25	2.05	2.55	2.9
10	4.25	.....	.....	4.6	4.0	2.6	2.4	2.1	2.9	2.0	2.4	2.65
11	4.02	.....	.....	5.65	3.6	2.4	2.2	1.9	2.6	1.9	2.3	1 3
12	.....	.....	.....	5.3	3.4	2.7	2.15	1.9	3.0	3.1	2.25	3.45
13	.....	.....	.....	5.6	3.3	4.55	2.5	1.3	4.3	3.65	2.25	3 45
14	.....	.....	.....	5.1	3.2	3.6	2.25	1.9	3.4	3.9	2.3	3.0
15	3.7	.....	.....	5.0	3.2	3.1	2.25	1.3	2.9	3.4	2.2	3.1
16	.....	*g*3.25	*k*2.65	4.35	3.7	2.3	2.1	2.25	2.7	2.7	2.2	3.4
17	.....	.....	.....	4.0	3.55	2.6	2.0	3.3	2.6	2.3	2.1	3.6
18	.....	.....	.....	3.65	3.3	2.5	2.3	2.5	6.2	2.15	1.95	3.5
19	*b*3.2	.....	.....	3.4	3.35	2.4	2.1	2.2	3.15	2.3	1.35	3.4
20	.....	.....	.....	3.35	3.6	2.3	2.5	1.9	5.1	2.65	1.3	3.3
21	.....	.....	4.35	4.05	3.3	2.35	2.2	1.9	5.65	2.9	2.05	3.1
22	*c*3.2	.....	.....	6.9	3.1	3.35	2.05	1.75	4.35	2.65	2.2	3.1
23	.....	*h*2.95	4.15	5.2	2.9	3.1	1.35	1.3	3.6	2.4	1.95	3.1
24	.....	.....	.....	4.4	2.3	2.7	1.35	1.7	3.3	2.35	1.95	3.0
25	.....	.....	3.9	4.3	2.65	2.45	1.9	1.7	3.05	2.15	2.0	2.3
26	*d*3.25	.....	3.6	4.15	2.6	2.95	1.75	1.7	3.0	2.15	2.1	2.9
27	.....	.....	9.15	4.5	2.35	6.3	1.3	2.2	2.35	2.2	2.45	2.75
28	.....	.....	13.1	4.7	2.9	4.25	1.3	2.3	2.7	1.35	2.2	2.7
29	.....	.....	11.35	4.7	2.75	3.6	1.3	2.35	2.6	1.95	2.4	2.7
30	.....	.....	8.65	4.5	2.7	3.1	1.7	2.0	2.5	1.9	5.0	4.0
31	.....	.....	9.25	.....	2.7	.....	5.3	4.0	.....	2.05	.....	3.75

See note on next page.

NOTE.—River frozen January 5 to March 28, 1905. Ice jam in latter part of March affected gage heights. Ice went out March 28. Readings are to the surface of the water in a hole cut in the ice, except January 15 and March 21, when readings were taken to the top of the ice. The following comparative readings were taken during 1905:

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Water surface.	Top of ice.	Thickness of ice.
1905.	*Feet.*	*Feet.*	*Feet.*	1905.	*Feet.*	*Feet.*	*Feet.*
b January 19..	3.2	3.3	0.6	*g* February 16.	3.25	3.5	1.3
c January 22...	3.2	3.3	.7	*h* February 23.	2.95	3.15	1.3
d January 26..	3.25	3.4	1.0	*i* March 2.....	3.1	3.3	1.3
e February 2..	3.1	3.3	1.1	*j* March 9.....	2.35	3.0	1.4
f February 9...	2.35	3.0	1.2	*k* March 16....	2.65	2.35	1.0

a January 3, water on top of ice.

DAILY GAGE HEIGHT, IN FEET, OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.—*Concluded.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1906 1	3.4	3.0	3.4	3.1	4.8	4.4	3.85	2.8	1.6
2	3.2	2.9	3.55	2 9	4.8	4.05	2.9	2.4	1.55
3	2.85	2.8	2.8	3.0	4.9	4.1	2.6	2 2	1.5
4	2.9	3.15	2.75	3.3	5.2	3.7	2.65	2.1	1.6
5	3.5	3.45	2.8	3.55	4.9	3.4	3.8	1.95	1.7
6	3.5	3.55	2.9	4.7	4.7	3.85	2.8	1.85	1.55
7	3.2	3.4	2.7	3.7	4.45	5.3	2.45	1.8	1.5
8	2.9	3.5	2.5	3.85	4.1	4.7	2.3	1.7	1.5
9	2.8	3.5	2.35	3.3	4.4	4 75	2.2	1.75	1.45
10	3.0	3.7	2.25	3.1	6.6	4.0	2.3	1.7	1.5
11	3.0	3.3	2.2	3.1	5.0	3.85	2.2	1.7	1.4
12	3.1	3.4	2.1	3.25	4.6	3.4	2.1	1.7	1.4
13	2.85	3.4	2.2	3.85	6.2	3.15	2.0	1.65	1.5
14	3.05	3.35	2.15	4.15	5.5	3.0	1.9	1.7	1.5
15	2.8	3.3	2.4	9.0	4.5	2.75	1.85	1.6	1.45
16	2.85	3.2	2.15	12.85	4.3	2.6	1.8	1.55	1.5
17	3.05	3.15	2.0	3.85	4.5	2.65	1.9	1.5	1.4
18	2.9	3.15	1.9	7.8	5.85	3.7	2.1	1.5	1.4
19	2.8	3.1	2.8	6.9	5.05	3.2	1.9	1.45	1.4
20	2.7	3.1	2.2	6.6	4.2	2.8	1.8	1.4	1 8
21	2.75	3.0	2.0	7.1	3.7	2.55	1.8	1.45	1.8
22	3.25	3.1	1.9	7.2	3.5	2.4	2.8	1.5	1.25
23	6.05	3.6	1.85	6.2	3.2	2.7	2.2	1.4	1.8
24	10.75	3.3	1.7	4.95	3.3	5.1	1.9	1.5	1.4
25	6.25	3.1	1.85	4.25	3.9	3.3	1.9	1.6	1.8
26	4.75	2.9	1.9	4.0	4.2	3.5	1 8	1.5	1.3
27	4.25	3.85	1.95	4.0	5.6	2.85	1.7	1.55	1.3
28	3.75	3.2	2.6	4.05	11.45	2.6	1.7	3.65	1.3
29	3.85	.....	3.3	3.9	9.75	2.55	1.7	2.3	1.4
30	2.9	.....	4.1	4.85	6.6	2.3	2.7	1.3	1.3
31	3.1	.....	3.3	.....	5.2	.....	4.2	1.7	.....

See note on next page.

NOTE.—The following ice conditions prevailed during 1906. River frozen over part of time, in left channel only, January 1 to 23; ice went out January 23. During February left channel near gage was frozen over; right channel near gage was open for a width of about 70 feet; open water strip extended upstream nearly to Baker's River, and some 500 feet downstream from gage. During March the open water strip in right channel narrowed down to 60 feet width, and extended but a short distance above and below the gage. Ice began to wear away again about March 24, and went out completely April 6 during the morning. During the frozen season gage readings are to surface of water, the gage being over the right channel, which remained open. The average thickness of ice for the left channel and for the frozen portion near the gage upstream and downstream was as follows:

Date.	Thickness of ice.	Date.	Thickness of ice.
	Feet.		*Feet.*
February 7	0.8	March 3	0.9
February 17	0.7	March 10	0.9
February 24	0.7	March 17	1.1

RATING TABLE FOR PEMIGEWASSET RIVER AT PLYMOUTH, N. H., FROM SEPTEMBER 5, 1903, TO DECEMBER 31, 1904.a

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*
1.25	117	2.70	780	4.90	2,860	8.20	8,870
1.30	124	2.80	860	5.00	2,980	8.40	8,770
.....	.....	2.90	940	5.10	3,100	8.60	9,170
1.40	140	3.00	1,020	5.20	3,220	8.80	9,570
.....	.....	3.10	1,110	5.30	3,350	9.00	9,970
1.50	160	3.20	1,200	5.40	3,480	9.20	10,370
.....	.....	3.30	1,290	5.50	3,620	9.40	10,790
1.60	185	3.40	1,380	5.60	3,770	9.60	11,210
.....	.....	3.50	1,470	5.70	3,920	9.80	11,680
1.70	215	3.60	1,560	5.80	4,080	10.00	12,050
.....	.....	3.70	1,650	5.90	4,240	10.50	13,100
1.80	250	3.80	1,740	6.00	4,400	11.00	14,150
.....	.....	3.90	1,830	6.20	4,720	11.50	15,200
1.90	290	4.00	1,920	6.40	5,060	12.00	16,250
.....	.....	4.10	2,020	6.60	5,400	12.50	17,300
2.00	340	4.20	2,120	6.80	5,750	13.00	18,350
2.10	395	4.30	2,220	7.00	6,110	14.00	20,450
2.20	455	4.40	2,320	7.20	6,470	15.00	22,550
2.30	515	4.50	2,420	7.40	6,830	16.00	24,650
2.40	575	4.60	2,530	7.60	7,210	17.00	26,750
2.50	640	4.70	2,640	7.80	7,590	18.00	28,850
2.60	710	4.80	2,750	8.00	7,970	.....	....

The above table is applicable only for open-channel conditions. It is based on fifteen discharge measurements made during 1903 and 1904. It is well defined between gage heights 1.6 and 6.7 feet. Above 6.7 feet the curve depends on one measurement at 10.8 feet. Above gage height 9.2 feet the rating curve is a tangent, the difference being 210 per tenth.

a The above table has been assumed to apply to the gage height records of this station from January 1, 1886, to September 4, 1903. In view of change in rating time during 1905 (see rating table for 1905-'06) this assumption may be considerably in error previous to 1903.

RATING TABLE FOR PEMIGEWASSET RIVER AT PLYMOUTH, N. H., FROM JANUARY 1, 1905, TO DECEMBER 31, 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*
.....	.....	2.00	465	3.00	1,190	4.00	2,180
.....	.....	2.10	525	3.10	1,275	4.10	2,235
.....	.....	2.20	585	3.20	1,365	4.20	2,340
1.25	170	.....	.....	.....	.....	.....	....
1.30	183	2.30	650	3.30	1,455	4.30	2,445
1.40	211	2.40	720	3.40	1,545	4.40	2,555
1.50	248	2.50	790	3.50	1,640	4.50	2,665
1.60	278	2.60	865	3.60	1,735	4.60	2,780
1.70	317	2.70	945	3.70	1,830	4.70	2,895
1.80	361	2.80	1,025	3.80	1,930	4.80	3,010
1.90	410	2.90	1,105	3.90	2,030	4.90	3,130

RATING TABLE FOR PEMIGEWASSET RIVER AT PLYMOUTH, N. H., FROM JANUARY 1, 1905, TO DECEMBER 31, 1906.—*Concluded.*

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*
5.00	3,250	6.00	4,590	7.00	6,185	8.00	7,970
5.10	3,875	.....	.....	.....	.....	.....	.....
5.20	3,500	6.20	4,890	7.20	6,525	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
5.80	3,630	.....	.....	.....	.....	.....	.....
5.40	3,760	6.40	5,200	7.40	6,875	.....	.....
5.50	3,895	.....	.....	.....	.....	.....	.....
5.60	4,030	6.60	5,520	7.60	7,230	.....	.....
5.70	4,165	.....	.....	.....	.....	.....	.....
5.80	4,305	6.80	5,850	7.80	7,595	.....	.....
5.90	4,445	.....	.....	.....	.....	.....	.....

The above table is applicable only for open-channel conditions. It is based on twelve discharge measurements made during 1905 and 1906, and the form of the 1904 rating curve. It is well defined. Above 8.00 feet use 1904 rating table.

ESTIMATED MONTHLY DISCHARGE OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.

(Drainage area, 615 square miles.)

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1886.							
April 15-30	18,810	2,605	7,247	11.78	6.57	.....	.....
May	4,975	1,182	2,834	8.80	4.88	.....	.....
June	2,850	598	1,085	1.76	1.96	.....	.....
July	1,718	895	551	.896	1.04	.....	.....
August	1,407	805	475	.772	.890	.....	.....
September	2,896	185	540	.878	.980	.....	.....
October	2,070	850	658	1.06	1.22	.....	.....
November 1-15	8,770	964	1,828	2.97	1.66	.....	.....
1887.							
April 15-30	15,720	2,717	7,295	11.86	6.62	.....	.....
May	16,460	2,190	6,871	11.17	12.88	.....	.....
June	20,450	766	3,006	4.89	5.46	.....	.....
July	8,970	766	2,002	3.26	3.76	.....	.....
August	2,020	598	1,040	1.69	1.95	.....	.....
September	900	850	565	.919	1.08	.....	.....
October	1,268	350	473	.769	.887	.....	.....
November 1-15	497	350	413	.672	.872	.....	.....

ESTIMATED MONTHLY DISCHARGE OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.

(Drainage area, 615 square miles.)

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1888.							
April 15-30	22,760	1,858	5,309	8.64	4.82	.....	.....
May	20,140	8,415	8,756	14.24	16.42	.....	.....
June	5,400	850	1,887	3.04	8.89	107	8.17
July	1,632	850	697	1.18	1.30	82	1.58
August	2,020	805	684	1.11	1.28	33	8.91
September	7,685	350	1,816	2.95	8.29	41	8.06
October	6,290	1,835	2,729	4.44	5.12	99	5.18
November 1-15	7,020	1,857	3,066	4.99	2.78	.....	a5.28
December	.....	.....	.....	.....	.....	.....	2.28
The period	.....	.....	.....	.....	.....	.....	29.46
1889.							
January	.....	.....	.....	.....	.....	.....	4.29
February	.....	.....	.....	.....	.....	.....	2.86
March	.....	.....	.....	.....	.....	.....	2.24
April 15-30	8,870	2,350	5,315	8.64	4.82	.....	a1.60
May	7,400	964	2,092	3.40	3.92	180	2.21
June	11,210	554	2,183	3.55	3.96	86	4.61
July	7,495	545	1,700	2.76	3.18	68	4.67
August	7,875	350	1,862	2.21	2.55	80	3.17
September	7,020	289	1,077	1.75	1.95	42	4.63
October	8,670	654	2,018	3.28	3.78	91	4.14
November 1-15	2,190	1,110	1,548	2.52	1.40	.....	a4.66
December	.....	.....	.....	.....	.....	.....	5.09
The year	.....	.....	.....	.....	.....	.....	44.17

a Rainfall for complete month.

ESTIMATED MONTHLY DISCHARGE OF PEMIGEWASSET RIVER, AT PLYMOUTH, N. H.—*Continued.*

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1890.							
January							3.85
February							4.82
March							4.41
April 15-30	8,970	8,620	5,714	9.29	5.18		a 2.19
May	17,510	2,270	6,619	10.76	12.41	200	6.24
June	3,770	720	1,690	2.75	3.07	100	2.95
July	7,495	395	1,154	1.88	2.17	49	4.46
August	10,680	270	1,671	2.72	3.14	56	5.60
September	15,410	900	3,302	5.87	5.99	110	5.63
October	7,210	964	2,101	3.42	3.94	80	4.93
November 1-15	1,857	1,110	1,360	2.21	1.24		a 2.05
December							3.94
The year							51.07
1891.							
January							6.09
February							3.85
March							3.85
April 15-30	15,410	3,100	8,380	13.63	7.60		a 2.31
May	4,560	1,335	2,705	4.40	5.07	220	2.28
June	2,350	493	1,190	1.93	2.15	75	2.86
July	3,415	305	783	1.27	1.46	26	5.58
August	3,100	270	809	1.32	1.52	29	5.29
September	1,335	185	515	.837	.934	76	1.23
October	593	165	234	.380	.438	26	1.66
November 1-15	1,940	145	421	.685	.382		a 3.26
December							5.45
The year							43.21

a Rainfall for complete month.

ESTIMATED MONTHLY DISCHARGE OF PEMIGEWASSET RIVER, AT PLYMOUTH, N. H.—*Continued.*

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1892.							
January							5.01
February							1.93
March							1.67
April 15-30	2,618	900	1,467	2.89	1.83		a 1.04
May	7,020	1,407	8,277	5.88	6.18	110	5.53
June	10,170	497	2,290	3.72	4.15	61	6.76
July	9,670	270	1,695	2.76	3.18	190	1.66
August	6,290	185	1,211	1.97	2.27	21	10.85
September	9,670	850	1,029	1.67	1.86	170	1.10
October	710	827	466	.755	.870	46	1.90
November 1-15	8,920	545	1,885	2.25	1.25		a 4.29
December							.95
The year							42.69
1893.							
January							2.48
February							5.73
March							2.78
April 15-30	5,280	2,020	2,923	4.75	2.65		a 2.42
May	17,200	1,488	7,117	11.57	13.34	290	4.61
June	2,805	895	958	1.56	1.74	91	1.92
July	395	165	241	.392	.452	20	2.27
August	6,925	165	692	1.13	1.30	22	8.01
September	1,560	270	619	1.01	1.13	59	1.92
October	6,925	270	1,648	2.68	3.09	57	5.46
November 1-15	1,785	497	864	1.41	.787		a 2.57
December							4.02
The year							42.19

a Rainfall for complete month.

ESTIMATED MONTHLY DISCHARGE OF PEMIGEWASSET RIVER, AT PLYMOUTH, N. H.—*Continued.*

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1894.							
January							2.01
February							2.75
March							1.84
April 15-30	18,560	2,305	6,513	10.59	5.91		*a* 1.67
May	14,680	654	2,519	4.10	4.73	110	4.36
June	6,290	497	1,380	2.24	2.50	68	3.70
July	766	165	419	.681	.785	32	2.43
August	270	145	170	.276	.318	10	3.12
September	4,400	145	593	.972	1.08	25	4.32
October	2,530	209	685	1.03	1.19	31	3.88
November 1-15	4,560	545	1,387	2.17	1.21		*a* 2.27
December							1.88
The year							34.18
1895.							
January							2.47
February							.30
March							1.66
April 15-30	13,730	3,415	6,432	10.46	5.84		*a* 7.21
May	6,290	710	2,313	3.76	4.33	180	2.46
June	1,785	395	845	1.37	1.53	41	3.75
July	710	209	388	.631	.728	23	3.12
August	1,182	239	469	.763	.880	22	3.99
September	710	185	294	.478	.533	15	3.53
October	2,190	305	677	1.10	1.27	64	2.00
November 1-15	5,400	545	1,457	2.37	1.32		*a* 5 26
December							5.52
The year							41.27

a Rainfall for complete month.

ESTIMATED MONTHLY DISCHARGE OF PEMIGEWASSET RIVER, AT PLYMOUTH, N. H.—*Continued.*

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1896.							
January							.39
February							5.51
March							7.83
April 15-30	18,560	2,530	7,986	12.99	7.25		*a* .94
May	2,618	593	1,358	2.21	2.55	150	1.69
June	1,632	239	716	1.16	1.29	96	1.34
July	3,285	185	497	.808	.932	82	2.92
August	1,335	239	493	.802	.925	25	8.61
September	6,290	270	1,298	2.11	2.35	42	5.55
October	11,210	545	1,738	2.83	8.26	64	5.09
November 1-15	19,610	900	3,560	5.79	8.23		*a* 5.26
December							1.07
The year							41.20
1897.							
January							8.27
February							2.79
March							3.49
April 15-30	13,840	3,220	7,497	12.19	6.80		*a* 1.60
May	22,240	1,835	4,085	6.64	7.66	167	4.57
June	13,420	900	2,658	4.32	4.83	88	5.49
July	30,640	654	8,878	6.81	7.27	107	6.77
August	1,335	395	698	1.18	1.80	51	2.53
September	443	185	259	.421	.470	51	.92
October	2,580	165	868	.590	.680	36	1.87
November 1-15	5,840	209	1,493	2.48	1.86		*a* 5.17
December							4.80
The year							43.27

a Rainfall for complete month.

ESTIMATED MONTHLY DISCHARGE OF PEMIGEWASSET RIVER, AT PLYMOUTH, N. H.—*Continued.*

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1893.							
January							5.38
February							3.56
March							1.26
April 15-30	11,420	3,100	5,395	8.77	4.89		a 2.83
May	14,360	2,020	3,460	5.63	6.49	220	2.90
June	4,160	710	1,517	2.47	2.76	95	2.92
July	654	156	290	.472	.544	23	2.31
August	766	145	302	.491	.566	11	5.29
September	1,182	145	341	.554	.618	14	4.47
October	7,685	270	1,122	1.82	2.11	53	3.98
November 1-15	2,340	654	1,147	1.87	1.04		a 3.64
December							1.72
The year							40.26
1899.							
January							2.83
February							2.06
March							5.70
April 15-30	14,880	4,805	9,448	15.36	8.57		a 1.77
May	16,140	964	3,680	5.98	6.89	590	1.17
June	1,182	239	458	.745	.831	30	2.74
July	836	185	317	.516	.595	17	3.44
August	497	132	197	320	.369	13	2.87
September	836	120	193	.315	.351	12	3.09
October	2,270	132	307	.499	.575	33	1.78
November 1-15	3,220	185	788	1.28	.713		a 1.54
December							1.78
The year							30.77

a Rainfall for complete month.

ESTIMATED MONTHLY DISCHARGE OF PEMIGEWASSET RIVER, AT PLYMOUTH, N. H.—*Continued.*

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1900.							
January							4.36
February							6.44
March							4.75
April 15-30	19,610	4,000	9,370	16.05	9.25		a .65
May	13,000	1,560	3,953	6.42	7.40	430	1.72
June	6,470	209	900	1.46	1.63	67	2.44
July	1,110	135	263	.428	.493	16	3.22
August	900	147	250	.407	.469	19	2.42
September	710	134	215	.350	.390	24	1.61
October	3,770	209	730	1.19	1.37	35	3.94
November 1-15	7,685	239	1,866	3.03	1.69		a 6.15
December							.97
The year							39.17
1901.							
January							1.52
February							.42
March							4.30
April 15-30	12,730	4,160	6,706	10.90	6.03		a 4.43
May	12,260	1,713	3,395	6.33	7.30	134	5.44
June	2,396	395	1,170	1.90	2.12	121	1.75
July	2,530	270	571	.928	1.07	16	6.79
August	6,290	270	1,016	1.65	1.90	43	4.37
September	395	135	259	.421	.470	19	2.42
October	3,770	209	660	1.07	1.23	90	1.37
November 1-15	710	239	361	.587	.327		a 1.77
December							6.20
The year							41.33

a Rainfall for complete month.

ESTIMATED MONTHLY DISCHARGE OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.—*Continued.*

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1902.							
January							2.27
February							1.88
March							4.37
April 15-30	6,290	1,940	3,266	5.81	2.96		*a*3.41
May	12,260	305	3,377	5.49	6.33	210	3.02
June	6,290	1,110	2,044	3.82	3.70	82	4.52
July	3,220	710	1,431	2.38	2.69	84	3.20
August	1,385	365	696	1.18	1.30	34	3.86
September	4,560	305	1,128	1.88	2.04	36	5.72
October	18,560	766	2,588	4.18	4.76	110	4.27
November 1-15	2,350	1,110	1,617	2.63	1.47		*a*1.16
December							5.22
The year							42.85
1903.							
January							3.92
February							3.14
March							5.29
April 15-30	3,100	350	1,729	2.81	1.56		*a*1.33
May	3,620	395	1,285	2.09	2.41	1,600	.15
June	10,900	350	2,099	3.41	3.80	60	6.34
July	2,396	310	725	1.18	1.36	31	4.44
August	2,190	443	758	1.23	1.42	43	3.28
September	497	144	264	.429	.479	66	.73
October	1,605	149	486	.790	9.11	23	3.94
November	710	215	412	.670	.748	50	1.50
December 1-20	940	215	376	.611	.454		*a*2.58
The year							36.59

a Rainfall for complete month.

ESTIMATED MONTHLY DISCHARGE OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.—*Continued.*

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1904.							
January							2.05
February							1.32
March							2.84
April 5-30	11,420	1,898	4.607	7.49	7.24		a5.58
May	11,840	980	4,741	7.71	8.89	170	5.14
June	1,200	282	587	.878	.974	48	2.26
July	1,020	149	388	.550	.634	15	4.14
August	5,400	215	594	.966	1.11	27	4.18
September	6,470	149	1,045	1.70	1.90	80	6.40
October	7,780	545	1,522	2.47	2.85	94	8.04
November	876	840	554	.901	1.01	120	.84
December	515	232	372	.605	.698	54	1.28
The year							39.07
1905.							
January							3.80
February							1.52
March							2 86
April	7,140	1,500	3,185	5.18	5.78	815	1.83
May	3,438	865	1,687	2.74	3.16	190	1.66
June	5,045	650	1,276	2.07	2.31	50	4.66
July	4,590	317	920	1.50	1.78	48	4.04
August	2,500	317	702	1.14	1.31	27	4.80
September	9,570	790	2,457	4.00	4.46	51	8.76
October	2,080	886	782	1.19	1.37	68	2.17
November	8,250	8.61	687	1.12	1.25	50	2.51
December	5,045	8.61	1,470	2.89	2.76	86	8.22
The year							41.33

a Rainfall for complete month.

ESTIMATED MONTHLY DISCHARGE OF PEMIGEWASSET RIVER AT PLYMOUTH, N. H.—*Concluded.*

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1906.							
January							2.42
February							2.32
March							8.15
April 6-30	16,980	1,275	4,180	6.80	6.82	265	a2.38
May	15,100	1,365	8,695	6.01	6.93	131	5.27
June	4,805	720	1,695	2.76	3.08	80	3.87
July	2,840	317	688	1.12	1.29	85	8.64
August	1,782	211	894	.641	.739	46	1.59
September	817	170	222	.861	.403	27	1.50

a Rainfall for complete month.

CONNECTICUT RIVER DRAINAGE BASIN.

Connecticut River has its source in Connecticut Lake, in northern New Hampshire. Its extreme headwaters, however, lie in the province of Quebec and in the mountains on the northern boundary of New Hampshire; thence the river flows in a southerly direction between New Hampshire and Vermont and through Massachusetts and Connecticut into Long Island Sound. The total drainage area is 11,085 square miles, of which 155 square miles lie in the province of Quebec. Its total length from Connecticut Lake to Long Island Sound is 345 miles. On its banks are many cities and towns of importance. It is in general closely followed by one or more railroad lines. Water power is used at several points, notably at Windsor Locks in Connecticut, Holyoke and Turner's Falls in Massachusetts, and Bellows Falls and Wilder in Vermont. The valley of Connecticut River proper is very generally in farm lands. Many of its tributary basins, however, especially in the northern portions, are heavily wooded.

DRAINAGE AREA OF CONNECTICUT RIVER AND TRIBUTARIES.

River.	Locality.	Area.
		Square miles.
Connecticut...	Mouth.....	11,085
Connecticut...	Hartford, Conn.....	10,285
Connecticut...	Orford, N. H., at gaging station.....	3,805
Connecticut...	In Canada.....	155
Ashuelot.....	Winchester, N. H., at gaging station.....	385
White.....	Sharon, Vt, at gaging station.....	680
Ammonoosuc.	Bretton Woods, N. H., at gaging station....	84
Zealand.....	Mouth and at gaging station.....	14
Israel..... ...	Below South Branch at gaging station.....	21.2
Israel.....	Above South Branch at gaging station.....	8.7
Little.....	Twin Mt., N. H., at gaging station.....	11
Little.....	Twin Mt., N. H., at mouth.....	12

ISRAEL RIVER (ABOVE SOUTH BRANCH) NEAR JEFFERSON HIGHLANDS, N. H.

This station was established September 2, 1903, by N. C. Grover. It is located at a small wooden highway bridge in the town of Randolph, about halfway between the railway stations of Jefferson Highlands and Bowman, 2½ miles from either place. The headwaters of the river lie on the slopes of Mount Adams and Mount Jefferson, at elevations approximating 5,000 feet. The length of the river from its source to the gaging station is about five miles. The elevation at the gaging station is about 1,400 feet. All slopes are steep; many are precipitous. There is no pondage or artificial storage of water. The underlying rock is granite, exposed in the mountain tops. The basin is generally in heavy virgin forest.

The channel is straight for 100 feet above and 50 feet below the station, and is about 20 feet wide. The banks are subject to overflow in extreme freshets. The current is strong at high and medium at low stages. The bed is gravelly and permanent.

Discharge measurements at high and ordinary stages are made from the bridge. Low-water measurements are made by wading about 20 feet above the bridge.

A standard chain gage, which is read once each day by E. A. Crawford, is attached to the upstream truss of the bridge. The length of the chain is 15.35 feet. The gage is referred to bench marks as follows: (1) Marked point on east end of cross timber of bridge; elevation, 8.50 feet. (2) Top of bowlder 150 feet east of bridge, 30 feet south of river; elevation, 12.10 feet. Elevations are above datum of gage.

DISCHARGE MEASUREMENTS OF ISRAEL RIVER (ABOVE SOUTH BRANCH) NEAR JEFFERSON HIGHLANDS, N. H.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
1903 Sept. 2	H. K. Barrows..	19	14.1	0.67	1.20	9.4
Sept. 18	H. K. Barrows.....	19	14.1	.57	1.17	8.1
Oct. 9	N. C. Grover.....	18	12.6	.46	1.15	5.8
1904 April 16	N. C. Grover.....	20.5	28	.94	1.44	22
April 18	N. C. Grover.....	21	24	.92	1.48	22
May 1	S. K. Clapp.....	25	46	2.18	2.33	100
May 11	S. K. Clapp.....	25	48	2.44	2.85	117
May 25	S. K. Clapp	21	29	1.14	1.60	83
June 15	S. K. Clapp	21	16	.41	1.08	6.6
July 22	S. K. Clapp	8	8.1	1.26	1.04	8.9
Aug. 10	S. K. Clapp	9	8.0	1.48	1.04	4.8
Sept. 24	H. K. Barrows..... ..	20	17	1.04	1.41	18
Oct. 18	T. W. Norcross.....	19	17	.75	1.32	12
1905 May 5	T. W. Norcross.....	22	35	1.69	1.92	60
Aug. 3	T. W. Norcross.....	28	29	1.34	1.73	89
Aug. 24*a*	T. W. Norcross..... ...	21.5	12.0	.87	1.27	10.5
Oct. 26*b*	T. W. Norcross.....	21	11.6	1.09	1.29	12.7
1906 May 1	T. W. Norcross.....	25	83	1.46	1.83	48
Aug. 22	G. M. Brett.....	9.2	5.0	0.84	1.03	4.2
Aug. 22	G. M. Brett.....	9.2	4 9	0.84	1.08	4.1
Oct. 1	F. E. Pressey.....	18	12.8	0.51	1.13	6.5

a By wading; meter on rod.
b By wading.

DAILY GAGE HEIGHT, IN FEET, OF ISRAEL RIVER (ABOVE SOUTH BRANCH), NEAR JEFFERSON HIGHLANDS, N. H.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1903					1903				
1	.....	1.08	1.22	a1.08	17	1.1	1.18	1.18	a1.8
2	1.2	1.15	1.2	1.08	18	1.18	1.5	a1.32	1.6
3	1.2	1.12	1.2	1.2	19	1.1	1.28	1.55	1.4
4	1.2	1.1	1.2	1.3	20	1.1	1.25	1.55	1.4
5	1.2	1.58	1.22	1.6	21	1.1	1.2	1.6	2.2
6	1.2	1.2	1.38	1.7	22	1.1	1.2	1.6	2.4
7	1.2	1.15	1.32	1.7	23	1.1	1.2	1.32	2.5
8	1.1	1.15	1.2	1.6	24	1.1	1.3	1.12	2.5
9	1.1	1.2	1.08	1.5	25	1.1	1.25	1.62	2.4
10	1.1	1.15	1.08	1.3	26	1.08	1.2	1.4	2.0
11	1.1	1.1	1.1	1 2	27	1.08	1.15	1.3	2.0
12	1.1	1.1	1.2	1.2	28	1.15	1.15	1.35	1.1
13	1.1	1.2	1.2	1.4	29	1.1	1.18	1.33	1.4
14	1.1	1.2	1.18	2.2	30	1.1	1.25	1.08	1.4
15	1.1	1.2	1.18	2.2	31	.....	1.22	.....	1.2
16	1.1	1.18	1.18	2.0					

a Anchor ice, November 18 to December 31, 1903.

DAILY GAGE HEIGHT, IN FEET, OF ISRAEL RIVER (ABOVE SOUTH BRANCH), NEAR JEFFERSON HIGHLANDS, N. H.—*Continued.*

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904												
1	a1.2	a0.8	a0.8	1.4	2.85	1.85	1.1	1.2	1.1	1.6	1.45	1.2
2	1.2	.8	.8	1.8	2.0	1.3	1.1	1.18	1.82	1.6	1.45	1.2
3	1.1	.8	.8	1.8	1.9	1.4	1.45	1.8	1.6	1.6	1.4	1.2
4	1.05	.78	.8	1.8	2.1	1.85	1.45	1.8	1.55	1.5	1.85	1.2
5	1.0	.78	.8	1.8	2.1	1.8	1.8	1.2	1.5	1.5	1.85	1.18
6	b1.0	.78	.8	1.25	2.0	1.8	1.25	1.15	1.4	1.6	1.85	1.18
7	.9	1.8	.8	1.65	2.1	1.45	1.2	1.1	1.4	1.6	1.8	1.18
8	.9	2.5	.8	1.6	2.1	1.4	1.15	1.05	1.85	1.6	1.8	1.15
9	.85	2.8	.8	1.5	2.0	1.85	1.1	1.0	1.8	1.55	1.25	1.15
10	.85	8.0	.8	1.5	1.9	1.8	1.05	1.0	1.8	1.5	1.25	1.15
11	.85	2.5	.8	1.5	2.85	1.25	1.0	1.05	1.25	1.5	1.2	1.12
12	.85	1.5	.8	1.5	1.8	1.2	.95	1.1	1.2	1.4	1.2	1.12
13	.82	1.8	.8	1.7	1.7	1.15	1.2	1.85	1.15	1.35	1.2	1.1
14	.82	1.1	2.0	1.7	1.7	1.15	1.1	1.3	1.15	1.8	1.6	1.1
15	.82	1.0	8.2	1.5	1.65	1.12	1.08	1.62	2.15	1.8	1.8	1.1
16	.8	1.0	8.0	1.45	2.0	1.12	1.05	1.55	1.6	1.8	1.4	1.1
17	.8	.95	2.7	1.4	3.2	1.1	1.0	1.5	1.6	1.8	1.6	1.1
18	.8	.92	2.4	1.4	2.1	1.1	.98	1.4	1.8	1.8	1.5	a
19	.8	.9	8.2	1.45	2.25	1.05	.98	1.8	1.2	1.28	1.4	.....
20	.8	.88	4.8	1.45	2.8	1.0	.98	1.25	1.7	1.28	1.6	.....
21	.8	.88	4.0	1.45	2.0	.95	.98	1.68	1.6	1.28	1.6	.....
22	.8	.88	8.4	1.5	2.0	1.85	.95	1.62	1.6	1.25	1.5	.....
23	.8	.88	8.0	1.6	1.8	1.25	.95	1.6	1.5	2.0	1.4	.....
24	.8	.85	4.4	1.68	1.75	1.25	.98	1.55	1.4	1.9	1.2	.....
25	.8	.85	4.8	2.7	1.6	1.3	1.0	1.5	1.6	1.8	1.2	.....
26	.8	.85	4.7	1.7	1.65	1.25	1.2	1.4	1.6	1.7	1.2	.....
27	.8	.82	4.0	1.7	1.65	1.1	1.2	1.8	1.5	1.75	1.6	.....
28	.8	.82	2.0	1.9	1.55	1.1	1.15	1.2	1.4	1.7	1.6	.....
29	.8	.82	1.7	2.9	1.5	1.15	1.18	1.15	2.0	1.6	1.4	.....
30	.8	.....	1.4	2.8	1.45	1.15	1.2	1.15	1.9	1.55	1.2	.....
31	.8	.....	1.4	.....	1.4	.....	1.15	1.1	.....	1.55	.....	.....

a River frozen January 1 to March 18, and December 18-81, 1904.
b January 6, 1904, ice 1.0 foot thick—.5 foot solid ice and .5 foot anchor ice.

DAILY GAGE HEIGHT, IN FEET, OF ISRAEL RIVER (ABOVE SOUTH BRANCH), NEAR JEFFERSON HIGHLANDS, N. H.—*Continued.*

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905								
1.	1.85	1.9	1.4	1.4	1.75	1.5	1.2	1.25
2.	1.85	1.85	2.25	1.45	1.75	1.45	1.2	1.25
3.	1.8	1.7	1.85	8.8	1.7	1.45	1.2	1.25
4.	2.7	1.6	1.65	2.7	1.6	1.45	1.2	1.25
5.	1.9	1.5	1.55	2.4	1.85	1.45	1.8	2.15
6.	1.85	1.6	1.5	2.0	1.8	1.4	1.8	2.1
7.	1.9	1.5	1.45	1.8	1.75	1.4	1.8	1.85
8.	1.6	1.7	1.4	1.8	1.75	1.4	1.8	1.8
9.	1.55	1.65	1.85	2.8	1.8	1.4	1.8	1.75
10.	1.85	1.55	1.8	1.7	1.7	1.85	1.3	1.65
11.	1.7	1.7	1.25	1.5	1.6	1.85	1.85	1.55
12.	1.6	1.95	1.25	1.5	1.55	1.55	1.8	1.6
13.	1.7	1.75	1.45	1.7	1.55	1.5	1.25	1.55
14.	1.65	1.65	1.4	1.5	1.65	1.5	1.25	1.5
15.	1 65	1.55	1.4	1.45	1.65	1.45	1.25	1.4
16.	1.9	1.5	1.85	1.4	1.6	1.45	1.2	1.35
17.	1.6	1.45	1.45	1.4	1.55	1.4	1.2	*a*
18.	1.85	1.45	1.4	1.85	2.5	1.4	1.55	.....
19.	1.8	1.65	1.35	1.3	2.1	1.65	1.5	.....
20.	1.75	1.5	1.8	1.25	1.95	1.6	1.4	.....
21.	1.7	1.45	1.25	1.25	1.7	1.5	1.4	.....
22.	1.75	1.4	1.2	1.85	1.65	1.4	1.35	.....
23.	1.65	1.85	1.2	1 4	1.6	1.35	1.35	.....
24.	1.5	1.8	1.2	1.45	1.55	1.35	1.8	.....
25.	1.5	1.8	1.2	1.4	1.8	1.85	1.8	.....
26.	1.95	1.9	1.85	1.35	1.75	1.3	1.8	.....
27.	2.8	1.75	1.3	1.4	1.7	.....	1.25	.....
28.	2.45	1.65	1.85	1.45	1.6	.....	1.8	.....
29.	2.05	1.5	1.8	1.4	1.55	.....	1.8	.....
30.	1.8	1.45	1.8	1.85	1.55	.....	1.25	.....
31.	1.65	.....	1.85	1.8	.....	.....	.....	.....

a River frozen January 1 to April 30 and December 17-81, 1905. Gage heights are somewhat unreliable owing to carelessness of gage reader.

DAILY GAGE HEIGHT, IN FEET, OF ISRAEL RIVER (ABOVE SOUTH BRANCH), NEAR JEFFERSON HIGHLANDS, N. H.—*Concluded.*

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1906								
1	1.73	1.6	1.4	1.15	1.2			
2	1.6	1.5	1.35	1.1	1.2			
3	1.95	1.9	1.35	1 05	1.85			
4	1.7	1.6	1.45	1.05	1.5			
5	2.15	1.9	1.45	1.05	1.3			
6	1.8	1.7	1.35	1.05	1.25			
7	1.7	2.4	1.3	1.45	1.2			
8	1.6	2.0	1.3	1.2	1.2			
9	1.5	1.9	1.3	1.15	1.25			
10	1.8	1.95	1.3	1.1	1.35			
11	1.5	1.75	1.45	1.1	1.2			
12	1.55	1.7	1.3	1.05	1.15			
13	2.75	1.65	1.3	1.05	1.2			
14	1.9	1.6	1.25	1.0	1.2			
15	1.7	1.55	1.2	1.05	1.2			
16	1.6	1.4	1.15	1.05	1.2			
17	1.7	1.4	1.2	1.05	1.15			
18	2.0	1.5	1.35	1.0	1.15			
19	2.25	1.45	1.2	1.0	1.15			
20	1.6	1.4	1.15	1.0	1.1			
21	1.7	1.85	1.15	1.05	1.1			
22	1.6	1.3	1.35	1.05	1.1			
23	1.65	1.3	1.3	1.05	1.15			
24	1.75	1.6	1.25	1.2	1.1			
25	1.75	1.45	1.2	1.1	1.1			
26	2.2	1.45	1.2	1.05	1.1			
27	3.0	1.4	1.2	1.15	1.1			
28	2.6	1.35	1.15	1.95	1.1			
29	2.5	1.45	1.25	1.45	1.05			
30	2.3	1.4	1.35	1.2	1.15			
31	1.6		1.3	1.2				

RATING TABLE FOR ISRAEL RIVER (ABOVE SOUTH BRANCH), NEAR JEFFERSON HIGHLANDS, N. H., FROM SEPTEMBER 2, 1903, TO DECEMBER 31, 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*
0.80	1.0	1.60	30	2.60	158	3.60	338
.85	1.2	1.70	38	2.70	176	3.70	356
.90	1.6	1.80	46	2.80	194	3.80	374
.95	2.2	1 90	55	2.90	212	3.90	392
1.00	3.0	2.00	67	3.00	230	4.00	410
1.10	5.8	2.10	79	3.10	248	4.20	446
1.20	8.6	2.20	93	3.20	266	4.40	482
1.30	13	2.30	108	3.30	284	4.60	518
1.40	18	2.40	124	3.40	302	4.80	554
1.50	24	2.50	140	3.50	320	.....	.....

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-'06. It is fairly well defined between gage heights 1.04 feet and 2.40 feet. Above 2.50 feet the curve is a tangent, the difference being 18 per tenth.

ESTIMATED MONTHLY DISCHARGE OF ISRAEL RIVER (ABOVE SOUTH BRANCH), NEAR JEFFERSON HIGHLANDS, N. H.

[Drainage area, 8.7 square miles.]

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1903.							
September 2-30	8.6	4.8	6.09	0.700	0.755	.....	a1.28
October	29	4.8	9.28	1.07	1.28	51	2.48
November 1-17	17	4.8	8.70	1.00	.632	... .	a1.41
December	.....	.....	.....	.....	.....	.....	2.02
1904.							
January	.....	.....	.....	.....	.....	.....	2.58
February	.....	.....	.....	.....	.....	.....	1.22
March 14-31	554	18	259	29.77	19.93	.....	a2.31
April	212	11	39	4.48	5.00	150	8.37
May	266	18	66	7.59	8.75	200	4.46
June	21	2.2	10.1	1.16	1.29	65	1.97
July	21	2.2	6.46	.748	.857	23	3.66
August	36	3.0	14.8	1.64	1.89	36	5.32
September	86	5.8	24.7	2.84	3.17	52	6.06
October*	67	11.6	26.4	3.03	3.49	184	2.60
November	30	8.6	17.5	2.01	2.24	162	1.38
December 1-17	8.6	5.3	6.85	.787	.498	.. ..	a0.65
The year	.....	.....	.....	.....	.....	.....	35.58

* Discharge interpolated October 27-31, 1905.
a Rainfall for complete month.

ESTIMATED MONTHLY DISCHARGE OF ISRAEL RIVER (ABOVE SOUTH BRANCH), NEAR JEFFERSON HIGHLANDS, N H.—*Concluded.*

[Drainage area, 8.7 square miles.]

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1905.							
January							2.20
February							2.70
March							2.15
April							0.35
May	176	13	48.4	5.56	6.41	157	4.07
June	61	13	31.1	3.57	3.98	96	4.14
July	100	8.6	19.6	2.25	2.59	69	3.74
August	284	11	42.5	4.89	5.64	119	4.72
September	140	27	41.5	4.77	5.32	167	3.19
October	34	8.6	18.7	2.15	2.48	223	a1.11
November	27	8.6	13.1	1.51	1.68	75	2.24
December 1-16	86	11	32.5	3.74	2.22		a2.68
The year							33.29
1906.							
January							1.30
February							1.20
March							1.40
April							.73
May	280	24	63.8	7.33	8.45		
June	124	13	33.1	3.80	4.24		
July	21	6.8	12.4	1.43	1.65		
August	61	3.0	7.84	.901	1.04		
September	50	4.0	9.59	1.10	1.23		

a Rainfall for complete month.

ISRAEL RIVER, BELOW SOUTH BRANCH, NEAR JEFFERSON HIGHLANDS, N. H.

This station was established September 2, 1903, by N. C. Grover. It is located at a small wooden highway bridge about two miles from the railway station at Jefferson Highlands, in the town of Jefferson. South Branch of Israel River has its mouth above this station and below the station previously described (page 45). South Branch drains an area of 10.5 square miles; its headwaters are on the slopes of Mount Jefferson and Mount Dartmouth, at elevations of 3,000 to 5,000 feet. The extreme length from its source to its mouth is about five miles. The elevation at its mouth is about 1,350 feet. As all the slopes are steep there is little or no storage of water. The underlying rock is granite, exposed in the mountain peaks. The basin has been generally "hard cut," as the lumbermen say, but has not been burned.

The channel is straight for 100 feet above and below the station, and is about 20 feet wide. The bed is rough and rocky but permanent. The banks are subject to overflow in extreme freshets. The current is strong at high and well sustained at low stages.

Discharge measurements are made from the upstream side of the bridge. The initial point for soundings is the right abutment of the bridge.

A standard chain gage, which was read once each day by E. A. Crawford previous to 1906—since that time by William Russell, is attached to the down-stream truss of the bridge; length of chain, 12.99 feet. The gage is referred to bench marks, as follows: (1) Marked point on center cross timber of bridge; elevation, 8.14 feet. (2) Top of bowlder 50 feet north of bridge, 15 feet west of highway; elevation, 5.20 feet. Elevations are above datum of the gage.

DISCHARGE MEASUREMENTS OF ISRAEL RIVER (BELOW SOUTH BRANCH), NEAR JEFFERSON HIGHLANDS, N. H.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. pr sec.*	*Feet.*	*Sec.-ft.*
1903 Sept. 2	H. K. Barrows	15	13.8	1.35	1.13	17.9
Sept. 18	H. K. Barrows	15	12.3	1.21	1.10	14.9
Oct. 9	N. C. Grover	15	10.4	1.11	1.03	11.5
1904 April 16	N. C. Grover	15	16	2.55	1.48	42
April 18	N. C. Grover	16	18	2.87	1.49	52
April 30	S. K. Clapp	44	64	4.75	2.55	304
May 1	S. K. Clapp	41	54	4.29	2.28	232
May 11	S. K. Clapp	42	57	4.80	2.40	273
May 25	S. K. Clapp	28.8	24	3.33	1.64	80
June 15	S. K. Clapp	12.3	12	1.25	1.09	15
July 22	S. K. Clapp	16	10.4	.79	.94	8.2
Aug. 10	S. K. Clapp	15	11.5	.82	1.00	9.4
Sept. 24	Barrows and Norcross	16	18.5	2.00	1.40	37
Oct. 13	T. W. Norcross	14	17	1.68	1.86	28
Nov. 18	T. W. Norcross	16	27	.89	1.98	24
1905 May 5a	T. W. Norcross	41	44	3.01	1.94	182
Aug. 3	T. W. Norcross	19	23	2.81	1.60	65
Aug. 23	T. W. Norcross	15	15.8	1.30	1.20	20.6
Aug. 24b	T. W. Norcross	20	18.0	1.18	1.20	21.3
Oct. 26	T. W. Norcross	16	16.4	1.86	1.23	22.3
1906 May 1	T. W. Norcross	40	30	3.27	1.80	98
Aug. 22	G. M. Brett	15.6	13	.90	1.07	11.8
Oct. 1	F. E. Pressey	16	13.9	1.01	1.20	14.0

a Measurement made from downstream side of bridge.
b By wading about forty feet above bridge; meter on a rod.

DAILY GAGE HEIGHT, IN FEET, OF ISRAEL RIVER (BELOW SOUTH BRANCH), NEAR JEFFERSON HIGHLANDS, N. H.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1903					1903				
1	.....	1.0	1.12	a1.18	17	1.0	1.02	1.15	a 1.6
2	1.1	1.12	1.05	1.18	18	1.1	1.55	1.28	1.4
3	1.1	1.02	1.05	1.18	19	1.02	1.25	1.28	1.4
4	1.1	1.0	1.05	1.18	20	1.02	1.22	1.28	1.3
5	1.2	1.42	1.12	1.18	21	1.0	1.1	1.28	2.5
6	1.1	1.15	1.8	1.18	22	1.0	1.08	a1.58	2.6
7	1.1	1.08	1.28	1.18	23	1.0	1.08	1.8	2.8
8	1.1	1.05	1.2	1.15	24	1.0	1.2	1.02	2.1
9	1.1	1.05	1.1	1.15	25	1.0	1.1	1.6	2.1
10	1.1	1.02	1.1	1.12	26	.98	1.08	1.92	2.7
11	1.1	1.0	1.1	1.12	27	.95	1.05	1.58	2.5
12	1.1	1.0	1.1	1.12	28	1.05	1.05	1.68	2.1
13	1.0	1.1	1.1	1.3	29	1.0	1.05	1.5	1.1
14	1.0	1.05	1.1	2.2	30	1.0	1.15	1.18	1.6
15	1.0	1.05	1.1	2.2	31	.....	1.12	.....	1.6
	1.0	1.02	1.12	1.8					

a Anchor ice, November 22 to December 31, 1903.

DAILY GAGE HEIGHT, IN FEET, OF ISRAEL RIVER (BELOW SOUTH BRANCH), NEAR JEFFERSON HIGHLANDS, N. H.—*Continued.*

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904												
1	a1.6	a0.85	a0.85	1.4	2.35	1.85	1.1	1.2	1.1	1.6	1.45	1.8
2	1.4	.85	.85	1.85	2.0	1.8	1.1	1.15	1.8	1.6	1.45	1.7
3	1.1	.82	.82	1.85	1.9	1.4	1.45	1.8	1.6	1.6	1.4	1.6
4	1.08	82	.82	1.85	2.1	1.85	1.4	1.3	1.5	1.6	1.85	1.6
5	1.0	.82	.82	1.8	2.1	1.8	1.8	1.2	1.5	1.5	1.85	1.4
6	b1.0	.82	.82	1.8	1.9	1.8	1.25	1.1	1.45	1.5	1.85	1.2
7	.95	c1.9	.82	1.7	2.1	1.45	1.2	1.05	1.45	1.6	1.8	1.2
8	.92	2.7	.8	1.6	2.0	1.4	1.15	1.05	1.4	1.6	1.8	1.2
9	.9	3.3	.8	1.6	1.9	1.35	1.1	1.0	1.35	1.55	1.3	1.15
10	.9	8.0	.8	1.5	1.9	1.8	1.05	1.0	1.3	1.5	1.28	1.15
11	.9	2 1	.8	1.5	2.4	1.25	1.0	1.1	1.25	1.5	1.25	1.15
12	.9	1.2	.8	1.5	1.85	1.2	.95	1.1	1.2	1.4	1.25	1.15
13	.88	1.2	.8	1.7	1.75	1.15	1.2	1.8	1.15	1.85	1.22	1.15
14	.88	1.1	2.4	1.7	1.7	1.15	1.1	1.2	1.15	1.8	1.65	1.15
15	.88	1.0	8.5	1.5	2.05	1.12	1.08	1.6	2.22	1.8	1.4	1.15
16	.85	1.0	3.4	1.45	2.1	1.12	1.05	1.5	1.6	1.28	1.2	1.15
17	.85	.9	3.0	1.4	3.25	1.1	1.0	1.4	1.6	1.28	1.6	1.15
18	.85	.9	3.7	1.4	2.05	1.1	.98	1.3	1.85	1.28	1.95	a
19	.85	.9	3.7	1.45	2.8	1.05	.98	1.2	1.2	1.25	1.9	.....
20	.85	.9	8.7	1.45	2.35	1.0	.98	1.15	1.7	1.25	1.6	.....
21	.85	.9	4.4	1.5	2.1	.95	.98	1.7	1.6	1.25	1.4	.....
22	.85	.88	4.2	1.5	2.0	1.35	.95	1.6	1.5	2.0	1.2	.....
23	.85	.88	3.7	1.6	1.8	1 8	.95	1.6	1.4	2.0	1.2	.....
24	.85	.88	3.0	1.7	1 7	1.25	.98	1.5	1.4	1.92	1.2	.....
25	.85	.88	4.7	2.7	1.65	1.8	1.0	1.4	1.6	1.85	1.2	.....
26	.85	.85	5.2	1.9	1.65	1.25	1.2	1.8	1.6	1.7	1.3	.....
27	.85	.85	5.0	1.8	1.75	1.15	1.2	1.25	1.5	1.7	1.6	.....
28	.85	.85	4 0	1.9	1.55	1.15	1.1	1.2	1.4	1.6	1.9	.....
29	.85	.85	2.2	2.7	1.5	1.1	1.8	1.15	2.05	1.5	1.9	.....
30	.85	.....	1.7	2.3	1.45	1.1	1.2	1.15	1.9	1.5	1.9	.....
31	.85	.....	1.4	.....	1 4	.....	1.15	1.1	.....	1.48	.....	.....

a River frozen January 1 to March 13, and December 18 to 81, 1904.
b January 6, 1904, ice 1.2 feet thick—.7 foot solid ice and .5 foot anchor ice.
c Anchor ice caused back water, February 7 to 16, 1904, approximately.

DAILY GAGE HEIGHT, IN FEET, OF ISRAEL RIVER (BELOW SOUTH BRANCH), NEAR JEFFERSON HIGHLANDS, N. H.—*Continued.*

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.								
1	1.35	1.9	1.4	1.45	1.7	1.45	1.15	1.2
2	1.35	1.8	2.15	1.45	1.7	1.4	1.15	1.2
3	1.3	1.7	1.8	2.9	1.6	1.4	1.15	1.2
4	2.7	1.6	1.6	2.7	1.5	1.4	1.15	1.2
5	1.95	1.5	1.55	2.4	1.8	1.4	1.25	2.0
6	1.85	1.6	1.5	2.4	1.8	1.35	1.25	2.1
7	1.95	1.5	1.45	2.2	1.7	1.35	1.2	1.8
8	1.6	1.7	1.4	2.0	1.65	1.35	1.2	1.7
9	1.5	1.6	1.35	2.5	1.7	1.3	1.2	1.6
10	1.85	1.5	1.35	2 0	1.6	1.3	1.2	1.5
11	1.75	1.7	1.3	1.8	1.55	1.3	1.25	1.5
12	1.65	1.9	1.25	1.7	1.5	1.5	1.25	1.6
13	1.75	1.75	1.5	1.6	1.5	1.45	1.2	1.5
14	1.7	1.65	1.45	1.6	1.6	1.45	1.2	1.45
15	1.7	1.55	1.45	1.55	1.6	1.4	1.2	1.4
16	1.95	1.45	1.4	1.5	1.5	1.4	1.15	1.35
17	1.75	1.45	1.45	1.45	1.5	1.35	1.15	a
18	1.35	1.5	1.4	1.4	2.3	1.35	1.35	.....
19	1.8	1.6	1.35	1.35	2.0	1.55	1.35	.....
20	1.75	1.5	1.3	1.3	1.8	1.5	1.35	.....
21	1.7	1.45	1.25	1.3	1.65	1.5	1.35	.....
22	1.75	1.45	1.25	1.35	1.6	1.4	1.3	.....
23	1.65	1.4	1.2	1.45	1.55	1.3	1.3	.....
24	1.5	1.35	1.2	1.4	1.5	1.3	1.25	.....
25	1.5	1.35	1.2	1.35	1.7	1.3	1.25	.....
26	1.9	1.95	1.4	1.3	1.7	1.25	1.25	.....
27	2.2	1.8	1.35	1.35	1.6	.....	1.2	.....
28	2.45	1.65	1.35	1.4	1.55	.....	1.25	.....
29	2.0	1.55	1.3	1.35	1.5	.....	1.25	.....
30	1.8	1.45	1.3	1.3	1.5	.....	1.2	.....
31	1.7	.....	1.35	1.25	.....	.....	.....	.....

a River frozen January 1 to April 30 and December 17-31. Gage heights are somewhat unreliable, owing to carelessness of gage reader.

DAILY GAGE HEIGHT, IN FEET, OF ISRAEL RIVER (BELOW SOUTH BRANCH), NEAR JEFFERSON HIGHLANDS, N. H.—*Concluded.*

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1906.								
1	1.8	1.8	1.50	1.20	1.25	.....	.....	.....
2	1.7	1.75	1.45	1.15	1.20	.....	.....	.....
3	1.9	2.05	1.45	1.15	1.95	.....	.....	.....
4	1.8	1.8	1.50	1.10	1.70	.....	.....	.....
5	2.2	1.7	1.50	1.10	1.40	.....	.....	.....
6	2.0	1.7	1.45	1.10	1.80	.....	.....	.....
7	1.9	2.2	1.85	1.60	1.25	.....	.....	.....
8	1.7	1.8	1.35	1.35	1.20	.....	.....	.....
9	1.65	1.8	1.35	1.20	1.25	.....	.....	.....
10	2.0	1.7	1.40	1.15	1.45	.....	.....	.....
11	1.65	1.75	1.45	1.15	1.80	.....	.....	.....
12	1.65	1.65	1.40	1.15	1.25	.....	.....	.....
13	2.8	1.6	1.85	1.15	1.20	.....	.....	.....
14	2.05	1.55	1.80	1.10	1.20	.....	.....	.....
15	1.8	1.5	1.25	1.10	1.20	.....	.....	.....
16	1.8	1.45	1.20	1.10	1.20	.....	.....	.....
17	1.9	1.45	1.20	1.05	1.15	.....	.....	.....
18	2.05	1.5	1.35	1.05	1.15	.....	.....	.....
19	2.25	1.5	1.20	1.05	1.15	.....	.....	.....
20	1.8	1.45	1.20	1.05	1.15	.....	.....	.....
21	1.85	1.4	1.20	1.15	1.15	.....	.....	.....
22	1.6	1.35	1.45	1.15	1.15	.....	.....	.....
23	1.55	1.35	1.25	1.10	1.20	.....	.....	.....
24	1.6	1.7	1.25	1.80	1.15	.....	.....	.....
25	1.7	1.55	1.25	1.10	1.15	.....	.....	.....
26	2.2	1.5	1.20	1.10	1.15	.....	.....	.....
27	2.95	1.45	1.15	1.10	1.15	.....	.....	.....
28	2.6	1.4	1.15	2.00	1.15	.....	.....	.....
29	2.2	1.45	1.10	1.45	1.10	.....	.....	.....
30	2.05	1.4	1.35	1.20	1.20	.....	.....	.....
31	1.9	.....	1.30	1.00	.....	.....	.....	.....

RATING TABLE FOR ISRAEL RIVER (BELOW SOUTH BRANCH), NEAR JEFFERSON HIGHLANDS, N. H., FROM SEPTEMBER 2, 1903, TO DECEMBER 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*
0.80	2.5	.....	.....	2.40	268	3.50	576
.85	3.7	1.40	40	2.50	296	3.60	604
.90	5.3	1.50	52	2.60	324	3.70	632
.95	7.4	1.60	67	2.70	352	3.80	660
1.00	10	1.70	86	2.80	380	4.00	716
.....	.....	1.80	108	2.90	408	4.20	772
1.10	16	1.90	132	3.00	436	4.40	828
.....	.....	2.00	157	3.10	464	4.60	884
1.20	22	2.10	184	3.20	492	4.80	940
.....	.....	2.20	212	3.30	520	5.00	996
1.30	30	2.30	240	3.40	548	5.20	1,052

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903 and 1904. It is well defined between gage heights 0.94 foot and 2.60 feet. Above gage height 2.10 feet the rating curve is a tangent, the difference being 28 per tenth.

RATING TABLE FOR ISRAEL RIVER (BELOW SOUTH BRANCH), NEAR JEFFERSON HIGHLANDS, N. H., FROM JANUARY 1, 1905, TO DECEMBER 31, 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*
.. ..	.....	1.50	51	2.00	154	2.50	298
1.10	15	1.60	66	2.10	182	2.60	327
1.20	21	1.70	84	2.20	211	2 70	356
1.30	29	1.80	105	2.30	240	2.80	385
1.40	39	1.90	128	2.40	269	2.90	414

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905–1906. It is well defined between gage heights 0.9 foot and 2.6 feet.

ESTIMATED MONTHLY DISCHARGE OF ISRAEL RIVER (BELOW SOUTH BRANCH), NEAR JEFFERSON HIGHLANDS, N. H.

[Drainage area, 21.2 square miles.]

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1903.							
September 2-30	22	7	12.7	0.599	0.646	.....	a1.23
October	59	10	17.0	.802	.925	38	2.43
November 1-17	30	13	17.7	.835	.528	.....	a1.41
December	.....	.....	.....	.....	.....	.....	2.02
1904.							
January	.....	.....	.....	.....	.....	.....	2.58
February	.....	.....	.....	.....	.....	.....	1.22
March 14-31	1,052	40	578	27.26	18.25	.....	a2.81
April	352	30	86.5	4.08	4.55	140	3.37
May	506	40	152	7.17	8.27	190	4.46
June	46	7.4	25.0	1.18	1.32	67	1.97
July	46	7.4	17.4	.821	.946	26	3.66
August	86	10	30.4	1.43	1.65	31	5.32
September	218	16	57.4	2.71	3.02	50	6.06
October	157	26	62.3	2.94	3.39	130	2.60
November	144	22	53.3	2.51	2.80	203	1.38
December 1-17	108	19	35.6	1.68	1.06	.....	a0.65
The year	.....	.....	.....	.....	.....	.....	35.58

a Rainfall for complete month.

ESTIMATED MONTHLY DISCHARGE OF ISRAEL RIVER (BELOW SOUTH BRANCH), NEAR JEFFERSON HIGHLANDS, N. H.—*Continued.*

[Drainage area, 21.2 square miles.]

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1905.							
January							2.20
February							2.70
March							2.15
April							0.35
May	356	29	109	5.14	5.93	146	4.07
June	141	34	69.0	3.25	3.63	88	4.14
July	196	21	43.9	2.07	2.39	64	3.74
August	414	25	102	4.81	5.54	117	4.72
September	240	51	78.0	3.68	4.11	129	3.19
October *	58	18	35.3	1.67	1.92	173	1.11
November	34	18	33.7	1.59	1.77	79	2.24
December 1-16	182	21	63.2	2.98	1.77		*a*2.68
The year							33.29

* Discharge interpolated October 27-31, 1905.
a Rainfall for complete month.

ESTIMATED MONTHLY DISCHARGE OF ISRAEL RIVER (BELOW SOUTH BRANCH), NEAR JEFFERSON HIGHLANDS, N. H.—*Concluded.*

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1906.							
January							1.30
February							1.20
March							1.40
April							0.73
May	428	58	149	7.03	8.10		
June	211	34	73.1	3.45	3.85		
July	51	15	32.1	1.51	1.74		
August	154	12	23.9	1.13	1.28		
September	141	15	28.3	1.33	1.48		

AMMONOOSUC RIVER AT BRETTON WOODS, N. H.

This station was established August 28, 1903, by N. C. Grover. It is located at the steel highway bridge near Mount Pleasant House, at Bretton Woods. The drainage area at this point is 34 square miles. The headwaters of the river come from the westerly slopes of Mount Jefferson and Mount Washington and the lesser peaks of the White Mountains lying to the south. The underlying rock is granite, which is exposed at points in the river bed and on the various mountain summits. The slopes and valleys are usually well forested, with a preponderance of evergreen growth. The area was cut in large part for spruce several years ago, but now has a thick forest cover. There is no pondage or artificial storage. The slope of the river is steep.

The channel is straight for 300 feet above and 200 feet below the measuring section, and is about 35 feet wide. The banks are high and not subject to overflow except in extreme freshet. The bed is somewhat rocky, but permanent. The current is medium at ordinary and sluggish at low stages.

Discharge measurements at high and ordinary stages are made from a footbridge located about 300 feet downstream from the highway bridge. Low-water measurements are made by wading at various sections in the vicinity where better velocities are found.

A standard chain gage, which is read twice each day by John Paige, is attached to the floor on the downstream side of the highway bridge; length of chain, 18.88 feet. The gage is referred to the following bench marks: (1) Marked point on bridge near gage; elevation, 17.33 feet. (2) Northwest corner of east abutment; elevation, 14.46 feet. (3) Top of bowlder 100 feet below bridge, between the river and tracks of Boston and Maine Railroad; elevation, 17.02 feet. Elevations are above the datum of the gage.

DISCHARGE MEASUREMENTS OF AMMONOOSUC RIVER AT BRETTON WOODS, N. H.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. pr sec.*	*Feet.*	*Sec.-ft.*
1903 Aug. 28	H. K. Barrows	32	69	0.65	1.65	45
Sept. 2	H. K. Barrows	32	62	.50	1.50	31
Sept. 8	H. K. Barrows	32	63	.46	1.48	29
Sept. 17	H. K. Barrows	24	45	.33	1.26	15
Sept. 17	H. K. Barrows	26	32	.50	1.26	16
Oct. 10	N. C. Grover	32	62	.65	1.64	40
1904 April 15	N. C. Grover	37	94	.95	2.00	89
May 2	S. K. Clapp	40	166	2.81	3.20	467
May 9	S. K. Clapp	40	175	3.62	3.47	634
May 10	S. K. Clapp	40	175	3.58	3.51	627
May 20	S. K. Clapp	39	167	2.99	3.15	499
May 25	S. K. Clapp	32	91	1.35	2.19	123
June 10	S. K. Clapp	30	66	.65	1.60	43
July 21*a*	S. K. Clapp	14	16	1.12	1.24	18
Aug. 9*b*	S. K. Clapp	14	17	1.36	1.30	23
Aug. 23	H. K. Barrows	35	32	.32	1.39	67
Aug. 24*c*	H. K. Barrows	22	25	1.76	1.67	44
Sept. 25	Barrows and Norcross	58	94	1.25	2.26	118
Oct. 11	T. W. Norcross	38	79	.78	1.84	62
Nov. 17	T. W. Norcross	35	62	.46	1.51	28
1905 May 4	T. W. Norcross	40	157	3.40	3.61	534
July 5	Murphy and Barrows	38	33	.65	1.30	54
Aug. 1*d*	T. W. Norcross	40	106	1.22	2.40	129
Aug. 4	T. W. Norcross	39	39	.70	1.93	62
Aug. 24*e*	T. W. Norcross	30	28	1.14	1.58	32
Oct. 27*f*	T. W. Norcross	24	28	1.07	1.57	30
1906 May 2	T. W. Norcross	40	117	1.36	2.50	159
Aug. 21	G. M. Brett	27.5	22	0.95	1.51	21
Oct. 1	F. E. Pressey	31	34	0.74	1.35	25

a Measured 400 feet above gage.
b Measured 800 feet above gage.
c Wading below gage.
d Meter in poor condition.
e By wading 150 feet above gage, meter on a rod.
f From upstream side of highway bridge.

DAILY GAGE HEIGHT, IN FEET, OF AMMONOOSUC RIVER AT BRETTON WOODS, N. H.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1903 1	.....	1.55	1.35	1.7	1.3	1903 17	.....	1.28	1.45	1.5	a
2	.....	1.55	1.42	1.62	1.3	18	.....	1.55	2.6	1.68	.....
3	.....	1.48	1.38	1.58	1.3	19	.....	1.4	1.95	1.65	1.5
4	.....	1.42	1.35	1.5	1.35	20	.....	1.38	1.75	1.6	.....
5	.....	1.52	1.52.	1.58	1.35	21	.....	1.35	1.6	1.55	2.82
6	.....	1.48	1.52	2.05	1.35	22	.....	1.32	1.6	1.5	2.62
7	.....	1.44	1.45	1.55	1.35	23	.....	1.3	1.68	1.5	2.22
8	.....	1.44	1.48	1.55	1.35	24	.....	1.3	1.78	1.48	1.78
9	.....	1.4	1.65	1.55	1.35	25	.....	1.3	1.65	1.45	1.6
10	.....	1.4	1.7	1.55	1.4	26	.....	1.3	1.65	1.4	1.6
11	.....	1.4	1.65	1.5	1.4	27	.....	1.3	1.6	1.4	1.65
12	.....	1.32	1.6	1.5	1.35	28	1.6	1.4	1.55	1.35	1.7
13	.....	1.32	1.52	1.5	1.52	29	.....	1.38	1.55	1.3	1.65
14	.....	1.32	1.5	1.5	2.12	30	1.52	1.35	1.6	1.32	1.6
15	.....	1.32	1.45	1.5	a	31	1.55	.....	1.65	.....	1.6
16	.....	1.23	1.45	1.5	. ....						

a River frozen December 15-31, 1903.

DAILY GAGE HEIGHT, IN FEET, OF AMMONOOSUC RIVER AT BRETTON WOODS, N. H.—*Continued.*

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904												
1	1.55	.....	.....	1.85	8.78	1.88	1.4	1.4	1.85	2.75	1.85	1.5
2	1.5	.....	.....	1.9	8.2	1.75	1.78	1.38	1.48	2.55	1.8	1.55
3	.....	.....	2.1	1.9	2.9	1.75	2.02	1.58	1.48	2.4	1.8	1.55
4	1.55	.....	.....	1.9	8.3	1.7	1.65	1.5	1.9	2.2	1.8	1.55
5	.....	.....	1.88	1.88	8.45	1.7	1.62	1.88	1.58	2.1	1.8	1.52
6	.....	*a*1.4	.....	1.95	2.95	1.7	1.5	1.4	1.5	2.2	1.78	1.5
7	.....	.....	1.7	2.1	8.1	1.72	1.42	1.38	1.48	2.08	1.8	1.5
8	.....	.....	.....	2.6	3.18	1.78	1.38	1.32	1.45	1.72	1.72	1.5
9	1.5	.....	.....	8.85	2.9	1.68	1.35	1.8	1.42	1.9	1.7	*f*1.45
10	1.5	.....	.....	4.25	3.32	1.6	1.35	1.3	1.4	1.9	1.7	.....
11	1.45	.....	*e*1.75	2.95	3.5	1.55	1.35	1.48	1.38	1.82	1.58	.....
12	1.45	.....	*e*1.75	2.55	2.92	1.5	1.35	1.68	1.35	1.78	1.58	.....
13	1.45	*b*1.85	.....	2.35	2.78	1.5	1.45	1.55	1.4	1.8	1.55	.....
14	1.4	.....	.....	2.05	2.6	1.48	1.38	1.5	1.4	1.8	1.55	.....
15	.....	.....	1.5	2.0	2.92	1.45	1.3	1.75	8.15	1.78	1.55	.....
16	.....	.....	1.5	1.8	3.85	1.42	1.3	1.48	2.2	1.75	1.62	.....
17	1.4	.....	1.55	1.9	4.22	1.4	1.3	1.4	1 8	1.7	1.65	*g*1.4
18	.....	.....	.....	2.0	2.98	1.4	1.3	1.4	1.8	1.7	1.6	.....
19	.....	*c*1.4	1.5	2.1	3.35	1.35	1.28	1.35	2.15	1.68	1.58	.....
20	.....	.....	.....	2.1	8.2	1.85	1.25	1.92	1.82	1.65	1.52	.....
21	.....	.....	1.5	2.0	2.82	1.35	1.25	2.3	2.7	3.55	1.58	.....
22	.....	2.5	1.55	2.0	2.58	2.02	1.25	1.82	2 25	8.05	1.6	.....
23	2.1	2.4	2.15	2.02	2.45	1.65	1.25	1.95	1.85	2.48	1.6	.....
24	2.2	2.82	2.4	2.48	2.32	1.48	1.25	1.7	1.92	2.25	1.55	1.35
25	.....	2.15	8.05	8.25	2.22	1.4	1.25	1.58	2.12	2 2	1.5	.....
26	.....	.....	7.6	2.82	2.18	1.68	1.3	1.52	2.0	2 28	1.52	.....
27	.....	*d*1.5	4.02	8 05	2.25	1.48	1.6	1.5	1.92	2.82	1.62	.....
28	.....	.....	2.32	3.3	2.08	1.45	1.35	1.42	1.82	2 2	1.5	.....
29	1.6	.....	2.0	3.95	1.95	1.4	1.45	1.4	1.9	2 85	1.5	.....
30	.....	.....	2.0	3.75	1.9	1.4	1.42	1.4	2.9	2.0	1.5	.....
31	.....	.....	1.85	.....	1.85	.....	1.85	1.85	.....	1.98	.....	*h*1.8

River frozen January 1 to March 25 and December 9-81, 1904. Readings are to the surface of the water in a hole cut in the ice. The following additional data was obtained during 1904:

Date.	Thickness of ice.	Date.	Thickness of ice.
1904	*Feet.*	1904	*Feet.*
a February 6	.65	*f* December 9	.15
b February 13	.85	*g* December 17	.6
c February 19	.9	*h* December 31	.75
d February 27	.4		
e March 11 and 12	.5		

DAILY GAGE HEIGHT, IN FEET, OF AMMONOOSUC RIVER AT BRETTON WOODS, N. H.—*Continued.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
1	.....	.....	.....	2.72	2.52	1.92	1.75	2.48	2.1	1.72	1.62	1.95
2	.....	.....	.....	2.28	2.38	1.85	2.18	2.0	2.0	1.7	1.6	1.9
3	.....	.....	.....	2.15	2.35	2.28	2.2	2.1	2.5	1.68	1.5	2.4
4	.....	*c*1.5	*h* .7	2.02	3.55	2.02	1.88	1.98	2.7	1.65	1.52	2.65
5	.....	.....	.....	2.0	2.88	1.95	1.75	1.9	2.65	1.65	1.58	2.15
6	.....	.....	.....	2.92	3.2	2.55	1.68	1.88	2.5	1.62	1.5	1.75
7	*a*3.1	.....	.....	2.68	3.45	2.2	1.62	1.82	2.25	1.6	1.52	1.58
8	.....	.....	.....	2.22	3.02	2.0	1.6	1.85	2.12	1.6	1.55	1.55
9	.....	.....	.....	2.12	2.8	1.98	1.6	2.02	1.98	1.58	1.55	1.55
10	.....	.....	.....	2.28	2.75	1.85	1.55	1.85	1.88	1.55	1.52	1.55
11	.....	*c*1.6	*i* .5	2.45	2.55	1.98	1.55	1.72	1.85	1.55	1.5	1.55
12	.....	.....	.....	2.62	2.52	2.35	1.52	1.68	2.12	2.25	1.5	1.55
13	.....	.....	.....	2.62	2.4	2.6	1.5	1.7	1.98	1.98	1.5	1.55
14	*b*1.85	.....	.....	2.55	2.42	2.75	1.5	1.68	1.92	1.92	1.4	1.5
15	.....	.....	.....	2.42	2.75	2.25	1.5	1.75	1.82	1.78	1.42	1.5
16	.....	.....	.....	2.28	2.7	2.05	1.5	2.75	1.8	1.72	1.48	.....
17	.....	.....	.....	2.12	2.7	1.98	1.78	2.15	1.8	1.7	1.5	.....
18	.....	*f* .9	*j* .6	2.0	2.7	2.0	1.7	1.8	2.4	1.7	1.42	.....
19	.....	.....	.....	1.88	2.72	1.98	1.65	1.68	2.3	1.8	1.4	1.5
20	.....	.....	.....	1.58	2.55	1.88	1.88	1.65	2.08	1.72	1.35	1.5
21	*c*1.5	.....	2.2	2.6	2.42	1.88	1.65	1.65	2.02	1.7	1.35	1.5
22	.....	.....	2.3	2.9	2.35	1.9	1.52	1.65	1.9	1.68	1.35	1.48
23	.....	.....	1.68	2.42	2.18	1.82	1.48	1.65	1.85	1.62	1.4	1.45
24	.....	.....	1.5	2.2	2.08	1.7	1.45	1.65	1.8	1.6	1.5	1.45
25	.....	*g* .8	2.3	2.28	2.0	1.62	1.5	1.6	1.88	1.58	1.65	1.45
26	.....	.....	3.4	2.45	2.0	2.12	1.5	1.6	1.9	1.55	1.65	1.45
27	.....	.....	3.0	2.55	2.5	2.3	1.48	2.55	1.82	1.55	1.6	1.45
28	*d*1.4	.....	2.88	2.68	2.28	2.0	1.42	2.05	1.82	1.55	1.6	1.45
29	.....	.....	2.98	2.65	2.22	1.85	1.4	1.75	1.8	1.55	1.7	1.62
30	.....	.....	3.58	2.8	2.15	1.75	1.65	1.98	1.75	1.55	2.1	2.0
31	.....	.....	3.58	.....	2.02	.....	3.05	2.15	.....	1.55	.....	1.7

NOTE.—River frozen January 1 to March 20 and December 16-18, 1905. Readings are to the surface of the water in a hole cut in the ice. The following comparative readings were taken during 1905:

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Water surface.	Top of ice.	Thickness of ice.
1905.	*Feet.*	*Feet.*	*Feet.*	1905.	*Feet.*	*Feet.*	*Feet.*
a January 7*....	.....	.....	.....	*f* February 18.	.9	1.5	1.9
b January 14....	.....	.....	1.8	*g* February 25.	.8	1.4	1.9
c January 21....	.....	.....	1.9	*h* March 4....	.7	1.2	1.9
d January 28....	1.4	2.1	1.9	*i* March 11....	.5	1.15	1.9
e February 4, 11.	... .	.....	1.9	*j* March 18....	.6	1.5	1.9

*Water flowing over the ice.

DAILY GAGE HEIGHT, IN FEET, OF AMMONOOSUC RIVER AT BRETTON WOODS, N. H.—*Concluded.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1906.												
1	1.55	1.75	.....	1.8	2.84	2.58	2.58	1.68	1.62	.....	.....	.....
2	1.55	1.75	.....	1.54	2.58	2.55	2.38	1.62	1.6	.....	.....	.....
3	1.55	1.75	.....	1.52	3.05	2.8	1.95	1.52	1.92	.....	.....	.....
4	1.58	1.75	.....	1.54	2.85	2.58	2.68	1.5	2.1	.....	.....	.....
5	1.6	1.75	.....	1.7	3.15	2.4	2.3	1.5	1.8	.....	.....	.....
6	1.6	.....	.....	1.7	2.82	2.75	2.08	1.65	1.68	.....	.....	.....
7	1.6	.....	1.6	1.54	2.72	3.1	1.95	1.72	1.62	.....	.....	.....
8	1.6	.....	1.5	1.52	2.55	2.72	1.88	1.62	1.6	.....	.....	.....
9	1.55	1.7	1.5	1.52	2.68	2.52	1.85	1.55	1.6	.....	.....	.....
10	1.55	1.6	1.5	1.52	2.95	2.35	1.9	1.5	2.1	.....	.....	.....
11	1.5	.....	1.5	1.47	2.6	2.28	1.88	1.5	1.75	.....	.....	.....
12	1.5	.....	.....	1.47	2.52	2.22	1.82	1.5	1.62	.....	.....	.....
13	1.5	.....	.....	1.6	3.8	2.1	1.78	1.5	1.6	.....	.....	.....
14	1.5	.....	.....	1.77	2.98	2.02	1.72	1.5	1.6	.....	.....	.....
15	1.52	1.5	1.5	3.87	2.85	1.98	1.75	1.48	1.6	.....	.....	.....
16	1.62	.....	.....	3.2	2.78	1.92	1.75	1.45	1.6	.....	.....	.....
17	1.58	1.5	.....	2.87	2.7	2.05	1.72	1.42	1.6	.....	.....	.....
18	1.55	.....	.....	2.77	2.6	2.18	1.72	1.4	1.58	.....	.....	.....
19	1.55	.....	.....	2.8	2.58	2.02	1.62	1.4	1.52	.....	.....	.....
20	1.55	1.5	.....	2.92	2.52	1.95	1.6	1.42	1.5	.....	.....	.....
21	1.55	1.58	1.35	3.27	2.48	1.85	1.88	1.5	1.5	.....	.....	.....
22	2.45	1.8	1.35	2.94	2.42	1.85	1.88	1.48	1.52	.....	.....	.....
23	3.68	1.7	1.38	2.62	2.3	1.88	1.8	1.68	1.6	.....	.....	.....
24	8.75	1.58	1.4	2.42	2.35	2.25	1.75	1.82	1.5	.....	.....	.....
25	2.5	1.58	1.4	2.1	3.08	2.05	1.62	1.62	1.45	.....	.....	.....
26	2.25	1.7	1.4	2.07	2.78	1.98	1.58	1.58	1.45	.....	.....	.....
27	2.15	1.62	1.58	2.07	4.65	1.88	1.52	2.2	1.6	.....	.....	.....
28	2.05	.....	2.08	2.02	4.2	1.75	1.5	2.7	1.62	.....	.....	.....
29	1.85	.....	1.7	2.17	3.55	2.48	1.5	1.95	1.52	.....	.....	.....
30	1.8	.....	1.7	2.82	2.8	2.58	1.95	1.75	1.9	.....	.....	.....
31	1.8	.....	1.68	.....	2.7	.....	1.95	1.7	.....	.....	.....	.....

NOTE.—The following ice conditions prevailed during 1906. River open January 1 to February 5, frozen most of time from February 5 to March 21, except for narrow open water strips just above and below gage. During frozen season gage heights are to water surface in hole cut in ice. Ice went out about March 21; anchor ice reported in river on April 1 and April 5.

The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Water surface.	Top of ice.	Thickness of ice.
1906.	*Feet.*	*Feet.*	*Feet.*	1906.	*Feet.*	*Feet.*	*Feet.*
February 9.....	1.7	2.1	0.4	March 15.....	1.5	1.75	0.35
February 10.....	1.6	2.1	0.4	.....	.....	.....	.....
February 15.....	1.5	1.75	0.35	.....	.....	.....	.....
February 17.....	1.5	1.95	0.4	.....	.....	.....	.....

RATING TABLE FOR AMMONOOSUC RIVER AT BRETTON WOODS, N. H., FROM AUGUST 28, 1903, TO DECEMBER 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*
1 25	15	1.80	58	2.70	238	3.80	820
1.30	18	.....	.....	2.80	277	3.90	880
.....	....	1.90	68	2.90	318	4.00	940
1.40	24	.....	.....	3.00	365	4.20	1,060
.....	.....	2.00	80	3.10	415	4.40	1,180
1.50	31	2.10	93	3.20	465	4.60	1,300
....	.....	2.20	108	3.30	520	4.80	1,420
1.60	39	2.30	125	3.40	580	5.00	1,540
.....	.....	2.40	146	3.50	640	5.50	1,840
1.70	48	2.50	172	3.60	700	6.00	2,140
.....	.....	2.60	203	3.70	760	.....	.....

The above table is applicable only for open-channel conditions. It is based on 21 discharge measurements made during 1903 and 1904. It is fairly well defined between gage heights 1.25 feet and 3.50 feet. Above gage height 3.30 feet the rating curve is a tangent, the difference being 60 per tenth.

RATING TABLE FOR AMMONOOSUC RIVER AT BRETTON WOODS, N. H., FROM JANUARY 1 TO DECEMBER 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*
.....	.....	2.00	75	3.00	310	4.00	726
.....	.....	2.10	88	3.10	348	4.10	770
.....	.....	2.20	108	3.20	388	4.20	815
.....	.....	2.30	120	3.30	428	4.30	860
1.85	17	.....	.....	.....	.....	.....	.....
1.40	20	2.40	189	3.40	469	4.40	905
1.50	26	2.50	160	3.50	510	4.50	950
1.60	33	2.60	185	3.60	552	4.60	995
1.70	42	2.70	218	3.70	595	4.70	1,040
1.80	52	2.80	243	3.80	638	.....	.....
1.90	63	2.90	275	3.90	682	.....	.....

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905, and the form of the 1904 curve. It is fairly well defined.

RATING TABLE FOR AMMONOOSUC RIVER AT BRETTON WOODS, N. H., FROM JANUARY 1 TO DECEMBER 31, 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*
.....	.....	1.50	20	2.00	70	.....	.....
.....	.....	1.60	27	2.10	84	.....	.....
.....	.....	1.70	36	2.20	100	.....	.....
.....	.....	1.80	46	2.30	118	.....	.....
1.85	13	1.90	57	2.40	138	.....	.....
1.40	15	.....	.....	2.50	160	.....	.....

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1906 and the form of the 1904 curve. It is not well defined. Above gage height 2.50 feet use the 1905 rating table.

ESTIMATED MONTHLY DISCHARGE OF AMMONOOSUC RIVER AT BRETTON WOODS, N. H.

[Drainage area, 34 square miles.]

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1903.							
September	35	17	23.3	0.685	0.764	.....	*a* 0.97
October	203	21	42.5	1.25	1.44	52	2.77
November	86	18	34.1	1.00	1.12	97	1.16
December 1-14	96	18	27.0	.794	.413	.....	*b* 3.84
1904.							
January	.....	.....	.....	.....	.....	.....	1.94
February	.....	.....	.....	.....	.....	.....	.48
March 26-31	3,100	63	734	21.59	4.82	.....	*b* 2.53
April	1,090	58	245	7.21	8.04	574	1.40
May	1,072	63	362	10.65	12.28	419	2.93
June	82	21	37.5	1.10	1.23	.....	.....
July	82	15	25.5	.750	.865	26	3.19
August	125	18	35.6	1.05	1.21	27	4.48
September	440	21	80.5	2.37	2.64	34	7.81
October	670	43	123	3.62	4.17	1.12	3.72
November	63	31	42.5	1.25	1.40	61	2.30
December 1-9	35	27	32.1	.944	.316	.....	.....

a Rainfall, September 15-30, 1903.
b Rainfall for complete month.

ESTIMATED MONTHLY DISCHARGE OF AMMONOOSUC RIVER AT BRETTON WOODS, N. H.—*Continued.*

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1905.							
March 21-31	544	26	256	7.53	3.08	.....	a 3.76
April	282	32	147	4.32	4.82	243	1.98
May	531	75	192	5.65	6.51	197	3.30
June	228	35	86.7	2.55	2.84	72	3.92
July	329	20	47.6	1.40	1.61	41	3.92
August	228	33	69.1	2.03	2.34	41	5.65
September	213	47	86.7	2.55	2.84	62	4.55
October	111	29	41.0	1.21	1.40	80	1.76
November	88	17	29.1	.856	.955	60	1.59
December 1-15	199	26	58.0	1.71	.934	.....	a .92
1906.							
January	.....	.....	.....	.....	.....	.....	.40
February	.....	.....	.....	.....	.....	.....	.62
March 21-31	81	13	27.1	.797	.326	.....	.....
April	457	18	132	3.88	4.33	333	1.30
May	1,020	118	290	8.53	9.83	178	5.50
June	348	41	122	3.59	4.00	89	4.50
July	207	20	59.6	1.75	2.02	60	3.34
August	213	15	34.6	1.02	1.18	27	4.30
September	84	17	32.5	.956	1.07	35	3.03

a Rainfall for complete month.

ZEALAND RIVER NEAR TWIN MOUNTAIN, N. H.

This station was established August 29, 1903, by N. C. Grover. It is located about 800 feet above the mouth of the river, which empties into the Ammonoosuc at a point midway between Fabyans and Twin Mountain, about 2½ miles from either place. The headwaters lie on the slopes of a spur of the White Mountains, at elevations of 2,500 to 3,000 feet. The length of the river from its headwaters to its mouth is about seven miles. The elevation at the mouth is approximately 1,500 feet. All slopes within the basin are steep. There is no pondage or artificial storage of water. The underlying rock is granite, which is exposed in the mountain peaks. About ten or twelve years ago this basin was entirely deforested and burned over. At the present time there is a thick stand of deciduous growth, consisting of poplar and bird cherry, averaging 18 to 20 feet in height, which affords a thick covering during the summer months, but practically no cover during the winter and spring. Within the basin we find the usual conditions of this stage of reforestation after a thorough burning.

The bed is rough and rocky, but permanent. The current is swift at high and medium at low stages. The banks are high and subject to overflow only in extreme freshets.

Discharge measurements at high stages are made from a highway bridge near the gage. At medium and low water measurements are made by wading close by.

A standard chain gage, which is read once each day by Charles Cote, is attached to trees on the bank just above the highway bridge; length of chain 12.38 feet. This gage has required frequent change in length of chain owing to the settling of one of the trees to which the gage is fastened. The gage is referred to a bench mark as follows: Top of large bowlder under the gage; elevation 3.56 feet above datum of gage.

DISCHARGE MEASUREMENTS OF ZEALAND RIVER NEAR TWIN MOUNTAIN, N. H.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. pr sec.*	*Feet.*	*Sec.-ft.*
1908 Aug. 29*a*	H. K. Barrows.....	21	29	0.45	2.01	13.1
Sept. 3*a*	H. K. Barrows.....	21	27	.40	1.98	10.7
Sept. 18*a*	H. K. Barrows.....	... ...	84	.68	2.22	28
Oct. 10*a*	N. C. Grover.....	22	35	.77	2.29	27
1904 April 15	N. C. Grover.....	19	25	1.92	2.52	48
April 30	S. K. Clapp.....	44	79	4.09	3.55	828
May 10	S. K. Clapp.....	36	56	3.25	3.00	182
May 19	S. K. Clapp.....	46	80	4.60	3.60	368
May 20	S. K. Clapp.....	88	54	8.37	3.08	182
May 25	S. K. Clapp.....	20	21	2.10	2.49	44
June 10	S. K. Clapp.....	9	10	2.10	2.18	21
July 21	S. K. Clapp.....	7	6.8	1.12	1.88	7.6
Aug. 9	S. K. Clapp.....	8	8.4	1.49	1.94	12.5
Aug. 23*a*	H. K. Barrows.....	86	40	.95	2.39	88
Sept. 25*a*	Barrows and Norcross..	35	46	1.48	2.65	68
Oct. 12	Barrows and Norcross..	28	33	.69	2.21	28
1905 May 3*a*	T. W. Norcross.....	44	85	1.99	2.67	70
Aug. 4*a*	T. W. Norcross.....	17	13	1.13	2.08	14.7
Aug. 25*b*	T. W. Norcross.....	13	9.8	.95	1.99	9.3
1906 May 2	T. W. Norcross.....	46	87	2.60	2.85	96
Aug. 21	G. M. Brett.....	20	12	0.55	2.01	6.8
Aug. 21	G. M. Brett.....	12.2	6.2	1.22	2.06	7.6
Oct. 3	F. E. Pressey.....	25	13.5	0.48	2.02	6.4

a By wading. *b* By wading; meter on a rod.

DAILY GAGE HEIGHT, IN FEET, OF ZEALAND RIVER NEAR TWIN MOUNTAIN, N. H.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1903						1903					
1	.....	2.0	1.9	2.2	2.2	17	.....	2.0	2.0	2.2	2.3
2	.....	2.0	1.9	2.2	2.15	18	.....	2.2	2.4	2.3	2.5
3	.....	2.0	1.9	2.3	2.1	19	.....	2.0	2.4	2.3	2.5
4	.....	1.9	1.9	2.2	2.2	20	.....	2.0	2.3	2.25	2.4
5	.....	2.2	2.0	2.2	2.2	21	.....	2.0	2.3	2.2	2.4
6	.....	2.0	2.0	2.2	2.3	22	.....	1.9	2.2	2.2	2.4
7	.....	2.0	1.95	2.2	2.3	23	.....	1.9	2.2	2.2	2.3
8	.....	2.0	1.95	2.3	2.25	24	.....	1.9	2.2	2.1	2.3
9	.....	1.9	2.0	2.3	2.2	25	.....	1.9	2.2	2.3	2.3
10	.....	1.9	2.0	2.2	2.3	26	.....	1.9	2.3	2.3	2.4
11	.....	1.9	2.0	2.2	2.4	27	.....	1.9	2.3	2.2	2.4
12	.....	1.9	2.0	2.2	2.4	28	.....	2.0	2.25	2.2	2.4
13	.....	1.9	2.0	2.3	2.3	29	2.0	2.0	2.2	2.15	*a*
14	.....	1.9	2.0	2.3	2.25	30	2.2	1.9	2.2	2.1	.....
15	.....	1.9	2.0	2.3	2.2	31	2.2	.....	2.3	.....	.....
16	.....	1.9	2.0	2.2	2.2						

a River frozen December 29-31, 1903.

DAILY GAGE HEIGHT, IN FEET, OF ZEALAND RIVER NEAR TWIN MOUNTAIN, N. H.—*Continued.*

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904										
1	*a*	2.4	3.5	2.4	1.84	1.84	1.74	4.34	3.25	2.85
2	.....	2.45	3.4	2.4	1.84	1.84	1.94	4.14	3.35	2.45
3	.....	2.3	3.3	2.3	1.74	1.94	1.94	3.44	2.85	2.45
4	.....	2.3	3.1	2.2	1.74	1.94	1.84	2.84	2.75	2.75
5	.....	2.4	3.0	2.2	1.74	2.04	1.84	3.04	2.75	2.75
6	.....	2.4	3.0	2.1	1.74	1.84	2.04	2.84	2.65	2.55
7	.....	2.5	2.9	2.1	1.74	1.84	2.04	2.84	2.85	*a*
8	.....	2.7	2.7	2.1	1.84	1.94	1.94	2.74	2.85	.....
9	.....	2.7	2.6	2.0	1.84	1.84	1.94	2.44	2.65	.....
10	.....	3.0	2.6	2.1	1.74	1.84	1.84	2.64	2.75	.....
11	.....	3.2	2.7	2.1	1.74	1.84	1.84	2.84	2.75	.....
12	.....	3.0	2.7	2.1	1.94	1.84	1.94	2.84	2.65	.....
13	.....	2.9	2.6	2.05	1.94	1.74	1.94	2.64	2.85	.....
14	.....	2.8	2.7	2.0	1.84	1.74	4.84	2.84	2.75	.....
15	.....	2.7	2.5	2.0	1.84	1.84	3.24	2.24	2.85	.....
16	.....	2.6	2.5	2.0	1.84	1.84	2.84	2.24	2.85	.....
17	.....	2.45	2.8	1.95	1.84	1.74	2.84	2.94	2.65	.....
18	.....	2.4	3.0	2.0	1.74	1.94	2.24	2.84	2.65	.....
19	.....	2.4	2.9	2.0	1.84	1.94	1.84	2.74	2.65	.....
20	.....	2.4	2.7	2.0	1.84	1.84	2.24	1.94	2.85	.....
21	.....	2.8	2.7	2.0	1.84	2.84	2.84	3.84	2.95	.....
22	.....	2.8	2.5	1.9	1.94	2.24	2.64	4.84	2.95	.....
23	.....	2.4	2.5	2.1	1.94	2.44	2.84	3.84	2.85	.....
24	.....	2.5	2.4	2.1	1.84	2.24	2.34	3.74	2.85	.....
25	.....	2.6	2.4	2.0	1.74	1.94	2.64	3.74	2.85	.....
26	.....	2.6	2.4	1.9	1.84	1.84	3.84	3.34	2.65	.....
27	3.0	2.7	2.4	1.9	2.84	1.84	2.84	3.24	2.75	.....
28	2.7	3.0	2.5	1.9	2.14	1.84	2.84	2.84	2.75	.....
29	2.5	4.0	2.4	1.9	1.94	1.94	2.64	2.84	2.55	.....
30	2.5	3.7	2.4	1.9	1.94	1.94	2.24	3.24	2.35	.....
31	2.4	.....	2.3	.....	1.84	1.84	.....	3.24	.....	.....

a River frozen January 1 to March 26 and December 7-31, 1904.

DAILY GAGE HEIGHT, IN FEET, OF ZEALAND RIVER NEAR TWIN MOUNTAIN, N. H.—*Continued.*

Day.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905									
1	*a*	2.85	2.35	2.3	2.6	2.9	2.3	3.0	2.6
2		3.25	2.4	2.9	2.35	2.7	2.3	3.5	2.5
3		3.1	2.7	2.6	2.3	3.0	2.3	2.3	3.0
4		3.0	2.5	2.4	2.2	3.2	2.3	2.5	3.2
5		3.2	2.4	2.3	2.2	2.35	2.3	2.35	3.0
6		3.4	3.0	2.3	2.2	3.0	2.3	2.3	*a*
7		3.4	2.7	2.3	2.2	2.65	2.3	2.35	
8		3.3	2.6	2.2	2.3	2.5	2.25	2.35	
9		3.3	2.5	2.2	2.3	2.4	2.25	2.3	
10		3.1	2.45	2.2	2.25	2.35	2.25	2.3	
11		3.0	2.3	2.2	2.2	2.3	2.2	2.3	
12		3.0	2.7	2.2	2.2	2.3	2.7	2.2	
13		2.9	2.3	2.2	2.4	2.5	2.3	2.2	
14		2.9	2.7	2.2	2.25	2.45	2.7	2.2	
15		2.7	2.5	2.3	2.3	2.35	2.45	2.2	
16		2.7	2.4	2.0	2.6	2.3	2.4	2.2	
17		2.6	2.4	2.3	2.55	2.3	2.4	2.15	
18		2.75	2.3	2.3	2.35	3.2	2.4	2.15	
19		2.7	2.3	2.4	2.2	2.65	2.7	2.1	
20		2.65	2.3	2.3	2.2	2.5	2.5	2.1	
21		2.7	2.4	2.2	2.2	2.5	2.5	2.1	
22		2.5	2.55	2.1	2.2	2.5	2.45	2.2	
23		2.5	2.3	2.1	2.15	2.45	2.45	2.2	
24		2.45	2.3	2.15	2.15	2.35	2.4	2.3	
25		2.4	2.2	2.2	2.0	2.45	2.4	2.4	
26		2.4	2.5	2.2	2.0	2.4	2.4	2.4	
27	3.15	2.6	2.6	2.2	2.75	2.4	2.35	2.4	
28	3.05	2.5	2.4	2.15	2.4	2.35	2.5	2.4	
29	2.95	2.45	2.35	2.1	2.4	2.3	2.5	2.4	
30	2.85	2.4	2.3	2.1	2.9	2.3	2.5	2.6	
31		2.35		2.9	3.2		2.5		

a River frozen January 1 to April 26 and December 6-31, 1905.

DAILY GAGE HEIGHT, IN FEET, OF ZEALAND RIVER NEAR TWIN MOUNTAIN, N. H.—*Concluded.*

Day.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.45	2.6	2.6	2.35	2.3			
2		3.0	2.6	2.45	2.3	2.15			
3		3.3	2.8	2.25	2.25	2.2			
4		3.2	2.6	2.65	2.25	2.1			
5		3.3	2.55	2.55	2.25	2.05			
6		2.9	3.2	2.45	2.25	2.0			
7		3.0	3.0	2.35	2.25	2.0			
8	2.55	2.7	2.9	2.3	2.85	2.0			
9	2.55	2.9	2.8	2.35	2.3	2.3			
10	2.55	3.0	2.7	2.4	2.2	2.0			
11	2.45	2.9	2.7	2.35	2.25	2.0			
12	2.35	2.8	2.6	2.3	2.25	1.95			
13	2.25	3.7	2.65	2.25	2.2	1.9			
14	2.55	3.05	2.5	2.15	2.15	1.9			
15	4.05	2.9	2.45	2.25	2.2	1.85			
16	3.55	2.95	2.3	2.3	2.2	2.05			
17	3.45	2.95	2.5	2.3	2.15	2.05			
18	3.55	2.9	2.45	2.35	2.1	2.15			
19	3.35	2.7	2.4	2.3	2.05	2.1			
20	3.85	2.7	2.3	2.3	2.05	2.05			
21	4.0	2.5	2.3	2.8	2.15	2.0			
22	3.15	2.45	2.35	2.5	2.15	2.0			
23	2.85	2.45	2.4	2.55	2.25	2.25			
24	2.75	2.5	2.7	2.4	2.2	2.35			
25	2.75	3.2	2.6	2.35	2.15	2.25			
26	2.75	2.7	2.45	2.25	2.15	2.25			
27	2.75	4.0	2.35	2.2	3.05	2.15			
28	2.65	3.8	2.35	2.15	2.65	2.15			
29	2.7	3.25	2.75	2.2	2.45	2.15			
30	3.75	2.85	2.7	2.6	2.35	2.35			
31		2.75		2.5	2.35				

RATING TABLE FOR ZEALAND RIVER NEAR TWIN MOUNTAIN, N. H., FROM AUGUST 29, 1903, TO DECEMBER 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*
1.75	4	2.20	22	2.70	82	3.60	368
1.80	5	.....	.....	2.80	109	3.70	402
.....	.....	2.30	28	2.90	189	3.80	436
1.90	8	.....	.....	3.00	170	3.90	470
.....	.....	2.40	35	3.10	202	4.00	504
2.00	12	.....	.....	3.20	234	4.10	538
.....	....	2.50	45	3.30	266	4.20	572
2.10	16	.....	.....	3.40	300	4.30	606
.....	.....	2.60	61	3.50	334	.....	.....

The above table is applicable only for open-channel conditions. It is based upon 16 discharge measurements made during 1903 and 1904. It is well defined between gage heights 1.88 feet and 3.60 feet. Above gage height 3.30 feet the rating curve is a tangent, the difference being 34 per tenth.

RATING TABLE FOR ZEALAND RIVER, NEAR TWIN MOUNTAIN, N. H. FROM JANUARY 1 TO DECEMBER 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*
2.00	10	2.70	78	3.40	298	4.10	567
2.10	14	2.80	100	3.50	330	4.20	609
2.20	20	2.90	127	3.60	368	4.30	652
2.30	27	3.00	156	3.70	406	4.40	696
2.40	35	3.10	188	3.80	445	4.50	740
2.50	46	3.20	222	3.90	485	.....	.....
2.60	60	3.30	257	4.00	526	.....	.....

The above table is applicable only for open-channel conditions. It is based on 18 discharge measurements made during 1903-1905. It is well defined between gage heights 1.9 feet and 2.6 feet.

RATING TABLE FOR ZEALAND RIVER NEAR TWIN MOUNTAIN, N. H., FROM JANUARY 1 TO DECEMBER 31, 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*
1.85	3	2.10	11	2.40	34	.....	.....
1.90	4	2.20	17	2.50	45	.....	.....
2.00	6	2.30	24	2.60	60	.....	.....

The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during 1906, and is merged with the 1905 rating curve at gage height 2.60 feet. It is fairly well defined. Above gage height 2.60 feet use 1905 rating table.

ESTIMATED MONTHLY DISCHARGE OF ZEALAND RIVER NEAR TWIN MOUNTAIN, N. H.

[Drainage area, 14 square miles.]

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1908.							
September	22	8	10.5	0.750	0.837	.....	*a* 0.97
October	35	8	17.8	1.27	1.46	54	2.77
November	28	16	28.6	1.69	1.89	160	1.16
December 1-28	45	16	29.0	2.07	2.16	.....	*b* 3.84
1904.							
January	.....	.....	.....	.....	.....	.....	1.94
February	.....	.....	.....	.....	.....	.....	.48
March 27-31	170	85	75.4	5.89	1.00	.....	*b* 2.53
April	504	28	97.9	6.99	7.80	560	1.40
May	334	28	101	7.21	8.31	280	2.93
June	35	8	15.0	1.07	1.19	.....	.....
July	90	4	7.35	.525	.605	19	3.19
August	121	4	18.0	.929	1.07	24	4.48
September	620	4	76.4	5.46	6.09	78	7.81
October	620	10	218	15.21	17.54	472	3.72
November	283	31	119	8.50	9.48	412	2.30
December 1-6	95	81	58.8	4.20	.937	.....	.....

a Rainfall, September 15-30, 1908.
b Rainfall for complete month.

ESTIMATED MONTHLY DISCHARGE OF ZEALAND RIVER NEAR TWIN MOUNTAIN, N. H.—*Concluded.*

[Drainage area, 14 square miles.]

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent. of rainfall.	
1905.							
January							
February							
March							3.76
April							1.98
May	293	31	120	8.57	9.88	299	3.30
June	156	20	48.2	3.44	3.84	98	3.92
July	127	10	29.7	2.12	2.44	62	3.92
August	222	10	38.3	2.74	3.16	56	5.65
September	222	27	65.1	4.65	5.19	114	4.55
October	100	20	40.4	2.89	3.33	189	1.76
November	330	14	41.3	2.95	3.29	207	1.59
December 1–5	222	46	128	9.14	1.70		a0.92
1906.							
January							.40
February							.62
March							
April 8–30	546	20	190	13.57	11.61		a 1.30
May	526	39	169	12.07	13.91	253	5.50
June	222	24	64.8	4.63	5.17	115	4.50
July	100	14	34.2	2.44	2.81	84	3.34
August	172	8	25.8	1.84	2.12	49	4.30
September	29	8	12.2	.871	.972	32	3.03

a Rainfall for complete month.

LITTLE RIVER NEAR TWIN MOUNTAIN, N. H.

This station was established January 21, 1904, by F. E. Pressey, and discontinuedSeptember 15, 1905. It was located at the rough wooden highway bridge about two miles southwest of Twin Mountain, and about two miles above the entrance of Little River into the Ammonoosuc. The area of the drainage basin at this point is about eleven square miles. This drainage basin is adjacent to that of Zealand River, previously described, and practically all forest cover has been removed from it. The slopes are steep, and there is no pondage or artificial storage. This station was established in order to obtain comparative data as to the time and duration of freshets. A few discharge measurements have been made during 1904 and 1905, but it is not intended to make any estimates of discharge for this point.

The channel is straight for about 50 feet above and 800 feet below the station. The banks are rocky, low, and clean, and liable to overflow. The bed of the stream is of large boulders and extremely rough. The current is swift at all stages.

A standard chain gage, which was read twice each day by Edward Lynch, is attached to the floor on the downstream side of the bridge; length of chain, 12.32 feet. The gage is referred to bench marks as follows: (1) A marked point on the floor of the bridge near the zero of the gage scale; elevation, 10.73 feet. (2) A cross on a boulder on right bank, about 32 feet from end of gage box; elevation, 9.05 feet. Elevations refer to gage datum.

DISCHARGE MEASUREMENTS OF LITTLE RIVER NEAR TWIN MOUNTAIN, N. H.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. ft.*	*Ft. pr. sec.*	*Feet.*	*Sec.-ft.*
Aug. 23*a*	H. K. Barrows.....	22	26	2.04	5.58	53
Sept. 25*a*	Barrows and Norcross..	22	32	2.06	5.75	66
Oct. 12*b*	T. W. Norcross.....	21	28	.94	5.30	26
1905.						
May 3*c*	T. W. Norcross.....	28	33	2.18	5.80	72
Aug. 25*d*	T. W. Norcross.....	24	18.3	.72	4.86	13.2

a By wading one mile below the gage.
b By wading.
c From the bridge.
d By wading; meter on a rod.

DAILY GAGE HEIGHT, IN FEET, OF LITTLE RIVER, NEAR TWIN MOUNTAIN, N. H.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904												
1	.....	4.6	4.7	4.9	6.15	5.2	4.9	5.2	5.0	6.05	5.2	5.1
2	.....	4.65	4.6	4.9	5.7	5.1	5.1	5.05	5.0	5.75	5.2	5.1
3	.....	4.6	5.0	4.9	5.85	5.05	5.35	5.15	5.1	5.65	5.2	5.1
4	.....	4.6	5.85	4.95	6.0	5.1	5.0	5.1	5.3	5.55	5.2	5.1
5	.....	4.65	5.05	5.05	6.1	5.0	5.0	5.1	5.15	5.45	5.2	5.1
6	.....	4.6	4.7	5.05	6.1	5.1	5.0	5.1	5.1	5.55	5.15	5.1
7	.....	5.1	4.65	5.45	6.05	5.0	4.95	5.0	5.1	5.45	5.1	5.1
8	.....	6.05	7.2	5.65	6.0	5.0	4.9	5.0	5.1	5.4	5.1	5.1
9	.....	4.8	5.0	6.15	6.0	5.0	4.9	5.0	5.1	5.35	5.1	5.1
10	.....	4.7	4.95	6.2	5.35	5.0	4.9	5.0	5.0	5.3	a5.25	5.1
11	.....	4.6	4.8	5.3	6.2	5.0	4.9	5.1	5.0	5.3	5.25	5.1
12	.....	4.6	4.3	5.5	5.9	4.90	4.9	5.15	5.0	5.3	5.2	5.1
13	.....	4.6	4.7	5.45	5.35	4.90	5.25	5.1	5.0	5.3	5.1	.....
14	.....	4.6	4.7	5.4	5.85	4.95	5.05	5.0	5.0	5.3	5.1	.....
15	.....	4.6	4.7	5.35	5.95	5.0	5.0	5.2	6.6	5.2	5.1	.....
16	.....	4.6	4.7	5.3	6.5	5.0	5.0	5.1	5.85	5.2	5.1	.....
17	.....	4.6	4.7	5.35	6.25	5.0	4.9	5.1	5.5	5.2	5.1	.....
18	.....	4.6	4.7	5.15	6.05	4.95	4.9	5.1	5.35	5.2	5.4	.....
19	.....	4.6	4.7	5.0	6.2	4.9	4.9	5.0	5.75	5.2	5.45	.....
20	.....	4.6	4.6	5.4	6.15	4.9	4.9	5.9	5.4	5.2	5.15	.....
21	4.65	4.6	4.6	5.15	5.9	4.9	4.8	5.85	5.95	6.2	5.25	.....
22	4.65	6.2	4.65	5.4	5.8	5.05	4.8	5.55	5.55	6.1	5.1	.....
23	5.05	5.0	6.85	5.15	5.7	5.0	4.8	5.75	5.45	5.9	5.1	.....
24	4.85	4.65	5.5	5.35	5.65	5.0	4.8	5.35	5.5	5.55	5.1	.....
25	4.7	4.6	5.7	5.95	5.6	4.9	4.9	5.3	5.75	5.5	5.1	.....
26	4.7	4.6	6.45	5.75	5.6	4.9	4.9	5.25	5.55	5.65	5.1	.....
27	4.7	4.7	5.4	5.55	5.55	4.9	5.1	5.15	5.45	5.55	5.2	.....
28	4.7	4.7	5.25	5.55	5.45	4.9	5.1	5.1	5.4	5.35	5.1	.....
29	4.65	4.7	5.15	6.0	5.3	4.9	5.45	5.1	5.45	5.3	5.4	.....
30	4.6	.....	5.2	6.1	5.25	4.9	5.15	5.05	6.05	5.25	5.1	.....
31	4.6	.....	5.1	.....	5.2	.....	5.0	5.0	.....	5.2	.....	.....

a November 10 to December 31, 1904, gage heights probably affected by anchor ice.

DAILY GAGE HEIGHT, IN FEET, OF LITTLE RIVER, NEAR TWIN MOUNTAIN, N. H.—*Concluded.*

Day	Apr.	May.	June.	July.	Aug.	Sep.	Day	Apr.	May.	June.	July.	Aug.	Sep.
1905							1905						
1	*a*	5.75	5.25	5.0	5.0	5.55	17	*a*	6.25	5.3	5.1	5.05	.....
2	.....	5.65	5.2	5.45	4.8	5.5	18	.....	6.45	5.3	5.0	4.9	.....
3	.....	5.75	5.45	5.5	4.8	6.1	19	.....	6.35	5.4	4.95	4.85	.....
4	....	6.85	5.4	5.85	4.75	5.8	20	.....	6.05	5.2	4.9	4.8	.....
5	.....	6.3	5.25	5.15	4.7	5.5	21	.....	6.0	5.2	4.9	4.75	.....
6	.....	6.5	5.85	5.05	4.7	5.4	22	.....	5.85	5.15	4.8	4.7	.....
7	.....	6.85	5.45	5.0	4.7	5.4	23	.....	5.6	5.05	4.8	4.8	.....
8	.....	6.45	5.45	5.0	4.95	.....	24	.....	5.55	5.0	4.8	4.7	.....
9	.....	6.5	5.3	4.9	4.95	.....	25	6.05	5.5	5.0	4.8	4.55	.....
10	.....	6.3	5.25	4.9	4.75	.....	26	6.05	5.6	5.3	4.8	4.4	.....
11	.....	6.3	5.2	4.9	4.7	.....	27	6.0	6.15	5.55	4.8	5.4	.....
12	.....	6.25	5.6	4.9	4.7	.....	28	6.0	5.9	5.4	4.7	4.95	.....
13	.....	6.1	5.55	4.9	4.75	.....	29	6.15	5.75	5.25	4.7	4.9	.....
14	.....	6.05	5.65	5.0	4.7	.....	30	6.25	5.75	5.15	4.9	5.7	.....
15	.....	6.1	5.4	4.95	4.75	.....	31	.....	5.55	.....	5.35	5.85	.....
16	.....	6.15	5.3	4.9	5.5	.....							

a River frozen January 1 to April 24, 1905.

DISCUSSION OF RESULTS.

In the previous report upon the Hydrography of the White Mountain Region, the hydrographic data obtained were considered in two parts: first, the records for the drainage basin of the Pemigewasset River, and second, the data which had been collected for the several basins during 1903–'04.

For the Pemigewasset basin there was available the records of gage heights, extending back to January 1, 1886, and rainfall records beginning with June, 1888, beside the data obtained by the survey. In the light of gagings made since 1904, it is probable that the bed of the river near the Plymouth gaging station changes in condition slightly from time to time, and a different rating curve has been used for 1905–'06. Consequently the estimates of flow made previous to September, 1903, may be considered as subject to some error, although it is believed that this is not very large. The following tables, regarding Pemigewasset River at Plymouth, continue the data presented in similar form in the first report, bringing it up to the present season:

PEMIGEWASSET RIVER AT PLYMOUTH, N. H.—TABLE SHOWING RATIO OF RUN-OFF TO RAINFALL FROM JUNE TO OCTOBER, INCLUSIVE, DURING THE PERIOD 1888 TO 1906.

Year.	Run-off. (Inches.)	Rainfall. (Inches.)	Ratio of run-off to rainfall.
1888	14.39	21.90	0.66
1889	15.42	21.22	0.73
1890	18.31	23.57	0.77
1891	6.51	16.62	0.39
1892	12.34	22.27	0.55
1893	7.71	17.58	0.44
1894	5.87	17.40	0.34
1895	4.95	16.39	0.30
1896	8.75	18.51	0.47
1897	14.55	17.58	0.83
1898	6.58	18.97	0.35
1899	2.74	13.92	0.20
1900	4.36	13.63	0.32
1901	6.79	16.70	0.41
1902	14.49	21.57	0.67
1903	7.97	18.78	0.43
1904	7.48	20.02	0.37
1905	11.18	24.43	0.46
1906 (June to September, inclusive)	5.51	10.60	0.52

Considering the 18 years, from 1888 to 1905, inclusive, and dividing this period into three parts,—six years, from 1888 to 1893, inclusive; six years, from 1894 to 1899, inclusive; and six years, from 1900 to 1905, inclusive. The average ratio of run-off to rainfall in the first period is 0.59; in the second period is 0.42 and in the third period is 0.44. Considering the 17 years, 1888–1904, inclusive, and omitting the five years, 1888, 1889, 1890, 1897 and 1902, as these show abnormally high ratios—perhaps due to exceptional conditions of ground water—we have 12 years. Dividing this into two periods of six years each, we find the ratio of run-off to rainfall in the first is 0.42 and in the second is 0.35.

In the following table have been arranged in cubic feet per second per square mile the minimum recorded run-off in each year, the mean for the lowest month and the mean for the three lowest months. The years from 1886 to 1906 have been divided into three periods of seven years each, and the average run-off in cubic feet per second per square mile for each period computed.

PEMIGEWASSET RIVER.

Year.	Minimum in cubic feet per second per sq. mile.	Mean for lowest month in cubic feet per second per sq. mile.	Average minimum for three low months in cubic feet per second per sq. mile.
1886	.30	.77	.85
1887	.57	.77	.79
1888	.50	1.11	1.73
1889	.39	1.75	2.16
1890	.44	1.88	2.45
1891	.24	.38	.63
1892	.30	.76	1.47
1893	.27	.39	.85
1894	.24	.28	.64
1895	.30	.48	.62
1896	.30	.80	.92
1897	.27	.42	.71
1898	.24	.47	.50
1899	.20	.32	.38
1900	.22	.35	.40
1901	.30	.42	.65
1902	.50	1.13	1.76
1903	.28	.43	.63
1904	.24	.55	.68
1905	.52	1.12	1.15
1906 (up to October 1)	.28	.36	.71
1st period (7 years)	.39	1.06	1.44
2d period (7 years)	.26	.45	.66
3d period (7 years)	.33	.62	.85

From the data which have been collected since September, 1903, the following tables are compiled, based on records of gage heights and numerous current meter measurements, and the rainfall records at the stations previously noted. The first of these tables shows the ratio of run-off to rainfall by months, of the different drainage areas. The second shows the average ratio of run-off to rainfall for the three months of July, August and September, 1904–'05–'06. The third shows the minimum recorded discharge in cubic feet per second per square mile for each of the three months, July, August and September, 1904–'05–'06; and the fourth shows the mean run-off in cubic feet per second per square mile for each of the stations for the months of July, August and September, 1904–'05–'06.

TABLE SHOWING RATIO OF RUN-OFF TO RAINFALL, BY MONTHS, FOR DIFFERENT DRAINAGE AREAS.

Rivers.	1903.	1904.								
	Oct.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Saco.....	0.51	2.10	2.20	0.74	0.88	0.20	0.22	0.73	.....	.....
Pemigewasset...	0.28	.....	1.70	0.48	0.15	0.27	0.80	0.94	1.20	.54
Israel (above)...	0.51	1.50	2.00	0.65	0.28	0.86	0.52	1.84	1.62	.....
Israel (below)...	0.38	1.40	1.90	0.67	0.26	0.31	0.50	1.30	2.03	.....
Ammonoosuc....	0.52	5.74	4.19	a0.63	0.26	0.27	0.34	1.12	.61	.....
Zealand.....	0.54	5.60	2.80	a0.61	0.19	0.24	0.78	4.72	4.12	.....

Rivers.	1905.									
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
Saco.....	.....	.....	.....	2.32	1.99	.55	.26	.43	.65	.88	.59
Pemigewasset..	.....	.....	.....	3.15	1.90	.50	.43	.27	.51	.63	.50
Israel (above)..	.....	.....	.....	.....	1.57	.96	.69	1.19	1.67	2.23	.75
Israel (below)..	.....	.....	.....	.....	1.46	.88	.64	1.17	1.29	1.73	.79
Ammonoosuc..	.....	.....	.....	2.43	1.97	.72	.41	.41	.62	.80	.60
Zealand	.....	.....	.....	.....	2.99	.98	.62	.56	1.14	1.89	2.07

1906.

Rivers.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
Saco	.....	.....	.....	3.09	1.25	.59	.50	.23	.24
Pemigewasset	.....	.....	.....	.....	1.31	.80	.35	.46	.27
Israel (above)	.....	.....	.....	.....	.....	.....	.....	.....	.....
Israel (below)	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ammonoosuc	.....	.....	.....	3.33	1.78	.39	.60	.27	.35
Zealand	.....	.....	.....	.....	2.53	1.15	.84	.49	.32

a Using rainfall at Jefferson Highlands.

TABLE SHOWING AVERAGE RATIO OF RUN-OFF TO RAINFALL FOR THE THREE MONTHS OF JULY, AUGUST AND SEPTEMBER, 1904–'05–'06.

Rivers.	1904.	1905.	1906.	Mean.
Saco	.27	.45	.34	.35
Pemigewasset	.24	.40	.36	.33
Israel (above)	.87	1.18	.....	.....
Israel (below)	.36	1.00	.....	.....
Ammonoosuc	.29	.48	.41	.39
Zealand	.40	.77	.55	.57

TABLE SHOWING THE MINIMUM DAILY RUN-OFF IN CUBIC FEET PER SECOND PER SQUARE MILE FOR SEVERAL RIVER BASINS, FOR THE MONTHS OF JULY, AUGUST AND SEPTEMBER, 1904–'05–'06.

Rivers.	Area.	1904.			1905.			1906.			Mean for three months.			Mean three years.
		July.	Aug.	Sept.	July.	Aug.	Sept.	July.	Aug.	Sept.	1904.	1905.	1906.	
Saco	385	.41	.39	.31	.56	.71	1.38	.66	.40	.28	.37	.88	.45	.57
Pemigewasset	615	.24	.35	.24	.51	.51	1.28	.51	.34	.28	.28	.77	.38	.48
Israel (above)	8.7	.25	.34	.61	.99	1.26	3.10	.78	.35	.46	.40	1.78	.53	.90
Israel (below)	21.2	.35	.47	.75	.99	1.18	2.40	.71	.57	.71	.52	1.52	.66	.90
Ammonoosuc	34	.44	.53	.62	.59	.97	1.38	.59	.44	.50	.53	.98	.51	.67
Zealand	14	.28	.28	.28	.71	.71	1.93	1.00	.57	.21	.28	1.12	.59	.66

TABLE SHOWING MEAN MONTHLY RUN-OFF IN CUBIC FEET PER SECOND PER SQUARE MILE FOR SEVERAL RIVER BASINS, FOR THE MONTHS OF JULY, AUGUST AND SEPTEMBER, 1904–'05–'06.

Rivers.	Area.	1904.			1905.			1906.			Mean for three months.			Mean three years.
		July.	Aug.	Sept.	July.	Aug.	Sept.	July.	Aug.	Sept.	1904.	1905.	1906.	
Saco	385	.65	.72	1.07	2.17	2.01	3.98	1.35	.68	.41	.81	2.72	.81	1.45
Israel (above)	8.7	.74	1.64	2.84	2.25	4.89	4.77	1.43	.90	1.10	1.71	3.97	1.14	2.27
Israel (below)	21.2	.82	1.43	2.71	2.07	4.81	3.68	1.51	1.13	1.33	1.65	3.52	1.32	2.16
Israel (between)	12.5	.87	1.29	2.62	1.94	4.76	2.92	1.58	1.28	1.50	1.59	3.21	1.45	2.08
Ammonoosuc	34	.75	1.05	2.37	1.40	2.03	2.55	1.75	1.02	.96	1.39	1.99	1.28	1.55
Zealand	15	.53	.93	5.46	2.12	2.74	4.65	2.44	1.84	.87	2.31	3.17	1.72	2.40
Pemigewasset	615	.55	.97	1.70	1.50	1.14	4.00	1.12	.64	.36	1.07	1.88	.71	1.22

DISCUSSION OF TABLES.

The first two tables are of doubtful value, and indicate plainly that in many cases the *average* precipitation over the various drainage basins was not obtained. These ratios for Israel River seem to be most widely at variance, indicating a much greater rainfall upon this basin than that shown at Jefferson Highlands.

The tables of minimum and mean run-off for the three summer months are of more definite value, although the number of years covered is too small to warrant definite conclusions.

It is evident that thus far the run-off has been rather high, as shown by the table of means for the three months. No *very dry* year has occurred as yet, although the present season (1906) has been one with considerably less than the average precipitation.

CONCLUSIONS AND RECOMMENDATIONS.

It is not possible to draw definite conclusions regarding the effect of deforestation upon run-off from the few years' data at hand. A good beginning has been made, however, in the study of this important question, and valuable information obtained, and it is hoped that the work can be carried on for several years to come and perfected more in detail, in the light of the experience gained in the past.

FOREST CONDITIONS IN SOUTHERN NEW HAMPSHIRE.

BY

CHARLES A. LYFORD, M. F.

and

LOUIS MARGOLIN, F. E.

November, 1906.

CONTENTS.

APPENDIX.

TABLES.

A. *Mill Tallies and Volume Tables.*

White Pine.

Chestnut.

Other Species.

B. *Yield Table for Second-Growth White Pine.*

C. *Financial Rotation for Second-Growth White Pine.*

APPENDIX.

A. *Mill Tallies and Volume Tables.*

WHITE PINE.

Volume Tables for Trees Less than 60 Years Old.

Volume Tables for Trees 60 Years and Older.

Volume Tables for All Ages Combined.

CHESTNUT.

B. *Log Rules.*

WHITE PINE.

HARDWOODS.

CHESTNUT.

ILLUSTRATIONS.

FOREST CONDITIONS IN SOUTHERN NEW HAMPSHIRE.

INTRODUCTION.

In March, 1905, the New Hampshire Legislature passed the following resolution, supplementary to one passed in February, 1903, which authorized the Forest Service (then the Bureau of Forestry) to conduct a general examination of the forests of the White Mountain region:

Resolved by the Senate and House of Representatives in general court convened, That the unexpended balance of the sum appropriated by Chapter 139, Laws of 1903, be, and hereby is, placed at the disposal of the Forestry Commission for use in the completion of the forest survey of the State, and the Governor is hereby authorized to draw his warrant for the same.

Approved March 10, 1905.

The results of the study authorized by the resolution of February, 1903, have already been published as Bulletin 55 of the Bureau of Forestry. The study of forest conditions in southern New Hampshire, authorized by the resolution just given, the results of which are here presented, completes the forest survey of the state.

The report may briefly be summarized as follows:

1. The area included is about 3,500,000 acres, or 57 per cent. of the entire state.

2. The present forest consists entirely of second growth, chiefly in small lots, but occupying about two thirds of the total land area. The forest area has been greatly extended by the abandonment of improved farm land, in rapid progress since 1880. White pine and gray birch have been the most aggressive in the process of restocking.

3. White pine, red oak and chestnut are the most important trees, and lend themselves the most readily to forest management. Methods of managing the various types of forest are proposed.

Under average conditions, the rate of growth in value for fully stocked white pine stands falls below 4 per cent. between fifty-five and sixty years of age.

Forest planting, both as a means of rendering productive abandoned fields and pastures and of assisting reproduction on lands already partially stocked with seedlings, should receive serious consideration.

With land at $5 and cost of planting at $7 an acre, and with money valued at 4 per cent., the financial rotation for white pine falls at fifty-five years.

4. The mill tallies show that:

(*a*) Under the present system of grading and with present prices, the appreciation in value of lumber due to improvement in quality with age is enough to prolong the financial rotation of white pine ten years.

(*b*) The appreciation in value of chestnut lumber due to improvement in quality with age may be left out of account for trees over sixteen inches in diameter.

(*c*) With present prices there is a slight advantage in cutting chestnut logs less than nineteen inches in diameter outside bark into switch ties, and larger logs into plank.

5. The forest fire problem is not a serious one, the chief demands being a further education of public sentiment, and a division of the expense of fire protection between the state and the towns.

6. The summer resort business is growing in importance, and should be encouraged by avoiding unnecessary clear cutting near places of special interest, and by leaving strips of woods along the roads.

7. The present method of taxing forests is unjust and the need for revision is urgent. A plan for taxing the gross income from forests at the time of final cutting is proposed.

8. A state forester is recommended to be head of the fire warden service, to furnish expert advice to forest owners, to collect and publish forest statistics, and to establish a state nursery.

Physiography.

Area.—The territory covered by this report and in it referred to as southern New Hampshire, is that part of the state lying south of an east and west line drawn through the northeast corner of the town of Freedom and passing through Tamworth and Sandwich in Carroll County, and through Campton, Rumney, Wentworth and Orford, in Grafton County. The area included is about 3,500,000 acres, or 57 per cent. of the entire state.

Topography.

New Hampshire, south of the White Mountains, may be divided into four topographic regions: (1) A hilly or mountainous area in the western portion, several miles wide and about eighty miles long, extending from the Massachusetts line near Winchendon northeastward to the center of Grafton County. The average height of this ridge is about 1,500 feet, the most prominent elevation being Monadnock, about 3,200 feet. Its western slopes are drained by the Connecticut River and its tributaries, the Mascoma, Sugar and Ashuelot rivers. The eastern slopes are drained by the Merrimack; (2) The southeastern portion of the state, extending about twenty-five miles inland from the coast, a low, level basin with only occasional hills. It is drained by the Piscataqua River, and its principal tributary the Salmon Falls River; (3) Between these two regions a well-drained, rolling stretch of country over 3,500 square miles in extent, with an average elevation of less than 600 feet. Occasional eminences like Kearsarge Mountain and the Mink Hills reach a much greater height. It is drained by the Merrimack River, which is formed by

the junction of the Pemigewasset, draining Squam and Newfound lakes, and the Winnipesaukee River, draining the lake of the same name; (4) The lake district, consisting of the large basin of Winnipesaukee, Squam and Ossipee lakes, lying mostly in Carroll County. This is essentially a plain with four isolated mountains imposed upon it, of which Gunstock and Ossipee reach a height of almost 2,400 feet.

Soil.—There are four general classes of rocks underlying the surface of New Hampshire, and in consequence four general classes of soil. In the Connecticut River Valley north of Claremont, and in the extreme northern part of the state, in the vicinity of Colebrook, the rock is mostly limestone. The soil is fertile and here is the best agricultural land. South of Claremont, in the eastern part of the valley, the rocks are slates and schists, and the soil therefore contains a large percentage of lime and magnesia. This is fertile and well suited for agriculture. A soil very similar to this is produced by the rocks bordering the coast of Rockingham County, and extending northward up the Piscataqua River. The remainder of the state is underlain by gneiss and granite, which produce soil of various qualities according to the local character of the country.

During the glacial period rocks were ground up and the soil was transported long distances. For this reason fertile lime soils are now found in many places south and southeast of Colebrook and Claremont. In the south-central part of the state the pulverization a d solution of the granite rocks by the ice and water added potash to the soil, thus benefiting it.

Though often fertile, by far the largest portion of southern New Hampshire is rendered unfit for agriculture by the great mass of boulders covering the surface of the land, or because the soil is not deep enough, or because it is too sandy.

Climate.—The climate of southern New Hampshire is in

the main much like that of the rest of New England. The following table gives the average temperature for a number of years:

	Mean temperature		
	Yearly	Summer	Winter
In the vicinity of Manchester, N. H.,	48°F.	70°F.	26°F.
In the Monadnock region,	42°	64°	21°
In southern New Hampshire,	44-48°	66-70°	21-26°

The average annual amount of precipitation in this region is between thirty-five and forty inches, which is more than enough to support a good forest growth. The amount of rainfall varies from place to place. In the southwestern part of the state it is forty-three inches. Near Portsmouth it is thirty-five inches, while it is forty-five inches in the Merrimack Valley between Manchester and Nashua.

The Original Forest.

Of the original forest which once covered southern New Hampshire practically nothing remains. From few small virgin stands, a study of the present second-growth forests, and bits of local history, however, a general idea of its composition can be gathered.

Along the river valleys and on the sandy soils in the eastern part of Rockingham County, white pine was predominant, with red and pitch pine occupying the drier, gravelly soils. On the higher elevations, with a lower limit approximating the 1,500-foot contour, red spruce found its home. The intermediate uplands, comprising the bulk of the area, supported a growth of mixed hardwoods and hemlock, with white pine scattered singly or in groups. In the swamps, which, although small, are common at all elevations, grew red maple, black and white ash, black gum, balsam, spruce, tamarack and, near the coast, white cedar.

The composition of the hardwood mixtures was variable. Associated with pine in the low-lying region, from the

lower Merrimack Valley to the coast, were white oak, black oak and red maple, with smaller proportions of red oak, black and paper birch, hickory, black cherry, elm, basswood, white ash, sugar maple, and beech. With the increase in elevation north and west, black oak disappeared, white oak became less common, and red oak appeared among the leading species, which, with considerable local variation, comprised red oak, red and sugar maple, black and yellow birch, beech, and, within their commercial range (see map), chestnut and white oak. Species of secondary importance were paper and gray birch, popple, white ash, elm, basswood, black cherry, butternut, and hickory. Above 1,200 feet elevation, yellow birch, sugar maple and beech became more prominent, and, in mixture with spruce, reached an altitude of 2,400 feet.

With the settlement of the country, lumbering and fire began to have their effect upon the forest, gradually transforming it from a few uniform, relatively permanent types to an irregular mixture of temporary types, all with a tendency to revert naturally to the original type. At first only the more valuable pine and oak were cut, and this culling process, by encouraging the less valuable species, exerted an unfavorable influence upon the composition of the forest. The demands of an increasing population, however, with the consequent improvement of transportation facilities, gradually led to the utilization of inferior material, and thus encouraged clear cutting. This clearing of the forests, supplemented by fire, was followed by an even-aged second-growth, the composition of which was largely determined by the relative abilities of the various species to reproduce under the conditions thus brought about. The hardwoods, which all sprout from the stump, were given an advantage over the softwoods, which do not sprout. White pine, although further handicapped by the infrequency of its seed years, escaped serious depletion by virtue of its rapid and vigorous growth. The slow-growing hemlock quickly overtopped in the competition for growing

NO. 2.—GENERAL VIEW, SHOWING BROKEN CHARACTER OF WOODLAND.

space, was enabled to continue the struggle for existence by its extreme tolerance of shade. Paper birch, gray birch and popple, with their light, wind-blown seed and rapid growth, became more abundant. Oak and chestnut, superior in sprouting capacity, at least held their own. And pitch pine, with its thick, fire-resisting bark and its meager demand for moisture, came to be the sole survivor on sandy or gravelly soils repeatedly swept by fire.

A third factor of importance in transforming past to present conditions has been the reversion of cleared land to forest. According to the reports of the United States Census, about one million acres of improved farm land has been abandoned in New Hampshire, mostly since 1880. This amounts to one fourth of the area included as southern New Hampshire. In restocking this land, white pine and gray birch have been most aggressive; and since gray birch is a short-lived, thin-foliaged tree, easily crowded out of existence, this process has greatly extended the area occupied by pine. But, as a result of insufficient seeding, most of the stands thus established were too open for proper development. Consequently the trees are many of them bushy in form, and much growing space has been wasted.

At the present time stands over eighty years old are rare. Below this all ages are well represented. In the vicinity of the older settlements, however, especially in the southeastern part of the state, most of the woodland has been cut over two or three times, and sapling stands are more abundant than elsewhere.

The Present Forest.

Extent.—The present forest occupies about 66 per cent. of the total land area. The greater part of it is composed of small lots, rarely exceeding 200 acres in extent, with cleared land interspersed. This necessitates a broad classification of the area according to the proportion of forest

and cleared land. On the accompanying map the area is divided into four classes as follows:

	Land area		Forest area	
	Acres.	Per cent.	Acres.	Per cent.
I. Over 90 per cent. forest (average 95 per cent.),	816,694	24.5	775,859	35.3
II. 50 to 95 per cent. forest (average 75 per cent.).	1,689,446	50.7	1,267,084	57.6
III. 10 to 50 per cent. forest (average 25 per cent.),	605,907	18.3	151,477	6.9
IV. Less than 10 per cent. forest (average 2 per cent.),	216,621	6.5	4,332	.2
Total,	3,328,668	100.0	2,198,752	100.0

The averages given are rough estimates, and the forest areas which are based on them therefore are only approximately correct.

In interpreting the results of this classification, it should be remembered that classes 2 and 3 are based on broad averages, and may include areas of unbroken forest or cleared land up to six or seven hundred acres in extent.

A study of the map reveals the following facts:

1. Class I is largely confined to the higher altitudes, but is found at lower elevations wherever unfavorable soil conditions have either prevented improvement for farms or else hastened their abandonment and reversion to forest.

2. Class II is the most extensive. It is also widely distributed, being common at all elevations.

3. Class III occurs partly as an extension of Class IV up the river valleys, but is also found in considerable quantities at higher elevations.

4. Class IV is almost entirely confined to the lower portions of the main river valleys.

It is also interesting to note that Class IV comprises only one fifth of the total cleared area, the other four fifths being mixed with forest, while of the total forest area one third is included in Class I.

Classification of the Forest.—A division of the existing forest into definite types is impracticable. Not only are recognized types numerous and ill-defined, with many intermediate gradations, but they are intermixed in quantities too small to be shown on a map of convenient scale.

The following scheme of classification was, therefore, adopted:

	Acres	Per cent.
Softwoods—over 80 per cent. softwoods,	38,012	1.2
Softwoods-hardwoods—50 to 80 per cent. softwoods,	790,105	23.7
Hardwoods-softwoods—50 to 80 per cent. hardwoods,	2,229,965	67.0
Hardwoods—over 80 per cent. hardwoods,	33,619	1.0
Pitch pine and scrub oak,	20,346	.6
Barren land,	7,507	.2
Less than 10 per cent. forest,	209,114	6.3
Total land area,	3,328,668	100.0

The above areas include both forest and cleared land. In order to obtain the areas actually occupied by forest, each type was subdivided into the classes given in showing the distribution of forest and cleared land, and the area of each subdivision multiplied by the average per cent. accepted for that class. The results of these calculations follow:

	Forest area	
	Acres	Per cent.
Softwoods,	24,143	1.1
Softwoods-hardwoods,	561,040	25.5
Hardwoods-softwoods,	1,585,836	72.1
Hardwoods,	8,405	.4
Pitch pine and scrub oak,	19,328	.9
Total forest area,	2,198,752	100.0

Under the head of softwoods are included all conifers or evergreen trees, of which only white pine, spruce and hemlock are important. The hardwoods, or broad-leaved trees, are more numerous. Those of importance are paper, black, yellow, and gray birch, red and sugar maple, red and white oak, chestnut, beech, white ash, and popple.

Softwoods.—With the exception of a small patch of spruce near the summit of Mount Monadnock, this type consists chiefly of white pine, and is confined to a few small areas within twenty miles of the coast. Near Fremont the type presents an unbroken forest, including many merchantable stands from fifty to eighty years old. Elsewhere it is found in agricultural sections, and comprises more or less scattered stands, most of which are too young to be merchantable. These consist usually of a mixture of white pine and gray birch. Since, however, gray birch is either removed for firewood or crowded out by the pine, it was disregarded in mapping.

Softwoods-hardwoods.—This class includes those portions of the present forest in which the original proportion of softwoods has been reduced, but not below 50 per cent. The bulk of it occurs in a continuous body, extending from the lower Merrimack Valley eastward to the coast, and thence northward in a narrow strip along the state line to Lake Winnipesaukee. A considerable amount is also found along the divide between the Connecticut and Merrimack watersheds, where, above 1,500 feet elevation, the softwoods are reinforced by spruce.

Hardwoods-softwoods.—This covers most of the area formerly occupied by the extensive hardwoods-hemlock-pine type referred to in the description of the original forest, and has encroached to a considerable extent upon the pine and spruce types. The proportion of softwoods has decreased, but the aggressiveness of pine and spruce in restocking abandoned farm land has prevented serious depletion.

Hardwoods.—The two areas falling under this head are situated in a farming section near the headwaters of minor tributaries to the Connecticut River. The small quantity of softwoods may be explained by the lack of abandoned farms and the abundance of sugar orchards.

Pitch pine and scrub oak.—In this type are included areas northeast of Lake Winnipesaukee, on which the soil

is coarse sand or gravel. The original forest was composed largely of red and white pine, but fires which followed lumbering have repeatedly swept the ground, which now is covered with a growth of scrub oak and scattered pitch pine, the only species able to endure such adverse conditions. Similar areas, though smaller, are found elsewhere, especially in the Merrimack Valley.

Barren land.—This includes land incapable of supporting commercial tree-growth, such as the summits of the higher mountains and the sandy barrens near the coast.

Commercial Range of Important Trees.—On the accompanying map is shown the range within which five important trees are found in commercial quantities. White pine and red oak were chosen because of their leading importance, and spruce, chestnut and white oak because of their limited range. The other trees are either of wide distribution or of minor importance.

An examination of the map brings out the following facts, considering which it should be kept in mind that even within their ranges, white pine, red oak, white oak, and chestnut are in general confined to elevations below, and spruce to elevations above, 1,500 feet.

1. White pine and red oak have a common range, broken only by the southern extension of the White Mountains.

2. Spruce is found in a belt, averaging about twenty miles in width, extending from the White Mountains southward along the divide between the Connecticut and Pemigewasset-Merrimack watersheds.

3. Chestnut extends in a broad tongue up the Merrimack Valley to Franklin, and in a narrow strip up the Connecticut River to Charlestown.

4. White oak extends up the Connecticut and Merrimack valleys a little beyond the chestnut, reaching the south shore of Squam Lake and the west shore of Lake Winnipesaukee; also from the lower Merrimack Valley eastward to the coast, and thence northward in a narrowing strip to the southeast shore of Lake Winnipesaukee.

LUMBERING.

Lumbering forms one of the leading industries of the state, the unfinished lumber products from southern New Hampshire alone amounting in 1905 to over $4,000,000. By far the most important species, both in value and quantity, is white pine, although large quantities of hemlock, oak, chestnut, and other hardwoods are also cut.

Stumpage is bought by the woodlot, rather than by the acre, cord, or thousand board feet. A lump sum of money is paid for the privilege of stripping an entire tract clean. The lumberman sets up his mill, saws all the trees fit for lumber, and cuts the rest into cordwood. The cleared land then reverts to the original proprietor. In exceptional cases timber is sold in the log, when a decimal cord scale is used by which the diameter outside the bark at the middle of the log gives the contents in cords. For reducing cords to board feet it is common practice to allow three cords to 2,000 feet board measure.

The small portable mill with a circular saw and a capacity of 15,000 feet per day, but cutting on an average only half that amount, is the most common type in use. There are few large stationary mills, and still fewer portable band-saw mills. The lumbering is usually done by contract, a certain sum per thousand feet being paid for cutting, hauling the logs to the mill, sawing them into boards, and "sticking" the lumber. Occasionally the contract for each of these operations is sublet to a different person. A general average for the cost of the entire process of manufacture, which includes loading the lumber on the cars, is about $7 per thousand board feet.

Since the value of lumber in southern New Hampshire is high, very little is wasted or left in the woods. This is especially true of white pine; logs measuring only two inches inside the bark at the small end and yielding only a foot or two of lumber are occasionally brought to the mill and sawed. The hardwoods are not so closely utilized. Large tops are sometimes left in the woods, though they are

NO. 3. PORTABLE SAWMILL.

NO. 4. LUMBER ON STICKS—SLASH IN BACKGROUND.

NO. 5. WHITE PINE SLASH.

frequently cut and sold as cordwood. The bulk of the lumber is cut round edge; that is, the boards are not passed through an edger. The better pine logs, however, are often so manipulated on the saw-carriage as to yield a certain quantity of square-edged boards.

Forest Fires.

Southern New Hampshire has not suffered from forest fires for a long time. This is due chiefly to the cleared land and roads, which break the forest and act as fire lines. The abandonment of farms, however, in rapid progress since 1880, and the increase in the number of people who frequent the woods for pleasure, are increasing the danger from this source, and call for greater precautions to prevent and control forest fires.

Approximately 35,000 acres of forest land have been burned over in the last five years. This area comprises a large number of small burns, widely distributed and representing a comparatively small amount of direct damage. Many of the fires occurred on land recently cut over, and those in merchantable stands, even where severe enough to kill the trees, caused little direct loss, since dead timber, if removed promptly, may be sold without other sacrifice than that arising from its forced utilization. The indirect damage, however, was much greater, since it must be measured by the loss of many years' growth in seedlings and saplings, and the deterioration due to the destruction of the vegetable soil.

The chief causes of forest fires are two: the railroads and the carelessness of pleasure seekers in the woods. Southern New Hampshire has many miles of railroad, and a large portion of the right of way adjoins woodland. The engines are equipped with spark arresters, but this measure of prevention is not sufficient, for in dry weather the smaller sparks escape through the meshes of the screen and frequently cause forest fires. Pleasure seekers, through carelessness either in leaving campfires or in dropping burning matches and cigar stubs, are responsible for a

great many fires. Minor causes of fire are brush burning and portable sawmills.

The railroads are prompt and liberal, both in furnishing assistance to fight fires set by them, and in paying damage for losses, direct or indirect, occasioned by such fires. Having thus accepted their share of the responsibility, they may be relied on to do all in their power to prevent fires. The chief improvements called for are:

1. A more efficient spark arrester.

2. A more thorough patrolling of the line during dry periods. Especial attention should be given to those portions of the line where the condition of the adjoining woods is most dangerous. A railway bicycle would be very convenient for the purpose of patrol.

3. A more active coöperation on the part of the owners of the adjoining woods, both in increased vigilance during dry periods, and in precautionary measures, such as safety strips. Adequate protection could be secured by a strip of woods 50 to 100 feet wide, adjoining the right of way, and annually cleared of inflammable material by raking and burning. Still further security would be afforded by a road or path, on which the mineral soil was kept exposed, extending between the strip and the protected woods. All cutting on this strip should be confined to the removal of single trees here and there, thus securing reproduction and renewal of the stand without interfering with its protective function.

Fires set by pleasure seekers are due entirely to carelessness, and the remedy lies in a further education of public sentiment. This may best be accomplished by the posting of notices impressing the necessity of care in regard to fires, and the strict enforcement of the fire laws.

Where the danger from fire is especially great, existing roads and trails should be kept clear of inflammable material and allowed to serve as fire lines.*

*For a full discussion of the fire question, including methods of fighting fires, see Report of the New Hampshire Forestry Commission for 1903-'04, pages 77 to 98.

Forest Management.

The forests of New Hampshire have suffered severely from the lack of intelligent management. They have been cut and culled without regard to the future, and have consequently deteriorated. By adopting a simple system of management a gradual improvement may be brought about. Unlike the White Mountain region, where the population is sparse, markets distant, and the predominating trees of slow growth, conditions in the southern part of the state lend themselves quite readily to the practice of forestry. Since all methods of management must be based on a knowledge of the silvical characteristics of the various trees in the forest, the important tree species will be considered separately. In applying the methods suggested below it should be remembered that forest management in the region has yet to pass through the experimental stage, and that, therefore, all methods are more or less dependent on future experience.

White Pine.—White pine is the most important tree in southern New Hampshire. The qualities which combine to make it so are its rapid growth, the extensive demand for its lumber, and its ability to grow in nearly all situations.

Silvical characteristics.—White pine is common at all elevations below 1,500 feet. It is adapted to a variety of soils, but grows most rapidly where the supply of moisture is plentiful and the soil well drained. On dry, sandy soils there is less competition from other species, and pine is more abundant, but its growth is slower. It cannot endure the excess of moisture in the swamps or the salt sea-breezes near the coast.

White pine is only moderately tolerant of shade. During the first few years of their existence the seedlings are less exacting, but their further development is dependent on a fairly abundant supply of light. Although the root system is distinctly lateral, the roots are deeply enough

embedded to give the tree a firm hold on the soil, rendering it more wind-firm than the shallow-rooted spruce.

The age at which white pine trees begin to bear seed varies considerably, but effective seeding cannot be relied upon before the fortieth year. Full crops of seed are borne only at intervals of from three to seven years. The seed are borne in cones, or "burrs," and require two years for development. At the end of the first summer the immature cones are about one inch long and may be found on twigs of the current season's growth. By these young cones a heavy crop of seed may be foretold a year in advance. The mature cones are four to six inches long and usually begin to open early in September. The light, winged seeds, two under each scale, are thus freed from the cone and in a strong wind may be carried several hundred feet. The cones remain on the tree until the following spring.

Germination of the seed cannot take place without a certain amount of moisture, and to further develop the roots of the seedling must come in contact with mineral soil. For this reason reproduction from seed cannot be secured where the soil is fully exposed to the drying action of the sun or where the litter of leaves and other vegetable matter is sufficient to prevent the roots of the seedling from reaching mineral soil. The growth of the seedling is slow at first, usually less than a foot for the first five years. After this the height growth becomes very rapid, averaging one to two feet annually for the next fifty years.

The only serious source of damage from natural causes is the white pine weevil. This insect appears in its adult or beetle form in the spring, and lays its eggs in the bark of the leading shoot, rarely attacking trees over thirty feet in height. The larvæ soon hatch, and during the summer feed on the tissue of the shoot, invariably killing it. One or more side branches turn up to replace the leader thus killed, resulting in a permanent crook or fork. A dense stand is less susceptible to injury from this source than an

open one, and the only practical remedy that may be applied as a check to this evil is the adoption of methods of regeneration that will insure proper density during the early stages of growth.

Management.—White pine may be grown to best advantage in pure, even-aged stands under a clear cutting system of management. An undergrowth of some shade-enduring species, such as sugar maple, may be of value as a soil cover, and will assist materially in cleaning the pine of its side branches, but it should not be allowed to interfere with the main crop. Where reproduction is secured by planting, this undergrowth may easily be regulated.

Until the stand is about thirty years old* it should be kept dense, in order to kill the lower branches while they are yet small. All cutting should be confined to the removal of any gray birch or other undesirable trees which are interfering with the pine. The first thinning should be made about the thirtieth year, or as soon after as the resulting returns will balance the cost of the operation. From 150 to 200 of the best developed, most promising trees on each acre should be selected for the final crop. The surrounding growth should then be thinned sufficiently to give the crown of each selected tree a chance to spread slightly. This operation should be repeated as often as the growing space thus provided becomes filled by the growth of the crowns. The thinnings should further include all overtopped and suppressed trees which can be marketed at a profit.

If higher grades of lumber than box boards or pail stock are desired, pruning may be advisable. This operation should be confined to stands in which the lower branches have been killed while small, and should consist in the removal at the time of the first thinning from the trees selected for the final crop of all limbs for at least one log length. The limbs should be cut off as close as possible to

* The age of pine may readily be determined in young stands by counting the whorls of branches (distributed at intervals of six inches to two feet along the main stem) allowing five years for the first foot above the ground.

the stem of the tree, avoiding unnecessary injury to the bark. The practicability of pruning may roughly be determined by estimating the added value at maturity due to pruning, discounting this at an acceptable rate of interest to the time of pruning, and comparing this discounted value with the actual cost. For example: Assume the added value at sixty years of age to be $1 per tree. Discounting this at 4 per cent. compound interest to the time of pruning, gives thirty-one cents. In this case an expense for pruning up to thirty-one cents per tree would be justified. At 5 per cent. the limit of expense would be twenty-three cents.

The determination of the financial maturity of the stand is explained further on in connection with the yield table for white pine. When the time for the final cutting has arrived, the chief problem is to secure a succeeding stand as cheaply as possible. Two methods are proposed, the choice of either being largely dependent on the results of future experiments:

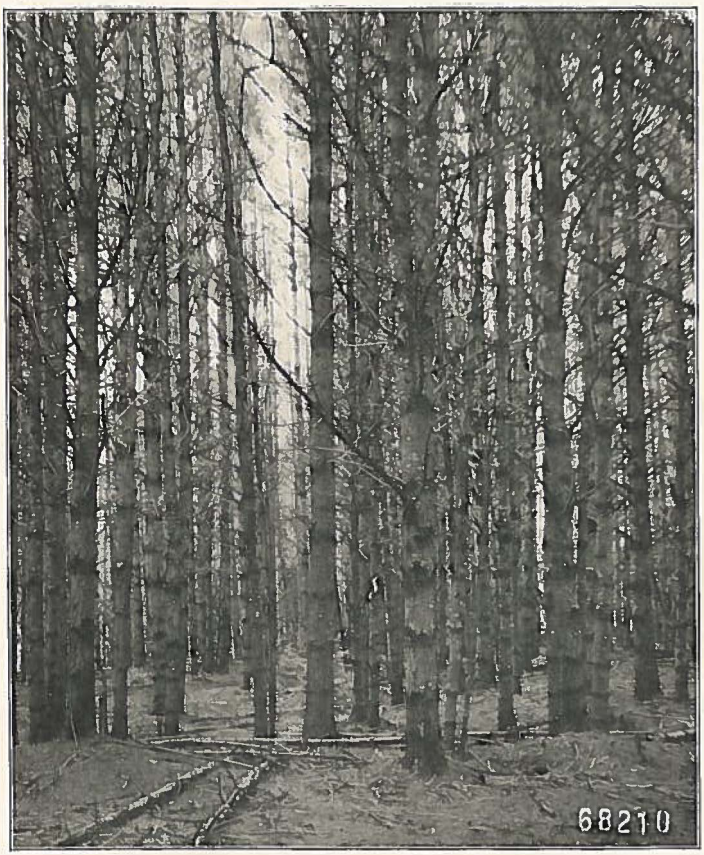
1. To cut clear, burn the slash, and plant the whole area the following spring. An unmerchantable growth, however, which will not seriously hinder planting operations, should be left in lumbering, since partial shade is beneficial until the seedlings begin to show a thrifty growth.

The main advantages of this method are that it insures comparative certainty of results, avoids loss of time in restocking, and secures the greatest possible yield from a given area. Its general adoption is restricted by the following considerations:

(*a*) The risk of loss by fire and the uncertainty of taxation.

(*b*) Forest planting can be perfected only by extended trial, and until this experimental element has disappeared its practice will be restricted to those who can afford the risk of failure.

(*c*) The direct outlay for planting involves a greater present sacrifice. and even though the ultimate return



NO. 6.—AN UNTHINNED WHITE PINE STAND.

NO. 7. THE SAME STAND THINNED.

NO. 8.—A WHITE PINE STAND BADLY IN NEED OF THINNING.

NO. 9.—A SIXTY-FIVE-YEAR-OLD WHITE PINE STAND,
showing retarded crown development resulting from long-continued crowding.

justifies it from a pecuniary standpoint, the remoteness of realization, usually beyond the life of the owner, often more than offsets the financial advantage.

2. To cut clear, leaving about three seed trees per acre, and avoiding the destruction of any unmerchantable growth which can serve as ground cover after logging.

The disposal of the slash will depend on the danger from fire. If the risk is considerable the slash should be burned, preferably on the snow, in order to reduce to a minimum the destruction of seed and seedlings. If the risk is slight, the brush should be scattered to hasten its decay.

For best results the cutting should follow closely a full seeding, which is indicated by a heavy crop of cones, from which the seeds are shed during the month of September.

The trees selected for seeding must be wind-firm. This quality in a tree depends chiefly on the degree in which it has been exposed to the action of wind. The choice will therefore be restricted to those trees whose crowns have been partially or wholly unprotected by their neighbors. Further, the seed trees should be located with reference to prevailing winds at the time of seeding. The carrying distance of the seed is largely controlled by the relation between slope and wind direction. On level ground effective seeding cannot be relied upon beyond a distance greater than two or three times the height of the tree.

This method by no means insures a reproduction of pure pine. The light seeded birches are almost certain to obtain a footing, while maples and other species are also likely to enter the mixture. The establishment of pine may often be assisted at small expense by transplanting seedlings three or four years old from the denser groups to the more open places. As soon as the reproduction is as complete as conditions will permit, the seed trees should be removed and the openings thus made filled by planting.

Another method of reproduction cutting worthy of trial, but applicable only to tracts of considerable extent, consists in clearing successive strips at right angles to the pre-

vailing winds, progressing from leeward to windward, and relying on seeding from the adjoining woods.

Uneven-aged stands.—Uneven-aged stands are the result of a partial stocking of abandoned farm land, followed by a gradual filling of the blanks. In many cases this process has been so slow that the trees first established have reached seed-bearing age and themselves assisted in the final completion of the stand. The older trees are usually scattered and bushy, while the younger ones occur in dense, even-aged groups.

Treatment.—If planting is practicable, remove the large, bushy trees wherever the surrounding growth is less than ten or fifteen feet high, and plant the openings thus made the following spring.

Thin the even-aged groups according to the instructions given for even-aged white pine.

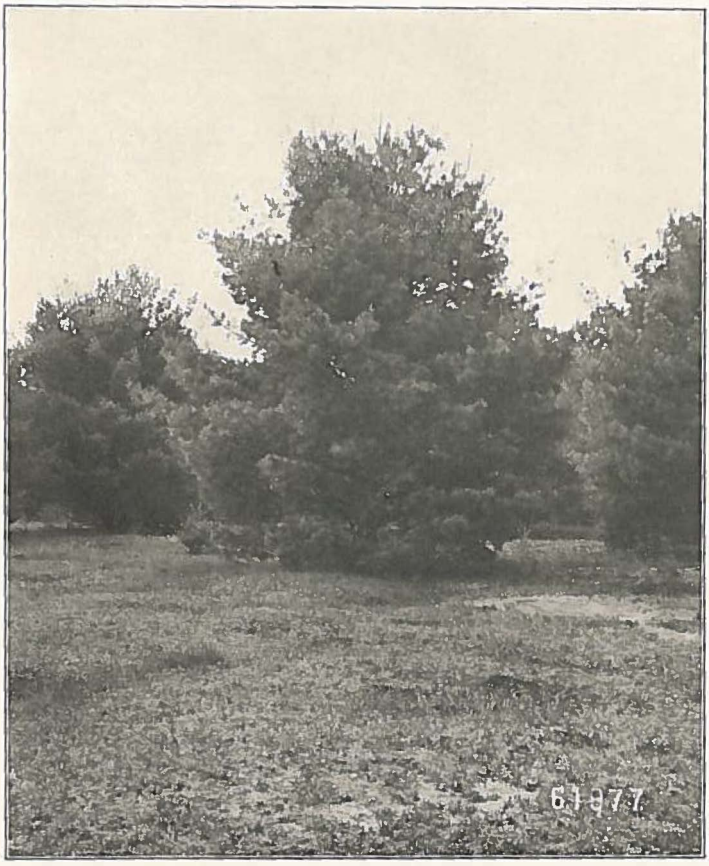
At maturity, cut clear and reproduce either by seed trees or by planting.

In determining the financial maturity of the stand, the relative proportion of the various age classes must be taken into account. The lower limit is the time at which the youngest class reaches merchantable size, and the time of maturity will advance with an increase in the proportion of the younger age classes.

Abandoned farm land partially stocked with white pine.—This is one of the most common types in southern New Hampshire. At least 800,000 acres of improved land have been abandoned since 1880, and a large part of this area is not yet fully stocked with trees. White pine and gray birch form the bulk of this volunteer growth, which is usually irregular, both in age and density. Where the trees are scattered singly, the stimulus of direct light from all sides has led to a bushy form, expressively called "cabbage pine." Where the trees occur in groups, those in the interior show proper form development, but unless the groups are unusually extensive, the bushy marginal trees occupy a large part of the growing space. The blanks

NO. 10. WHITE PINE REPRODUCTION ON ABANDONED PASTURE.

NO. 11. IRREGULAR GROWTH OF WHITE PINE ON ABANDONED PASTURE.



NO. 12. "CABBAGE" PINE.

NO. 13. FURTHER DEVELOPMENT OF "CABBAGE" PINE.

between the trees are usually grassy, but in some places, especially in the southeastern part of the state, they are partially or wholly filled with a growth of shrubs.

Treatment.—1. If planting is practicable. Cut all bushy or otherwise defective pine which will pay for their removal. This will generally include all such trees large enough to yield a 10-foot log four inches in diameter at the small end. In addition, cut all other merchantable pine, except those in fully stocked, even-aged groups more than one fourth of an acre in extent.

Where the chances for natural seeding are slight, complete the stand by planting white pine. Where, on the other hand, the chances for natural seeding are good, with seed trees less than 200 feet to the windward, all blanks bordered by trees less than three or four feet high should be left to nature awhile longer. Where the bordering trees are higher, the blanks should be planted at once, in order to prevent the trees from growing bushy.

2. If planting is not practicable. The stand will gradually be completed by natural seeding, and become subject to the treatment proposed for uneven-aged stands.

As influencing the practicability of planting, it is worthy of note that a supply of seedlings may often be cheaply obtained by thinning the denser clumps of volunteer growth, and that the returns will be measured, not entirely by the growth of the trees planted, but also by the improvement in form of the trees already on the ground.

White Pine and Gray Birch.—Gray birch is the common associate of white pine in restocking abandoned farm land. It usually precedes the pine and grows rapidly from the start, but, being short-lived, thin-foliaged, and very intolerant of shade, it is readily crowded out. In the struggle, however, the pine is apt to be seriously damaged by the lashing of the limber birches, and suffers still further injury when the dying birches are finally bent to the ground under a load of snow or sleet.

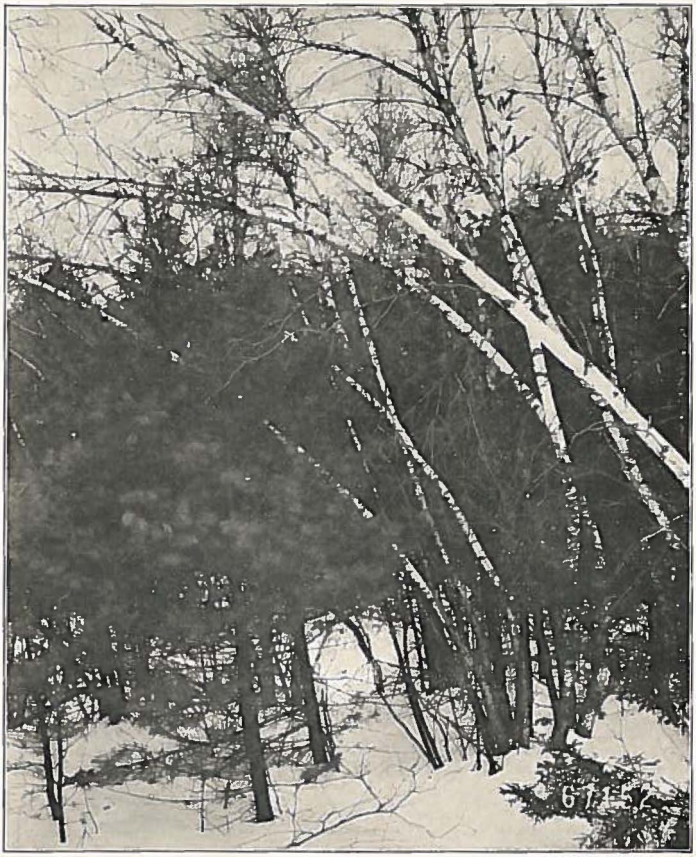
Treatment.—Remove all merchantable gray birch which

threaten to damage the pine, even though the operation barely pays for itself. In general, the danger is greatest when the two species are approximately of the same height. If the birch can be marketed at a profit or utilized to advantage by the owner, care should be taken to cut it before it begins to decay. As a general rule, gray birch rarely exceeds five inches in diameter without becoming unsound. Pure gray birch should be cut clear at maturity, and, if practicable, the area should be planted with white pine. The sprouting of the birch stumps may be checked by timing the cutting as closely as possible with the beginning of decay, and by cutting in late summer so that the young shoots may not have time to harden before the early frost.

Mixed stands.—Fully 90 per cent. of the forest of southern New Hampshire consists of mixed stands, the composition of which is extremely variable, including almost every conceivable combination of species. The problems of management are correspondingly varied and the following directions are intended to serve only as a general guide, the specific application being of necessity left to the judgment of the owner.

Treatment.—The management of mixed stands should aim both to hasten their development by thinning and to improve their composition by favoring the more desirable kinds of trees.

The general rule of thinning is the same as that proposed for pure white pine, but the variety of species makes the problem more complicated. The relative desirability, or the relative tolerance of shade, of the different species will often influence the choice of trees to be removed. Thus the red maple, where it overtops a more valuable species such as the red oak, should be taken out; and the sugar maple, which is very tolerant of shade, may often serve to advantage as an understory, a position in which the light-needing birches could not exist. The final or reproduction cutting is also complicated by the variety of species. The conifers, which do not sprout, must be reproduced by seed; the chest-



NO. 14.—DAMAGE TO WHITE PINE AND GRAY BIRCH.

NO. 15. MIXED HARDWOODS.

NO. 16. WHITE PINE IN MIXTURE WITH HARDWOODS,
Showing superior height and crown development of the pine.

NO. 17. SPROUT CHESTNUT WITH SECOND-GROWTH HARDWOODS.

nut and oaks, superior in sprouting capacity, may be reproduced by sprouts from the stump; and each species possesses certain peculiarities which must be taken into account.

In short, the proper management of mixed stands is primarily dependent on a knowledge of the relative values and silvical characteristics of the various trees in the mixture. Accordingly the essential facts for the important trees are presented below.

Chestnut.—Chestnut is occasionally found in nearly pure stands, but is usually in mixture with other species, occurring either singly or in scattered groups. It shows a preference for well-drained slopes and ridges, and is never found in swamps and rarely at the bottoms of ravines. The essential requirement for satisfactory development is a well-drained soil, fairly deep, and moderately fertile. In tolerance of shade it may be classed with white pine. Although its root system is distinctly lateral, chestnut may be classed as a deep-rooted species. No deep taproot is developed, but the side roots, which spread out extensively, are often three feet or more below the surface of the ground.

Reproduction takes place chiefly by means of sprouts. The capacity of this species for producing sprouts from the stump is exceptional, and has been the chief means of preserving it on cut-over land. An abundance of seed is borne, with full crops every two or three years, but only a small portion escapes destruction by animals and man, and the few seedlings that appear are apt to be devoured by cattle or to perish for want of light. In rate of growth, chestnut ranks with white pine. Sprouts from the stump are less persistent in growth than trees of seedling origin, but grow very rapidly at the start, usually from three to six feet during the first season. Seedlings are longer-lived, but, since they must develop a root system of their own, their growth at first is slower, rarely exceeding eight inches the first year.

The extensive demand for chestnut ties, poles and posts,

and the exceptional sprouting capacity of the species, unite to make a sprout system of management the most profitable. A rotation of thirty-five or forty years will yield sizes suitable for ties and posts, and fifty years will afford a considerable amount of saw timber and poles. To encourage a vigorous sprout growth, the final cutting should be made during the late fall, winter or early spring, since sprouts from summer cuttings are likely to be killed by the early frosts before they have time to harden. It is not definitely known how many successive crops of sprouts may be grown from the same stump, but even under the most favorable conditions the number is certain to be limited, and it will always be advisable to encourage seedling growth.

Red Oak.—Red oak usually occurs as scattered dominant trees in mixture with other species, rarely forming over 50 per cent. of the stand. It seems to prefer the gentle to moderate slopes where the soil is fairly deep and well-drained. A shallow, rocky soil is usually unfavorable, but wherever the rock is broken up sufficiently to allow the entrance of the stout, down-reaching roots, a fairly good development is possible. The young sprouts and seedlings can stand a moderate amount of shade, but do not demand it, and are sooner or later suppressed and killed if overtopped by larger trees In sprouting capacity and rate of growth, red oak closely approaches chestnut.

Its excellent form development, freedom from defects, and the consequent high value of large logs, together with its wind-firmness and usual scattered occurrence, will often make it advisable to hold over trees of this species for a second rotation.

White Ash.—White ash is widely though scatteringly distributed. It thrives best in moist situations, often associating with black ash in swamps. The tree can endure a moderate amount of shade when young, but becomes intolerant with age. The roots penetrate deeply, making the tree decidedly wind-firm. It sprouts freely from the stump, and bears full crops of seed every two to five years. The

NO. 18. SUGAR BUSH.

seed ripens in late September and falls with the first heavy frost. The trees are usually of excellent quality, with straight, clear boles and few defects.

White ash is a valuable species of fairly rapid growth, and its presence should always be encouraged.

Sugar Maple.—Sugar maple is found in nearly all situations, except in swamps and on dry, sandy soils. It is exceedingly tolerant of shade, and thus naturally adapted for use as an understory with white pine and other intolerant species. For this purpose it should be given the preference over the equally tolerant but less desirable red maple, beech and hemlock. With a plentiful supply of light the rate of growth is fairly rapid, approaching that of white pine for the first twenty to thirty years. Its sprouting capacity is poor. The tree is also valued for its production of sugar.*

Birches.—The birches are prolific seeders, producing an abundance of light, wind-blown seed, which gives them a decided advantage in the restocking of areas cleared by fire or lumbering. Gray birch has already been discussed in connection with white pine.

Paper birch prefers a loose, well-drained soil, and will not grow in swampy situations. It is naturally adapted for growth on the shallow, rocky soils of the steeper slopes. It is shallow-rooted and very intolerant of shade.

Black birch thrives best on the lower and middle slopes, but is found everywhere outside of the swamps. It is more tolerant of shade than paper birch, but is a light-demanding species and its seedlings are quickly killed by the shade of an older stand.

Yellow birch is less common and is usually confined to the richer soils near streams and at the borders of swamps. It is moderately shade-enduring in youth, but the demand for light increases with age, and after the sapling stage the tree is decidedly intolerant.

*For the management of sugar orchards see Bulletin No. 59 of the Forest Service, "The Maple Sugar Industry."

In sprouting capacity and rate of growth, the three birches are inferior to chestnut, but they are commercially valuable trees of moderately rapid growth, and as such are entitled to favorable consideration in future management.

Popple.—Popple is of common occurrence, but is nowhere found in large quantities. It is shallow-rooted, very intolerant of shade, and reproduced readily by suckers from the roots. The light seed is carried long distances by the wind, but is very short-lived, and seedlings are scarce. The rate of growth is rapid at first, but is not persistent, decay usually beginning at the butt soon after the fortieth year. After fire or lumbering a stand of popple is by no means undesirable. The trees grow rapidly to merchantable size and their thin-foliaged crowns let through enough light for an undergrowth of white pine or other valuable species.

Hemlock.—Hemlock is rarely found in pure stands, but is common in mixture with other species. It prefers the deeper, moister soils along streams, but also thrives on the steep rocky slopes of the higher ridges and knolls. It is very tolerant of shade, which enables it to maintain an existence as an understory in mixture with trees of more rapid growth. Its rate of growth is very slow. Even where the seedlings have plenty of light they grow slowly for the first five or ten years, and thus hemlock has been crowded back into a subordinate position in the second growth.

Beech.—Beech is of common occurrence and is found in all situations except in swamps. It is exceedingly tolerant, reproducing freely in dense shade, and as a result is usually present as an undergrowth. Its thin bark makes it very susceptible to injury by fire and other destructive agencies.

Red maple.—Red maple is widely distributed. It shows a preference for moist situations but will grow both in swamps and on the shallow soils of steep, rocky slopes. It sprouts freely from the stump and in tolerance of shade closely approaches sugar maple.

NO. 19. SECOND-GROWTH SPRUCE.

White, black and chestnut oaks.—These oaks resemble red oak in their silvical characteristics, but are inferior to it in rate of growth and sprouting capacity.

Spruce.—Spruce is generally confined to elevations above 1,500 feet. This limits its occurrence to the higher knolls and mountains where the soil is usually shallow and rocky. The present stands in southern New Hampshire are largely even-aged, partly as a result of lumbering and fire, but more commonly due to the restocking of abandoned farm land. A large part of the original spruce forests was succeeded after lumbering by a growth of hardwoods, especially paper birch and popple, under which spruce seedlings are now gradually appearing.

Because of its slow growth and its restriction to the less accessible situations, spruce can not be managed as intensively as white pine. Planting is impracticable under present conditions, and in many cases thinning will not pay for itself. The tree is very shallow-rooted and the consequent lack of windfirmness prohibits the use of scattered seed trees. It is very tolerant, however, and this ability to develop under the shade of an older stand suggests a gradual removal, reproduction being secured from self-sown seed, either by the cutting of single trees as they reach maturity, or by successive cuttings extending throughout a mature stand and leading to the production of a new stand approximately even-aged. These successive cuttings encourage seed production, create conditions favorable to the growth of seedlings, and remove the remaining trees as soon as the reproduction is complete.

Pitch Pine and Scrub Oak.—The redemption of land occupied by this type can readily be accomplished, but will not attract private enterprise. The first few attempts must be largely experimental, and the high initial expense is likely to reduce the return on the investment below the rate demanded.

The first step is protection from fire, which will usually necessitate the construction and maintenance of fire lines,

patrol during dry seasons, and the strict enforcement of rules against trespassing. The fire lines should consist of strips about ten feet wide, kept clear of inflammable material by annual burning. An ordinary woods road will serve the purpose effectively.

Wherever red or white pine is present, natural seeding should be given a chance, but in most cases planting will be necessary. Both white and red pine should be tried. The first is more valuable commercially, while the second thrives better on dry, sandy soils. The scrub oak will hinder planting operations, but will afford desirable protection to the seedlings while they are establishing their root systems, and will not seriously interfere with their further development. The pitch pine should be removed as soon as the white and red pine seedlings begin to show a rapid height growth.

The Farm Woodlot.—A class of forest of decreasing but still considerable extent is the farm woodlot, which supplies the fuel, fence posts, and other material used on the farm. In the past these woodlots have as a rule been cut and culled without regard to the future, and have consequently deteriorated. By adopting a simple system of management, this deterioration may be avoided, and a gradual improvement of conditions brought about.

The first step should be improvement cuttings. Instead of taking the best trees, the less desirable kinds should first be removed, especially where they are impeding the development of more promising neighbors.

The cutting of the main crop should be conducted with a view to securing satisfactory reproduction. Groups of desirable young trees which have sprung up in accidental or intentional openings should be taken as starting points and the surrounding timber removed in successive narrow bands. A woodlot thus managed should give a sustained annual yield of about three fourths of a cord per acre.

Forest Planting.—The possibilities of forest planting in southern New Hampshire deserve serious consideration.

There are thousands of acres of run-out pastures and agricultural fields, at present lying idle, which are capable of yielding an attractive return under forest management. If left to nature, these lands will gradually revert to forest, but the loss of time and the uncertainty of satisfactory results are strong arguments in favor of planting. The need is especially great on lands already partially stocked with seedlings, where bushy development can be avoided only by planting the blanks.

The native trees best adapted for planting are white pine, chestnut, red oak, white ash, and sugar maple. Foreign trees worthy of trial are Scotch pine, Norway spruce, and European larch.* Of these white pine is by far the most promising, and the practicability of planting this species is well shown in tables XXII to XXV.

The Summer Resort Business.

As a summer resort New Hampshire is growing in importance from year to year. A special report issued by the state bureau of labor in 1899 points out the magnitude of the summer business, and gives detailed statistics, of which the following is a summary:†

General Summary of the Summer Business of 1899.

Capital invested in summer property..		$10,442,352.00
Number of different guests remaining one week or longer.....	58,222	
Number of transient guests remaining less than one week.....	95,706	
Number of persons occupying cottages	20,352	
Total number guests and in cottages..	174,280	
Total population of the state in 1900 was	411,588	
Number male help employed.....	3,297	
Number female help employed.....	9,057	
Total number help employed.....	12,354	
Total wages paid.....		539,901.00

* Directions for planting any of these trees may be had by applying to the office of Forest Extension, Forest Service, Washington, D. C.

† The Summer Season in New Hampshire, Special Report by the State Bureau of Labor, 1899.

Number of towns and cities where guests are taken	204	
Number of towns and cities where guests are not taken	31	
Number of farm houses where boarders are taken	1,621	
Increase in number of guests in 1899 over 1898	8,093	
Increase in cash received at hotels and farm houses in 1899 over 1898		$402,341.00
Cash received from the summer people		4,947,935.00
Cash received from railroad fares (estimated)		600,000.00
Cash received from stage fares		63,275.00
Cash received from steamboat fares on Lakes Winnepesaukee, Asquam, Sunapee and Newfound		60,369.00
Cash invested in buildings and properties for summer use		937,785.00
Total volume of summer business and investment for 1899		$6,609,364.00

There is no doubt that the summer resort business is much greater today than in 1899, when the above figures were published. No recent statistics, however, are available.

Of the great number of summer visitors, a few go to the extreme northern portion of the state to fish and hunt, many go to the mountains, while others remain in the lake district. The greatest number, however, are scattered throughout the small towns and farms of the southern part of the state, and their recreation, in the main, consists of walks and drives along wooded roads, and picnics held in the adjoining woodlots. Extensive lumbering, with the resulting piles of unsightly slash, may ruin a place as a summer resort. Forest management should take into account the benefits and profits derived from this subsidiary business. In all cases it would be best to:

1. Avoid cutting of any kind during the summer-outing season.

2. Leave strips of woods along the roads.

3. Leave undisturbed favored picnic grounds or places of special interest.

Relation of the State to the Forest.

New Hampshire is peculiarly indebted to the forest for its prosperity. The chief industries of the state, lumbering, the summer resort business, and all manufactures relying on water power, largely depend upon its presence. Fortunately there is very little danger of an extensive destruction of the forest. So much of the land is fit for nothing but tree growth, and reproduction takes place so readily, that the danger lies rather in the lack of intelligent management, leading to a deterioration in the character and composition of the forest and a consequent reduction in revenue to the state as a whole.

The duty of the state is to encourage proper forest management (1) by preventing the destruction of timber by fire, (2) by a just tax system, and (3) by educational measures.

Fire Laws.

The present laws relating to forest fires impose heavy fines and penalties for the malicious burning of timber; for starting fires on property of others; and for allowing fires started on one's own land to do damage to neighboring property. They hold proprietors of railroads liable for all damages done to property by fires from locomotives. In addition they provide for the following excellent fire-warden system:

CHAPTER 97, LAWS OF 1905.

AN ACT FOR THE PROTECTION OF FORESTS FROM FIRE.

Section 1. In cities and towns where organized fire departments are established, the chief of the fire department is hereby constituted forest fire warden for such city or town. In time of drought the forest fire wardens, themselves or by some agent or agents designated by them, shall, when directed by the forestry commission, patrol the woods in their respective cities or towns,

warning persons who traverse the woods, campers, hunters, fishermen and others, about lighting and extinguishing fires. They shall post extracts from the fire laws, and other notices sent to them by the forestry commission, along highways, along streams and waters frequented by tourists and others, at camp sites and in other public places. If, in woodlands thus posted, any person, other than the owner of said lands or his agents acting under his direction, shall build fires when warned not to do so by the forest fire warden, or shall fail to extinguish a fire when ordered to do so by the warden, he may be arrested by the warden without a warrant.

SECT. 2. It shall be the duty of the warden to extinguish all brush or forest fires occurring in his town, and he may call such assistance as he shall deem necessary to assist him in so doing, and may require the use of wagons, tools, horses, etc., for that purpose. If any person fails to respond to the warden's call for his assistance or the use of his property, he shall be fined not exceeding ten dollars. The city or town shall pay reasonable compensation for their services to all persons summoned to assist the warden and for the use of all property required by him in the extinguishment of a forest or brush fire. In case the warden and the persons summoned to assist him or to furnish the use of property shall fail to agree upon the terms of compensation at the time or after the required service has been rendered, the dispute shall be referred to the commissioners of the county in which the city or town is located for final settlement.

SECT. 3. Forest fire wardens shall make reports of their doings to the forestry commission in such form and at such times as the commission may require. If a warden has reason to believe that any brush or forest fire in his city or town was caused in violation of statute he shall report to the county solicitor all the facts coming within his knowledge and said solicitor, if the facts as so reported seem to him sufficient, shall take action to recover the penalty fixed by statute for such violation.

SECT. 4. In towns where no organized fire department exists, the forestry commission shall annually designate some member of the board of selectmen as forest fire warden, who shall perform in his town all the duties hereinbefore set forth for wardens in cities and towns having organized fire departments. All forest fire wardens hereinbefore provided for shall receive pay for their services from the city or town treasury in such sums and in such manner as they are ordinarily paid for services as members of the fire department or as selectmen.

SECT. 5. In unorganized towns, the forestry commission, on

application of the owners of forest land situated therein, are authorized to appoint a suitable number of special forest fire wardens, to define their duties and to fix their compensation. The cost of such special forest fire wardens shall be paid by the persons making application for their appointment, and, upon certificate of the forestry commission, one half of such sum shall be repaid to the applicants by the treasurer of the county wherein said unorganized township is located.

SECT. 6. If any forest fire warden provided for in sections 1 and 4 of this act shall neglect or refuse to perform the duties prescribed for him he shall forfeit not less than $100 nor more than $500, to be recovered in an action for debt, upon complaint of the forestry commission, and all forfeitures so recovered shall be paid into the state treasury.

SECT. 7. It shall be the duty of any person who discovers a forest or brush fire not under the control or supervision of some person to extinguish it or to report it immediately to the local fire warden, and failure to do so shall be punished by a forfeiture not exceeding ten dollars, to be recovered upon complaint of the warden.

SECT. 8. All acts and parts of acts inconsistent with this act are hereby repealed, and this act shall take effect upon its passage.

Approved March 10, 1905.

The most serious defect of the fire-warden law is that it imposes the burden of fire protection entirely on the towns. The state has supervision over the warden system, yet bears no part of the expense further than the cost of maintaining the forestry commission. The benefits derived from preserving forest growth are shared by the entire state, and in justice the state should bear at least a part of the expense of protection.

It often happens that a town having large wooded areas has less to lose by a destruction of its forest than an adjoining town. Yet, under the present system, the entire cost of protection falls on the first town.

To insure a more equitable distribution of the expense, it is recommended that the cost of preventing and fighting fires be equally divided between the state and the various towns; the town in each case to pay the whole cost, later

receiving half of it back from the state. The burden thus imposed on the state would be slight, while the poorer towns would be greatly helped.

Taxation.

The present system of taxing forests is to levy a general property tax on the assessed value of the land and the trees on it taken together. The rate of taxation varies somewhat from town to town, but ranges from one and one-half to two and one-fourth per cent. of the assessed value. An exception to this method of taxing forest property was provided by a law passed in 1903, which in substance is as follows: The owner of any land which is planted with timber or forest trees, not less than 1,200 to the acre, is entitled to a rebate of taxes upon that land. For the first ten years after the land has been planted there is a rebate of ninety per cent.; for the second period of ten years after such planting, a rebate of eighty per cent.; and for the third and final period of ten years, a rebate of fifty per cent. of the taxes. This abatement provision, although three years old, is not widely known among landowners, and has so far been inoperative.

To attain the greatest good with the least amount of sacrifice, a system of taxation must conform to certain well-known principles.

1. It must be just and equitable; in other words, it should be fairly apportioned.

2. It must not impose an undue burden on the person taxed. Every tax should be levied at the time and in the manner in which it is most easily and conveniently paid. It is not fair that a person should pay a tax on a piece of property before he derives an income from it. The state of New Hampshire recognized this principle when it enacted the law that "real estate shall be taxed independently of any mines or ores contained therein until such mines or ores shall become a source of profit." (Chapter 55, section 4 of the Public Statutes of the State of New Hampshire, and General Laws in force January 1, 1901.)

3. A tax must not seriously impair the source of income. If a tax works in such a way as to cause the income-bearing property to disappear, the state loses a source of revenue for the future.

4. Finally, it must be easily levied and collected, or it will lead to confusion and evasion.

Forest property possesses certain characteristics which are not common to other classes of property, and which entitles it to a more lenient method of taxation.

1. Its presence is a social benefit. It furnishes recreation, protection from wind, and confers various other benefits upon others than the owner of the property. The chief industries of the state are more or less dependent upon it.

2. It is a long-time investment and brings returns only at long intervals. An annual tax on growing timber must be paid from income of other property, which is hardly fair.

3. As yet it receives inadequate protection from fire, and a forest, therefore, represents a risky investment.

4. There is wide choice as to the time when the timber can be cut. Where the owner of a woodlot would be willing to let his timber grow a number of years longer if the tax rate were low, he may be forced to cut it at once if the tax rate is high. When the crop is harvested, the land, in many cases, is not worth much, and unless the tract is at once reforested, the state, for a long time, derives very little revenue from it.

The present tax system in New Hampshire violates three of the four principles of taxation just given and makes no allowance for the peculiar character of forest property. In fact, forest property is generally taxed higher than other kinds of property, sometimes as high as thirty per cent. of its gross income, as shown by the table on page 207.

The present method of taxing forests often *forces* the owner to cut his timber, whereby the state loses a source of revenue. The proprietor is never certain how high his

land will be assessed. There is an element of uncertainty which interferes with a proper system of management. A case is known where a tract of land of 100 acres in Cheshire County, of which about eighty acres is covered with a good growth of pine, was assessed at $1,000 in 1897, $1,300 in 1899, $1,600 in 1900, $2,000 in 1901, $2,300 in 1902, $2,300 again in 1903, $3,250 in 1904, $4,500 in 1905, and finally $5,000 in 1906. This illustrates the present faulty method of assessment, and the constantly increasing tax.

The abatement provision of the 1903 law, encouraging planting, is beneficial as far as it goes, but it works an injustice on the county and town in which the plantation is situated. The entire state benefits when such a plantation is made, and if a subsidy is to be given to planters, in the form of a rebate in taxes, the state should pay part of the subsidy. As soon as a fair system of forest taxation is adopted such an inducement will be unnecessary.

The following is offered as an ideal system for taxing forests:

Tax the gross income from forest property at the time when the income becomes available; that is, when the forest is cut. The tax rate should be determined upon before the new method becomes operative, and should be changed only after giving notice several years in advance.

The amount of lumber cut in the entire state does not vary greatly from year to year, while the amount cut in any town or county is not so uniform. To avoid wide fluctuations in the amount of revenue derived by towns and counties, the forest tax should be collected by the state, and apportioned among the smaller political divisions by state authorities.

A small annual tax on the value of the land may be levied, but this tax should be deducted from the final income tax, and in making such deductions the tax already paid should be carried forward with compound interest at a reasonable rate to the time when the final tax is paid.

The best method of administering the tax and of appor-

tioning it among the towns and counties, the proper tax rate, the proper rate of interest to be allowed on taxes already paid, and all other details are left for the state authorities to work out.

This method of taxation cannot readily be applied to timber already standing, but as the various lots are lumbered they will be amendable to the new system.

The following table shows the time when the crop is financially ready to be cut, the gross income from growing a crop of trees, the amount of taxes to be paid, and the proportion of the income that goes to the state in the form of taxes, under the present system of taxation and under the proposed method. A tax of 15 per cent. of the gross income was assumed merely for the purpose of illustration; the value of the land is set at $5 and the cost of planting at $7 per acre. The figures for this table were obtained in the way explained on pages 240–244, where the question of rotation is discussed.

Money valued at Per cent.	Financial rotation Years	Gross returns	Taxes (2 cents on a dollar.) Amount	Per cent. of gross returns
		UNDER PRESENT METHOD.		
3	65	$334.43	$100.23	30.0
4	55	238.28	49.14	20.6
5	50	189.00	31.78	16.8
		UNDER PROPOSED METHOD.		
3	90	$545.10	$81.77	15.0
4	70	385.02	57.75	15.0
5	50	189.00	28.35	15.0

This table shows (1) the high tax rate exacted under the present system, in spite of the 1903 abatement law, for which proper deduction was made in calculating the above values; (2) that the time for cutting the crop may be hastened by as many as twenty-five years under the present method, with a corresponding loss of revenue to the state as a whole.

It is safe to say that hardly any other business would tolerate such a tax rate. The reason the owners endure it is that they have no clear conception of how high the tax is, and because the tax assessors are often lenient in their appraisement of forest property.

Educational Measures.—The educational function of the state has already been extended to agriculture in the form of a State Agricultural College and Experimental Station, and can still more justly be used in promoting forestry. Effective measures would be:

1. To furnish expert advice, not free, but at a charge in proportion to the expense incurred.

2. To collect and publish statistical information of interest to forest owners.

3. To establish a state nursery, from which plant material should be sold at cost.

A State Forester.—The development and execution of a wise forest policy demands a technically trained state forester, who should be put at the head of the fire-warden service, and be given charge of all other forest interests of the state.

FOREST MEASUREMENTS.

Forest management is largely dependent on a knowledge of yield. By yield is meant the amount of wood which now is, or may be expected in the future, on a given area. The measurement of yield falls into two parts:

1. The determination of the volume and value of single trees and stands by means of mill tallies and volume studies.

2. The prediction of the yield from entire stands by means of yield tables based on sample plots.

To illustrate the practical use of the tables a third part has been added:

3. The determination of the proper time for cutting white pine stands.

Mill Tallies.—There is a great variation in the quality of wood that may be cut from even the same tree. In the lumber market these various qualities are separated into a number of corresponding "grades," more or less uniform throughout the country. Except in special cases it does not concern the lumber manufacturer to what use a board will be put; if it answers a certain description it is placed in a certain grade, whether ultimately used for furniture, interior finish, or panelling.

This common system of grading lumber is not followed in southern New Hampshire. A very crude method is here in use, and almost every mill has its own special grades; some of these grades are recognized by most mills. There are several reasons why the various lumber association rules are not in use here. The bulk of the lumber, coming from comparatively young second-growth, is of inferior quality. In many cases the difference between the best and poorest boards is not enough to make two separate grades under the common rules of grading. In the second place, practically all of the lumber cut is for local use in a

few well-known industries, and the boards are separated at the mill according to the use to which they will be put. Hence, instead of calling boards No. 1 common, cull, or mill-cut, they are known as box-boards, furniture stuff, coffin and casket stock, etc. Two or more grades may be of the same value and yet have different names, as for example, window sash planks and refrigerator stock. Again, many lumbering operations are so small that it would hardly be worth while to subdivide the product into several grades. The fact that a large proportion of the boards cut is not edged is still another reason why the common system of grading is not followed here, round-edged lumber rarely being recognized by those rules.

The four main factors which affect the quality of a board are its width, the proportion of sap to heartwood, its soundness, and the presence or absence of knots. In southern New Hampshire the second-growth timber was found to be quite sound. Sapwood is not considered a serious defect here. The width of the board and its clearness from knots are, therefore, the only factors which affect the value of lumber.

In general, the bigger the tree the better the lumber obtained from it. Hence, trees increase in value as they increase in size, not only because big trees have more lumber than small ones, but also because the lumber is of better grade. One tree may have only three times as much lumber as another, and yet have four or five times the value.

To determine as accurately as possible the rate of appreciation in value with increase in size, the graded yield and the money value of the more important commercial trees in southern New Hampshire were studied in several localities, under average conditions of manufacture. The results here given represent averages of a great many measurements, and can, therefore, be safely applied only to averages of entire stands. Their accuracy in application will also vary somewhat from mill to mill, according to the care exercised in logging and sawing the timber.

The method of carrying on these tallies was as follows: Each tree was measured as it was felled in the woods, the measurements were recorded, each log was marked with a number so that it might be identified at the mill, and the lumber sawed out from the identified logs was measured and inspected. The quantity and the grades of lumber from each log were recorded on a separate sheet, and by bringing together the sheets corresponding to the various logs of any given tree, the exact amount and quality of lumber obtained from that tree were ascertained.

Over 5,000 trees, or about 20,000 logs, were thus followed through in seven different mills situated in various parts of the state—one mill in the town of Warner, two mills in Sutton and one in Henniker in Merrimack County, two mills in Winchester in Cheshire County, and one mill in Brookline in Hillsborough County.

The manner of measuring lumber is uniform in all the mills studied. Theoretically, the scaler or "marker" is supposed to measure a board or plank at its average width, considering both the wide and the narrow faces of the board. In practice the board is always measured on its narrower face, at its average width. This method was followed in making the mill tallies. The boards from young timber, especially those coming from upper logs, are very irregular in shape; and, since most of the lumber is not edged or squared, it is very difficult in many cases to determine the average width of the board. The skill of the marker will influence the accuracy of measurement, though the error tends to rectify itself in the long run.

In considering the detailed discussion of the mill tallies and tables, the following points must be constantly borne in mind:

1. All lumber was measured "green." Lumber shrinks slightly in the process of seasoning or drying.

2. A large proportion of the lumber is cut "round-edged;" that is, the boards are not edged or squared. The volume tables cannot, therefore, be used in regions where all the lumber is squared.

3. Whenever the diameter of a tree is given the diameter outside the bark, 4½ feet above the ground, is meant, unless otherwise specified.

4. When the diameter of a log is given, the diameter *inside* the bark, at the smaller end of the log, is meant, unless otherwise specified.

5. The tables were constructed by the statistical method of plotting the data on cross-section paper, drawing curves, and reading the averages from these curves. For this reason some of the tables have certain values for which there was apparently no basis. These values were read directly from the curves.

6. In constructing the volume tables, no allowance was made for waste due to the carelessness of the sawyer, to unnecessarily heavy slabbing, or to miscut boards. In applying these figures for practical purposes, a slight reduction—never more than 5 per cent.—should be made for these unavoidable losses.

7. It must be constantly remembered that the values given in these tables represent *averages* of many measurements, and cannot safely be used for single trees or logs.

White Pine.—About 2,500 pine trees, or more than 10,000 logs, were followed through six mills. Five of these mills were equipped with circular saws 48 inches in diameter and removing a kerf of about ¼ of an inch. The one in Brookline was a portable band-mill, with a saw eight inches wide, 34½ feet long, and removing one inch of kerf with every eight cuts.

The system of grading the lumber was practically the same in all the five circular-saw mills. In general, the wide, clear stuff was cut into 2⅛-inch, round-edged plank, for door and window sash stock. The small, knotty logs were cut into inch or 2⅛-inch box-boards. Whenever possible, all logs squaring more than six or seven inches, but not clear enough for the best 2⅛-inch grade, were cut into 1-inch square-edged box-boards, and two widths were recognized, commanding different prices; namely, boards less

than ten inches wide, and boards ten inches or more in width.

The Waterloo Mill.—The trees cut at this mill came from a mixed pine and hardwood stand, which had come up on land lumbered fifty-five to sixty years ago. The trees in mixture, named in order of their abundance, were white pine, red oak, paper birch, hemlock, red pine, white ash, popple, white oak, and sugar maple. Over 50 per cent. of all the trees were white pine, occurring, as a rule, in small, pure stands in the moister situations. The average age of the trees was about fifty years. Almost 70 per cent. of the pines were seven to eleven inches in diameter, breasthigh, and from forty-five to sixty-five feet in height. There was very little waste in lumbering, low stumps and short tops being the rule. The stumps rarely exceeded eight inches in height, and the average length of top left in the woods was seventeen feet. The diameter of the small end of the last log, inside the bark, was five inches or less. Fifty-five per cent. of all the pine lumber was cut into 1-inch stuff, while 45 per cent. was 2⅛-inch plank. Seventy-five per cent. was round-edged, and the remainder square-edged.

The Henniker Mill.—The trees cut at this mill, although slightly younger than those cut at Waterloo, and growing in a pure stand, were so nearly of the same size and general character as the trees described above, that the data collected at the two mills were thrown together and worked up as one stand.

The South Sutton Mill.—This was one of the best lots of second-growth white pine found anywhere in the state. It was a fairly even-aged, practically pure stand, about seventy-five years old. By actual survey and measurement it was found to run 99,137 board feet per acre in the best part of the stand, of which 97,024 feet were white pine. The average stand on an area of about four acres was 75,000 board feet per acre.

The pine was mixed with a very small per cent. of hem-

lock, white oak, red maple and several scattered trees of other species. The stand was situated at the foot of a moderately steep slope, on a rather shallow, sandy loam, abounding in springs and water holes. The pine trees were tall, cylindrical, of good form, but not well cleaned, the dead limbs on many trees persisting almost to the ground. In the more open places the trees were forked, yielding large quantities of inferior box-boards. The trees varied from eight to twenty-five inches in diameter, and from 60 to 100 feet in height. The average height of stump cut was sixteen inches, the average length of the top left in the woods was about nineteen feet, and the average diameter at the small end of the last log was six inches inside the bark. Fifty-five per cent. of all the pine cut was round-edged, while 45 per cent. was squared; 76 per cent. was cut into 1-inch boards, and the rest into 2⅛-inch plank.

The Brookline Mill.—This woodlot consisted of several more or less even-aged stands of pine, mixed with varying proportions of chestnut, chestnut oak, popple, black oak, white oak, hemlock, paper birch, etc. The pine followed through the mill was about seventy years old, eight to twenty-two inches in diameter, and sixty to ninety feet tall. There was little waste in logging. The stumps were rarely more than ten inches high, while the tops left in the woods average about fifteen feet. The diameter at the small end of the log was between four and five inches inside the bark. The milling was done with a band saw, and the grades turned out were different from those made in the other mills described. The best logs were cut into 1⅜-inch boards to be used in making refrigerators. Fairly clear lumber, not good enough for this best grade, was cut into 1⅝-inch stuff, while the poorest logs went into 1¼-inch box-boards. Sidings obtained in squaring, and the square-edged boards obtained from the larger knotty logs, were put into 1-inch box-boards. Seventy-five per cent. of all the lumber cut was round-edged, and the remainder squared;

39 per cent. was one inch thick, and 61 per cent. was thicker than one inch, 29 per cent. being 1⅜ inches, 21 per cent. 1¼ inches, and 11 per cent. 1⅝ inches thick.

In addition to the above, about 600 pine trees were followed through two other mills, described in connection with the chestnut mill tallies.

Tables I, II and III show the number of board feet cut at the mill, from different sized trees.* It will be noticed by comparing these tables, that of two trees having the same diameter and height, the older one has the greater volume. This is due to the fact that a tree becomes more cylindrical with age.

TABLE I.—VOLUME TABLE FOR WHITE PINE.—WATERLOO AND HENNIKER, AGE 50 YEARS.

Diameter breasthigh.	Height—Feet.						Basis.
	30	40	50	60	70	80	
Inches.	Volume—Board feet.						Trees.
5	9	18	15	.....	.....	.....	18
6	12	18	23	27	.....	.....	66
7	17	26	33	88	.....	.....	98
8	24	36	44	51	.....	.....	180
9	32	46	58	69	80	92	146
10	41	56	70	85	100	116	185
11	.....	65	84	105	124	143	104
12	.....	72	99	126	150	170	74
13	.....	83	116	148	176	198	64
14	.....	.....	130	170	204	228	26
15	.....	.....	144	196	238	258	14
16	.....	.....	.....	221	264	291	21
17	.....	.....	.....	247	293	324	2
18	.....	.....	.....	.....	324	360	1
19	.....	.....	.....	.....	354	397	8
							Total.....902

*The left-hand vertical column in each table shows the diameter of the tree at breast height (4½ feet above the ground). The uppermost horizontal line shows the total height of the tree from the ground to the top of the crown. To find the volume of a tree of any given diameter and height, as for example, 12 inches in diameter and 60 feet in height, in table I, look in the left-hand column for the diameter (12), and under the height (60), find the volume of the tree (126 board feet).

TABLE II.—VOLUME TABLE FOR WHITE PINE.—SOUTH SUTTON, AGE 75 YEARS.

Diameter breasthigh.	Height—Feet.									Basis.
	40	50	60	70	80	90	100	110	120	
Inches.	Volume—Board feet.									Trees.
7	25	40	.....	.....	.....	.....	.....	.....	.....	2
8	35	50	65	80	.....	.....	.....	.....	.....	18
9	45	65	80	95	.....	.....	.....	.....	.....	19
10	55	75	95	115	130	150	170	.....	.....	28
11	70	90	115	140	160	185	205	.....	.....	25
12	85	105	135	165	190	220	245	.....	.....	40
13	95	125	155	190	225	255	285	.....	.....	29
14	.....	140	180	225	260	300	330	370	.....	37
15	.....	165	210	260	300	345	385	425	.....	28
16	.....	190	240	295	345	395	435	485	.....	39
17	.....	215	275	335	390	445	495	550	.....	41
18	.....	245	310	375	440	495	555	620	675	41
19	.....	275	350	420	490	555	620	690	745	32
20	.....	.....	395	465	540	615	685	760	820	31
21	.....	.....	435	515	595	675	755	835	900	20
22	.....	.....	.....	560	645	735	820	905	980	17
23	.....	.....	.....	.....	700	795	885	980	1,060	12
24	.....	.....	.....	.....	755	860	950	1,055	1,135	7
25	.....	.....	.....	.....	805	925	1,020	1,130	1,210	11
26	.....	.....	.....	.....	.....	985	1,090	1,200	1,280	5
										Total,477

TABLE III.—VOLUME TABLE FOR WHITE PINE.—BAND-SAW.—BROOKLINE, AGE 70 YEARS.

Diameter breasthigh.	Height—Feet.						Basis.
	50	60	70	80	90	100	
Inches.	Volume—Board feet.						Trees.
7	40	50	60	.....	.....	.....	3
8	50	65	80	.....	.....	.....	10
9	65	80	100	120	.....	.....	16
10	80	100	120	150	180	.....	32
11	100	120	145	180	210	.....	32
12	120	145	170	210	245	.....	48
13	135	170	200	240	280	.....	32
14	.....	195	230	275	320	.....	33
15	.....	225	265	310	360	.....	36
16	.....	260	300	350	405	.....	33
17	.....	295	340	390	450	.....	31
18	.....	330	380	430	500	600	26
19	.....	365	420	475	550	650	28
20	.....	405	465	525	600	700	18
21	.....	.....	510	580	660	760	12
22	.....	.....	555	635	725	825	10
23	.....	.....	600	695	795	895	7
24	.....	.....	550	760	865	970	5
25	.....	.....	.....	830	940	1,050	2
26	.....	.....	.....	900	1,020	1,135	1
27	.....	.....	.....	975	1,100	1,225	.....
28	.....	.....	.....	.....	.....	1,320	1
							Total.....411

Table IV shows the number of board feet that was obtained per cubic foot of the used volume of the trees.

TABLE IV.—RELATION BETWEEN VOLUME OF USED LENGTH, WITH BARK, IN CUBIC FEET AND ACTUAL MILL CUT, IN BOARD FEET.—WHITE PINE.

Diameter breasthigh.	Circular saw.		Band saw.
	Henniker and Waterloo, age 50 years.	South Sutton, age 75 years.	Brookline, age 70 years.
Inches.	Number of board feet per cubic foot.		
5	4.7	5.5	.....
6	5.0	5.7	6.2
7	5.3	5.8	6.4
8	5.6	5.9	6.5
9	5.9	6.1	6.6
10	6.1	6.2	6.8
11	6.8	6.8	6.9
12	6.5	6.5	7.0
13	6.7	6.6	7.1
14	6.8	6.7	7.3
15	6.9	6.8	7.4
16	7.0	6.9	7.5
17	7.1	7.0	7.6
18	7.2	7.0	7.7
19	7.3	7.1	7.8
20	.....	7.1	7.8
21	.....	7.2	7.9
22	.....	7.2	8.0
23	.....	7.2	8.1
24	.....	7.3	8.1
25	.....	7.3	8.2
26	.....	7.3	8.3
27	.....	7.3	8.3
28	.....	7.3	.....
29	.....	7.3	.....
30	.....	7.4	.....
31	.....	7.4	.....
Average	6.8	7.0	7.4
Basis, trees.....	900	475	411

In general there is relatively less waste in sawing a large log than in sawing a smaller one. Furthermore, an older tree gives more board feet per cubic foot than a younger tree of the same diameter and height, because, as remarked above, the younger tree is less cylindrical; thus, while there were sawed out on an average 6.3 board feet per cubic foot in the 50-year-old pine, a cubic foot of timber in the 75-year-old

stand yielded 7.0 board feet. The 70-year-old stand, falling in age between the other two stands, if cut with a circular saw should have yielded only about 6.8 board feet per cubic foot. Cut with a band saw it actually gave 7.4 board feet, indicating a gain of .6 of a board foot for every cubic foot. This represents a saving of almost 9 per cent., by using a band instead of a circular saw.

It is assumed here that the saving of 9 per cent. was due mainly to the narrower kerf of the band saw; for although the great bulk of lumber cut was round-edged, and therefore gave a higher yield than if squared, this was neutralized by the fact that the average thickness of boards cut here was less than at the other mills.

A careful study of the data showed that although lumber improves in quality with growth in diameter, it is not much affected by the height of the tree. Two trees of the same diameter but of different heights will bring the same value per thousand board feet of lumber, though the taller tree, having the greater volume, will also have a greater total value. In making the graded volume table, therefore, height was disregarded, and the trees were arranged in diameter classes only.

Table V shows the percentage of the different grades that may be cut from trees of different diameters.

TABLE V.—PERCENTAGE OF GRADES SAWED FROM SECOND-GROWTH WHITE PINE.

Diameter breast-high.	Round-edged.			Square-edged.		Basis.
	1 inch box boards.	2⅛ inch box boards.	2⅛ inch clear plank.	Less than 10 inches wide.	10 inches wide or more.	
Inches.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Trees.*
5	26	74	.....	.....	....	18
6	27	68	5	.....	.....	66
7	21	67	6	6	.....	104
8	41	39	10	10	.....	149
9	42	24	16	18	.....	168
10	38	18	18	26	.....	159
11	36	14	28	27	.....	129
12	37	9	20	34	.....	115
13	33	7	24	34	2	94
14	34	4	26	34	2	64
15	31	8	24	32	10	48
16	27	4	33	25	11	60
17	27	1	31	23	18	45
18	28	.....	27	17	28	42
19	28	1	28	17	31	36
20	22	.....	33	15	30	31
21	28	.....	11	16	45	21
22	24	.....	20	18	43	18
23	24	.....	29	8	39	14
24	31	.....	17	10	42	8
25	22	.....	32	6	40	11
26	28	....	25	18	34	6
						1,401

It will be noticed from this table that although no general law can be laid down as to the increase or decrease of any particular grade, yet as the trees grow in diameter there is a more or less steady decrease in the per cent. of the poorer grades,—the box boards,—and a rather uniform increase in the proportion of better grades, especially the clear plank and the wide square-edged boards. Tables VI and VII show more satisfactorily how the improvement in the quality of the lumber with the growth of the tree takes place. In making these tables the following values per 1,000 board feet based on lumber f. o. b. Warner, N. H., were used:

1-inch box boards, round-edged,	$12.00
2¼-inch box boards, round-edged,	13.00
2⅛-inch clear plank, round-edged,	25.00
1-inch square-edged boards, less than 10 inches wide,	20.00
1-inch square-edged boards, 10 inches wide or more,	22.00

TABLE VI.—VALUE (F. O. B.) OF SECOND-GROWTH WHITE PINE.

Diameter breasthigh.	Value of lumber per thousand board feet.	Diameter breasthigh.	Value of lumber per thousand board feet.
Inches.		*Inches.*	
5	$12.00	16	$18.33
6	12.50	17	18.53
7	13.11	18	18.70
8	13.87	19	18.85
9	14.81	20	18.98
10	15.72	21	19.09
11	16.40	22	19.18
12	16.95	23	19.26
13	17.40	24	19.33
14	17.78	25	19.40
15	18.08	26	19.46

Starting with a 5-inch tree in table VI, where the lumber is fit only for 1-inch box boards, the value is $12 per thousand board feet. From this point there is a comparatively rapid increase in value, as the better grades enter and increase in proportion, until the 13- or 14-inch diameter is reached, where, although the value per thousand feet is still increasing, the rate of increase falls off, because all the grades have now entered. The increase in value now depends only on the increase in the proportion of the good grades and a corresponding reduction in the proportion of the poorer grades. At 26 inches the value of the lumber is $19.46 per thousand board feet.

TABLE VII.—RELATION BETWEEN INCREASE IN VOLUME AND INCREASE IN VALUE.—WHITE PINE.

Diameter breasthigh.	Volume of average tree.	Value of average tree.	Increase in diameter breasthigh.	Increase in total volume of tree.	Increase in total value of tree.	Basis.
Inches.	*Board ft.*		*Inches.*	*Per cent.*	*Per cent.*	*Trees.*
5	12	$0.14	From 5 to 6	66.7	78.5	18
6	20	.25	6 7	55.0	64.0	66
7	31	.41	7 8	45.1	53.6	104
8	45	.63	8 9	37.8	47.6	149
9	62	.93	9 10	33.9	41.9	168
10	83	1.32	10 11	32.5	37.1	159
11	110	1.81	11 12	30.0	33.7	129
12	148	2.42	12 13	28.0	31.0	115
13	193	3.18	13 14	26.8	29.6	94
14	232	4.12	14 15	23.3	25.5	64
15	286	5.17	15 16	20.6	22.2	48
16	345	6.32	16 17	18.6	19.9	60
17	409	7.58	17 18	16.9	17.9	45
18	478	8.94	18 19	14.9	15.8	42
19	549	10.35	19 20	13.8	13.9	36
20	622	11.79	20 21	12.1	12.9	81
21	697	13.31	21 22	10.9	11.4	21
22	773	14.88	22 23	9.4	9.8	18
23	846	16.29	23 24	8.8	8.7	14
24	916	17.71	24 25	7.3	7.7	8
25	983	19.07	25 26	6.8	7.1	11
26	1,050	20.48				6
						1,401

Table VII shows the relation between the increase in the total volume of the tree and the increase in its total value, expressed in percentages. This emphasizes the tendency shown by the former table. Up to 13 inches in diameter the rate of increase in value is comparatively much higher than the rate of increase in volume, but for the higher diameters, the difference between the two rates is so small as to be negligible.

It will be shown farther on when the subject of rotation is considered, that under the present system of grading, and with present prices, the increase in value per thousand feet of lumber with the increase in the diameter of the tree is enough to prolong the most profitable rotation for white pine by ten years. Should a more careful system of grading white pine lumber be introduced into southern New England, the rotation will be still further lengthened.

Chestnut.—The bulk of the chestnut timber in the state, being of small size, is cut into railroad ties and fence posts. The larger logs are sawed either into switch ties, or into plank, used for furniture and coffin stock.

Practically all the ties are sold to the Boston and Maine Railroad, the only railroad in this part of the state. The sawed ties are piled along the railroad track and, the purchasing agent being notified, an inspector is sent to inspect and grade the ties. The printed specifications of the company recognize two classes of ties:

All ties to be sound and free from shakes and rotten knots. To be 8 feet long, flattened on two sides, and to have 6 inches and over face, and to be 6 inches in thickness. Ties to be sawed square ends. No. 2 ties will be taken on the basis of 10 per cent. of the total number of No. 1 ties accepted, and must be not less than 5 inches face.

In practise these rules are seldom followed. The rigidity with which they are enforced depends on the demand for ties, on the number of ties delivered, and on the disposition of the inspector. Some inspectors are more lenient than others. In general, a big batch of ties is more favorably graded than a smaller lot.

After a careful consideration of the question, the following system of grading ties was used in making the mill scale tallies:

All sound ties, free from large rotten knots, measuring at least 5 inches face, were classed as No. 1.

Sound ties with less than 5 inches, but at least 4 inches face, were classed as No. 2.

Ties less than 4 inches face, and unsound ties, were classed as culls, and tallied as fence posts.

Switch ties were formerly accepted only when delivered in sets as follows:

7 ties 9 feet long	6 ties 13 feet long
11 ties 10 feet long	5 ties 14 feet long
9 ties 11 feet long	2 ties 15 feet long
7 ties 12 feet long	1 tie 16 feet long

At present the railroad company accepts switch ties not in sets, but they must be 9 to 16 feet long, 7 inches thick, with at least 7 inches face.

Switch ties are bought by the thousand feet, board measure, the contents being determined by multiplying the length of the tie in feet by the face and the thickness in inches, and dividing the product by 12. Ordinary cross-ties are bought by the piece.

About 1,200 chestnut trees, or some 6,000 logs, were followed through two mills. The two stands were 3 to 4 miles apart, of the same general character, growing in similar situations, and on practically the same exposure. The chestnut was mixed with a small proportion of hemlock, red oak, paper birch, popple, ash and other hardwoods. White pine occurred scattered singly or in small groups throughout both areas. Over 95 per cent. of the chestnut on both tracts were sprouts.

The chestnut on the Pisgah tract was 59 years, 7 years older than that on the Ashuelot tract, and was therefore somewhat larger and of better quality. In the older stand 97 per cent. of all the trees ran from 9 to 18 inches in diameter breasthigh, and from 70 to 85 feet in height. Individual trees over 100 feet in height were not rare. The diameter of the last log averaged from 5.5 to 6.7 inches inside the bark. The length of the used portion of the tree varied from 25 to 57 feet.

In the younger stand, 52 years old, 96 per cent. of all the trees were from 8 to 15 inches in diameter. The average length of the used part of the tree varied from 25 to 47 feet. The diameter at the top of the last log averaged 5 to 7 inches inside the bark.

The larger chestnut logs of the Pisgah tract were cut into 1½-inch round-edged plank, while similar logs on the Ashuelot lot were cut into switch ties. A certain quantity of plank was obtained at the latter mill from sidings of logs cut into ties.

One of the questions for this study to decide was whether it pays better to put the larger logs into switch ties than cutting them into plank.

Table VIII was constructed to show the money value of chestnut trees of different sizes, assuming the following prices, based on lumber f. o. b. Winchester, and ties delivered at the track:

1½-inch plank ($28 per thousand feet surface measure), $18.67 per thousand board feet.

Switch ties, $16.00 per thousand board feet.

No. 1 ties, 48 cents apiece.

No. 2 ties, 25 cents apiece.

Posts (including cull ties), 15 cents apiece.

TABLE VIII.—VOLUME AND VALUE OF CHESTNUT.

Diameter breasthigh.	Ashuelot—Trees cut into posts, ties and switch ties.				Pisgah—Trees cut into posts, ties and plank.			
	Volume of used portion of tree including bark.	Value of tree.	Value per cubic foot.	Basis.	Volume of used portion of tree including bark.	Value of tree.	Value per cubic foot.	Basis.
Inches.	*Cu. ft.*		*Cents.*	*Trees.*	*Cu. ft.*		*Cents.*	*Trees.*
7	5.0	$0.41	8.2	7	.....	.....	.....	.....
8	6.9	.63	9.1	87	9.6	$0.72	7.5	8
9	9.3	.91	9.8	100	12.3	1.03	8.4	15
10	12.2	1.25	10.2	109	15.4	1.42	9.2	52
11	15.6	1.63	10.4	95	19.0	1.90	10.0	87
12	19.5	2.06	10.6	61	23.2	2.42	10.4	104
13	23.7	2.53	10.7	43	27.6	3.01	10.9	117
14	28.2	3.04	10.8	27	32.4	3.64	11.2	103
15	33.0	3.61	10.9	13	37.4	4.30	11.5	74
16	38.0	4.22	11.1	12	42.9	4.98	11.6	52
17	43.0	4.87	11.3	7	48.7	5.68	11.7	31
18	47.8	5.52	11.5	4	54.7	6.39	11.7	23
19	52.9	6.15	11.6	2	60.9	7.11	11.7	11
20	57.4	6.74	11.7	.....	66.8	7.85	11.8	5
21	.....	.....	.....	.....	72.9	8.57	11.8	1
				517				678

To compare the relative values of two trees it is necessary to know their volumes. Since it is difficult and impracticable to determine the volume in board feet of trees cut into ties and posts, the volume of the used portions of the tree, expressed in cubic feet, was taken as a basis for comparison, and the value per cubic foot of trees of different sizes was determined. Table VIII shows the volume of the used portion of the tree in cubic feet, the total value of the tree, and the value per cubic foot, of the chestnut from each tract.

It will be seen from this table that for the smaller sizes the Ashuelot chestnut has a greater value per cubic foot than the Pisgah lumber. This is because the trees cut at the former place were not so closely utilized as at the Pisgah mill. In

other words, the Ashuelot mill left longer tops in the woods, using only the better portion of the tree. This, of course, had the tendency to raise the value per unit of volume, but to lower the total value of the tree. In the higher diameters the better quality of the Pisgah lumber was enough to overcome this difference, and we find that above twelve inches in diameter not only the total value of the Ashuelot trees, but also the value per cubic foot, is lower. The difference in value between switch-tie lumber and round-edged plank was another factor which influenced the relative values of the trees. This is clearly shown in table IX, which compares the values of logs cut into switch ties and sidings, and the same sized logs cut into plank.

TABLE IX.—RELATIVE VALUES OF LOGS CUT INTO SWITCH TIES AND INTO PLANK.—CHESTNUT.

Diameter outside bark at middle of log.	Contents of log cut into switch ties and sidings.		Value of log cut into switch ties and sidings.	Contents of logs cut into plank.	Value of log cut into plank.
	Switch ties.	Sidings.			
Inches.	*Bd. ft.*	*Bd. ft.*		*Bd. ft.*	
12	64	13	$1.26	59	$1.10
13	68	18	1.43	71	1.33
14	70	29	1.65	82	1.53
15	70	42	1.89	95	1.77
16	70	57	2.19	108	2.02
17	84	60	2.47	122	2.28
18	88	67	2.65	136	2.52
19	105	59	2.78	150	2.80

It will be seen from this table that there is some advantage in cutting logs less than nineteen inches in diameter outside the bark into switch ties rather than into lumber. The larger logs, however, can more advantageously be put into plank. This is because there is comparatively less waste due to sawkerf and slabs in cutting a larger log.

TABLE X.—RELATION BETWEEN INCREASE IN VOLUME AND INCREASE IN VALUE.—CHESTNUT.

Increase in diameter breasthigh.	Ashuelot.		Pisgah.	
	Increase in volume of used portion of tree.	Increase in value of tree.	Increase in volume of used portion of tree.	Increase in value of tree.
Inches.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
From 7 to 8	38.0	53.7	.....	.....
8 9	34.8	44.4	28.1	45.1
9 10	31.2	37.4	25.2	37.9
10 11	27.9	30.4	23.4	33.8
11 12	25.0	26.4	22.1	27.4
12 13	21.5	22.8	19.0	24.4
13 14	19.0	20.2	17.4	20.9
14 15	17.0	18.8	15.4	18.1
15 16	15.1	16.9	14.7	15.8
16 17	13.2	15.4	13.5	14.1
17 18	11.2	13.3	12.3	12.5
18 19	10.7	11.4	11.3	11.3
19 20	8.5	9.6	9.9	10.4
20 21	.....	.....	9.1	9.2

Table X shows the relation between the increase in the total volume of the tree and the increase in its total value, expressed in percentages. The fact is brought out here, as was the case with the white pine, that in the smaller diameters the rate of increase in value is comparatively much higher than the rate of increase in volume. Above 16 inches the difference in the two rates is small. This is especially true for the Pisgah lumber.

To summarize, the chestnut mill scales show that with present prices it pays better to cut logs less than 19 inches in diameter outside the bark into switch ties and larger logs into plank; and that in considering the proper rotation for chestnut coppice the increase in the value of trees more than 16 inches in diameter, due to the improvement in the quality of the lumber, may be left out of consideration, if prices remain as they are at present, and no new grades are introduced.

Red Oak.—The red oak on second-growth woodlots is usually less than 16 inches in diameter breasthigh, and yields inferior grades of lumber. The wood is quite sound but knotty, and, if graded according to the rules of the National Hardwood Lumber Association, the bulk of it would fall into

"shipping culls." The lumber is used in making furniture, mostly chairs, and is rarely separated into grades.

About 700 trees were followed through several mills, mostly in Merrimack County. About 85 per cent. of the lumber was cut into 1⅛-inch round-edged boards, the extra ⅛ inch being allowed for shrinkage in drying and dressing. The rest of the lumber was cut into 1½-inch round-edged plank.

The trees were from 50 to 80 years old, the age varying rather uniformly with the diameter. The used portion of the trees ranged from 15 to 50 feet in length, yielding from 1 to 4 12-foot logs. The hardwoods are not so closely utilized for lumber as the conifers, the cutting limit here being 5 to 9 inches inside the bark at the small end of the last log. The stumps, also, were quite high, varying from 1.1 to 1.6 feet.

The used length of the tree, rather than its total height, was chosen as a basis for the table, because of the difficulty in estimating the total height of a hardwood tree.

Table XI shows the volume in cubic feet of the used length of the tree, the amount of lumber sawed out at the mill, and the number of board feet obtained per cubic foot.

TABLE XI.—VOLUME TABLE FOR RED OAK.

Diameter breasthigh.	Used length.—Feet.										Number of bd. ft. per cu. ft.	Basis 693 trees.
	10		20		30		40		50			
	Volume.		Volume.		Volume.		Volume.		Volume.			
Inches.	*Cu. ft.*	*Bd. ft.*	*Cu. ft.*	*Bd. ft.*	*Cu. ft.*	*Bd. ft.*	*Cu. ft.*	*Bd. ft.*	*Cu. ft.*	*Bd. ft.*		
5	1.7	7	2.3	.....	.....	.....	.....	.....	.....	.....	3.6	3
6	2.2	9	3.2	15	.....	.....	.....	.....	.....	.....	4.0	19
7	2.9	14	4.7	22	6.0	29	7.5	34	.....	.....	4.4	73
8	3.6	18	6.0	30	7.5	39	9.2	43	.....	.....	4.8	128
9	4.6	25	7.5	40	9.4	48	11.4	58	.....	.....	5.1	142
10	5.7	31	9.1	50	11.3	60	13.8	73	17.4	99	5.4	129
11	7.0	37	11.0	68	13.9	74	16.4	90	20.5	118	5.5	72
12	8.3	44	18.1	78	16.3	89	19.5	110	28.9	143	5.7	44
13	9.5	54	15.7	93	19.2	107	22.9	132	27.4	174	5.8	32
14	11.1	65	18.3	109	22.2	126	26.5	160	31.8	208	5.9	14
15	.....	.....	21.2	124	25.8	149	30.7	190	86.1	243	6.1	10
16	.....	.....	24.2	143	29.2	173	35.0	225	41.2	288	6.2	8
17	.....	.....	27.8	168	33.3	201	39.9	262	46.8	330	6.4	7
18	.....	.....	31.2	181	37.8	232	45.0	308	53.0	.....	6.6	1
19	.....	.....	34.9	202	42.0	265	50.7	356	59.3	.....	6.8	1
20	.....	.....	.....	223	.....	300	56.7	405	.....	.....	7.0	.....
											Av., 5.57	

Table XII shows the value of red oak trees of various sizes, with lumber at $20 per thousand board feet.

TABLE XII.—VALUE OF TREES WITH LUMBER AT $20 PER THOUSAND BOARD FEET.—RED OAK.

Diameter breasthigh.	Used length.—Feet.					Basis. 668 trees.
	10	20	30	40	50	
Inches.						
5	$0.14	.....	.....	.....	.....	3
6	.18	$0.30	.....	.....	.....	19
7	.28	.44	$0.55	$0.68	.....	73
8	.36	.60	.78	.86	.....	128
9	.50	.80	.98	1.16	.....	142
10	.62	1.00	1.20	1.46	1.98	129
11	.74	1.26	1.48	1.80	2.36	72
12	.88	1.56	1.78	2.20	2.86	44
13	1.08	1.86	2.14	2.64	3.48	32
14	1.30	2.18	2.52	3.20	4.16	14
15	.....	2.48	2.98	3.80	4.86	10
16	.....	2.86	3.46	4.50	5.76	8
17	.....	3.26	4.02	5.24	6.60	7
18	.....	3.62	4.64	6.16	.....	1
19	.....	4.04	5.30	7.12	.....	1
20	.....	4.46	6.00	8.10	.....	.....

Paper birch.—More or less paper birch is found in almost all second-growth hardwood stands, but the tree is rarely more than 15 inches in diameter breasthigh. The lumber which is sound, but knotty, is used extensively for spool and bobbin stock, and more rarely for chairs.

Table XIII is based on the measurements of 427 trees, taken in various parts of the state. Practically all the lumber was cut into $1\frac{1}{8}$-inch round-edged boards. The trees varied from 45 to 60 years in age, and from 6 to 15 inches in diameter. The used portion of the trees was from 10 to 37 feet, yielding 1 to 3 12-foot logs. The diameter at the small end of the last log ranged from 4 to 10 inches inside the bark.

In this table, as with the red oak, the used length of the tree, rather than its total height, was the basis chosen, because of the difficulty in determining the height of a hardwood tree.

TABLE XIII.—VOLUME TABLE FOR PAPER BIRCH.

Diameter breasthigh.	Used length.—Feet.										Number of bd. ft. per cu. ft.	Basis 427 trees.
	10		20		30		40		50			
	Volume of used length.											
Inches.	*Cu. ft.*	*Bd. ft.*	*Cu. ft.*	*Bd. ft.*	*Cu. ft.*	*Bd. ft.*	*Cu. ft.*	*Bd. ft.*	*Cu. ft.*	*Bd. ft.*		
6	2.2	9	4.1	17	5.2	21	6.3	26	7.5	31	4.1	16
7	2.0	14	5.2	24	6.0	32	8.1	38	9.7	46	4.7	58
8	3.6	18	6.6	34	8.8	42	10.0	51	12.1	62	5.1	70
9	4.4	24	8.0	43	10.3	56	12.1	65	15.1	82	5.4	82
10	5.2	29	9.8	55	12.6	71	14.9	83	18.0	101	5.6	70
11	6.3	37	11.6	67	15.0	87	17.0	104	21.4	124	5.8	57
12	7.8	46	13.7	81	17.9	106	21.1	124	24.9	147	5.0	86
13	.....	.....	15.9	95	20.9	125	25.0	150	28.8	173	6.0	13
14	.....	.....	18.2	111	24.1	147	28.9	176	32.8	200	6.1	10
15	.....	.....	21.0	130	27.6	171	32.8	203	36.9	229	6.2	6
16	.....	.....	.....	.....	31.0	195	37.0	233	41.5	261	6.3	.....
											Av., 5.52	

Table XIV shows the value of paper birch trees, with lumber at $16 a thousand board feet.

TABLE XIV.—VALUE OF TREES WITH LUMBER AT $16 PER THOUSAND FEET.—PAPER BIRCH.

Diameter breasthigh.	Used length.—Feet.					Basis 427 trees.
	10	20	30	40	50	
Inches.						
6	$0.14	$0.27	$ 0.34	$0.42	$0.50	16
7	.22	.38	.51	.61	.74	58
8	.29	.54	.67	.82	.99	79
9	.38	.69	.90	1.04	1.31	82
10	.46	.88	1.14	1.33	1.62	70
11	.59	1 07	1.39	1.66	1.96	57
12	.74	1.30	1.70	1.98	2.35	36
13	.....	1.52	2.00	2.40	2.77	13
14	.....	1.78	2.35	2.82	3.20	10
15	.....	2.08	2.74	3.25	3.66	6
16	.....	.....	3.12	3.73	4.18	.....

Hemlock.—Hemlock occurs in greater or smaller quantities in almost every stand, and is cut together with the other species. It is usually put into building material, either as one-inch squared boards, as 2 by 4 and 3 by 4-inch studs, or as joists. When occurring sparingly in mixture with white pine, the hemlock is cut into box boards. The lumber, as a rule, is sound and fairly free from shake, and is rarely separated into grades.

Table XV is based on the measurements of 317 trees taken in various parts of the state in connection with the mill tallies of other species. About half of the lumber was put into studs, and the rest into inch boards. The trees were from 55 to 80 years old, ranged in height from 35 to 65 feet, and most of them were 7 to 15 inches in diameter breasthigh. The diameter at the small end of the last log varied from 4.4 to 6.5 inches inside the bark. The used portion of the trees was from 15 to 45 feet long. The table shows the volume in cubic feet of the used length of the trees, the amount of lumber sawed out at the mill, and the number of board feet which was obtained per cubic foot.

TABLE XV.—VOLUME TABLE FOR HEMLOCK.

Diameter breasthigh.	Total height—Feet.										Number of bd. ft. per cu. ft.	Basis 317 trees.
	30		40		50		60		70			
	Volume of used length.											
Inches.	*Cu. ft.*	*Bd. ft.*	*Cu. ft.*	*Bd. ft.*	*Cu. ft.*	*Bd. ft.*	*Cu. ft.*	*Bd. ft.*	*Cu. ft.*	*Bd. ft.*		
6	1.8	5	2 8	.....	3.7	.....	.....	.....	.....	.....	4.5	4
7	2.7	10	3.8	20	5.0	30	6.3	42	.....	.....	5.0	17
8	3.9	17	5.0	28	6.6	39	8.1	50	.....	.....	5.3	40
9	5.0	26	6.5	36	8.4	49	10.0	60	11 8	.....	5.5	57
10	6.4	36	8.5	46	10.6	59	12.5	71	14.3	86	5.6	57
11	8.0	47	10.5	58	13.0	72	15.2	86	17.3	103	5.6	41
12	10.2	60	12.8	72	15.4	86	18.2	103	20.8	123	5.7	42
13	12.2	.....	15.2	88	18 3	104	21.5	124	24.3	148	5.7	17
14	.....	.....	17.7	107	21.2	125	25.0	147	28.2	173	5.8	14
15	.....	.....	20.0	126	24.4	148	28.8	172	32.8	204	5.9	14
16	.....	.....	22.5	148	27.6	171	33.0	200	37.5	240	6.1	6
17	.....	.....	.....	.....	30.8	197	37.7	233	42.8	281	6.2	8
											Av., 5.7	

With hemlock at $15 per thousand board feet, Table XVI shows the value of the various sized trees.

TABLE XVI.—MILL SCALES—SOUTHERN NEW HAMPSHIRE.—VALUE OF TREES WITH LUMBER AT $15 PER THOUSAND BOARD FEET.—HEMLOCK.

Diameter breasthigh.	Total height—Feet.					Basis 317 trees.
	30	40	50	60	70	
Inches.						
6	$0.07	.....	.....	.....	.....	4
7	.15	$0.30	$0.45	$0.63	.....	17
8	.26	.42	.59	.75	.....	40
9	.39	.54	.73	.90	.....	57
10	.54	.69	.89	1.06	1.29	57
11	.70	.87	1.08	1.29	1.54	41
12	.90	1.08	1.29	1.55	1.84	42
13	.....	1.32	1.56	1.86	2.22	17
14	.....	1.60	1.88	2.20	2.60	14
15	.....	1.89	2.22	2.58	3.06	14
16	.....	2.22	2.56	3.00	3.60	6
17	.....	.....	2.96	3.50	4.22	8

Volume Tables.

Certain kinds of wood are not cut into boards or plank, but are utilized in the form of bolts and billets. The lumber, in that case, is sold by the cord. This is especially true of spruce sold for pulp, and popple used either for pulp or excelsior.

To determine as accurately as possible the amount of lumber that may be obtained from trees of various sizes, measurements were made on 900 spruce and 300 popple. The diameter was measured at intervals of 4 feet along the stem, and the limit of cutting was fixed at 4 inches outside the bark. The thickness of bark was measured on 300 spruce trees, at intervals of eight feet along the stem, and its volume computed. It was found to be about 11 per cent. of the total volume of the tree with the bark, varying only very slightly with the size of the tree.

All volume measurements were made on green logs.

Spruce.—Only second-growth spruce was measured. Six hundred trees were taken at Waterville, in Grafton County, and 300 trees more at Stoddard, in Cheshire County.

The Waterville spruce was an even-aged stand about 70 years old. The trees ranged in height from 48 to 64 feet, and in diameter from 5 to 14 inches. The used portion of the trees ran from 18 to 46 feet in length. The height of stump was usually less than a foot.

The Stoddard spruce was rather irregular in age, varying from fifty to ninety years. The heights ran from 40 to 80 feet, and the diameters from 4 to 19 inches. From 10 to 60 feet of the length of the trees were utilized. The stumps were from .2 to .3 of a foot higher than in the Waterville spruce.

In spite of the slight variation in size and age, the difference in volume between trees of the same diameter and height from the two stands was so small that the data collected in both places was worked up in one table.

Table XVII shows the volume of second-growth spruce of different diameters and heights. To obtain the volume of peeled spruce, deduct 11 per cent. from these volumes.*

TABLE XVII.—VOLUME TABLE FOR SECOND-GROWTH SPRUCE.

Diameter breasthigh.	Height—Feet.					Basis.
	40	50	60	70	80	
Inches.	Volume of used length including bark—Cubic feet.					Trees.
4	0.9	.....	.....	.....	.....	5
5	1.8	2.4	.....	.....	.....	33
6	3.5	4.2	5.3	6.6	.....	99
7	5.1	6.2	7.3	9.0	.....	127
8	7.0	8.8	9.7	11.3	.....	168
9	8.9	10.6	12.1	14.0	.....	155
10	10.9	13.4	15.2	17.1	.....	103
11	.....	16.2	18.4	20.7	.....	64
12	.....	19.3	21.9	24.4	.....	37
13	.....	22.7	25.6	29.0	33.7	22
14	.....	26.0	30.0	33.4	38.2	29
15	.....	.....	34.2	38.0	43.2	23
16	.....	.....	38.8	43.1	48.6	13
17	.....	.....	43.5	48.2	54.5	10
18	.....	.....	48.0	53.0	60.0	9
19	.....	.....	.....	58.3	66.0	6
						903

*The volume tables are given in cubic feet. To reduce them to cords it is only necessary to divide them by the number of cubic feet allowed to the cord. It is common practise in many places to allow 100 cubic feet to the cord.

Popple.—Three hundred popple were measured, all of them taken at Plainfield, in Sullivan County. All measurements, except the breasthigh diameter, were made on peeled logs. The trees varied in age from 25 to 50 years. They were from 50 to 75 feet high, and from 5 to 13 inches in diameter. The used portion of the trees ran from 17 to 56 feet in length, and the height of stumps from .6 to 1.3 feet.

Table XVIII gives the volume of peeled popple.

TABLE XVIII.—VOLUME TABLE FOR POPPLE.

Diameter breasthigh.	Height.—Feet.				Basis.
	50	60	70	80	
Inches.	Volume of used length peeled.—Cubic feet.				Trees.
5	2.0	2.2	.....	.....	19
6	3.1	3.6	4.5	.....	69
7	4.3	5.3	6.5	7.7	65
8	5.7	7.3	8.8	10.2	58
9	7.1	9.6	11.7	13.4	40
10	.....	12.2	14.9	17.2	15
11	.....	.....	18.3	21.3	13
12	.....	.....	22.3	.....	8
13	.....	.....	26.8	.....	2
					289

All the above tables can be directly applied in finding the contents and value of entire stands. For a full description of methods used for measuring the height and diameter of trees, and the use of volume tables, consult "The Woodsman's Handbook," Bulletin 36, Bureau of Forestry, U. S. Department of Agriculture, which may be had on application to the Forest Service, Washington, D. C.

Yield Tables.—A yield table is a statement in tabular form of the amount of lumber per acre that may be expected at different ages in a forest of a specified description. Its principal use is in foretelling future yield.

The yield of a forest depends on a number of factors, all of which must be known before the future production of lumber can be predicted:

1. The composition and character of the forest must be known. Pine will produce more lumber per acre in sixty years than red oak or chestnut. Again, the amount of lumber produced by chestnut will be different according to whether the forest is of seedling or sprout origin.

2. The region where the forest is found. Tables which apply to New Hampshire conditions may not apply to Minnesota.

3. Even in the same region the site quality will have a marked influence on the amount of lumber produced by a stand. Soil, moisture, exposure to light and wind, all have their influence on the growth of the trees and are finally reflected in the yield.

4. The method of managing the forest and the time when thinnings and cuttings are made will affect the production of lumber.

Furthermore, all the above factors may be identical for two stands, and their yield may still be quite different, because one of the stands is fully stocked while the other is only partially stocked. Since yield tables are generally used as standards of measurement or comparison, it is customary to base them on fully stocked stands.

The following yield tables are based on fully stocked, even-aged, unmanaged, pure white pine stands in southern New Hampshire, and apply only to stands that agree with this description.

One hundred and ninety-six sample plots of white pine were taken in fifteen different towns, well scattered over the southern portion of the state. Because of the difficulty in finding larger areas which would conform to all the requirements, most of the sample plots were only one-quarter of an acre in extent. The data was then worked up in the office. The volume in board feet for each plot was obtained by the use of Table XXXVI, the yield being expressed for whole acres. The results were plotted on cross-section paper, curves were drawn through the maximum and the minimum points, and the confined zone was divided into three equal bands. In this way three site qualities were distinguished—Quality I representing

that most favorable to tree growth, Quality III the most unfavorable, and Quality II the average or intermediate quality of locality.

Table XIX shows the volume of lumber in board feet and the value per acre that may be expected at every fifth year, from twenty to ninety years, on the best, the average, and the poorest site qualities, of a fully stocked, pure, even-aged, unmanaged white pine stand.

TABLE XIX.—YIELD TABLE FOR WHITE PINE.

YIELD PER ACRE.

Age.	Quality I.—Value of lumber.			Quality II.—Value of lumber.			Quality III.—Value of lumber.		
	Volume.	f. o. b. value.	Stumpage value.	Volume.	f. o. b. value.	Stumpage value.	Volume.	f. o. b. value.	Stumpage value.
Years.	*Bd. ft.*			*Bd. ft.*			*Bd. ft.*		
20	4,600	$56.35	$6.44	3,150	$33.59	4.41	1,700	$20.83	$2.38
25	8,400	104.58	13.44	5,900	73.45	9.44	3,450	42.95	5.52
30	15,100	191.77	27.94	10,800	137.16	19.98	6,550	83.19	12.12
35	24,950	338.09	57.39	18,050	237.86	41.52	11,200	147.28	25.76
40	33,550	474.73	110.72	25,000	353.75	82.50	16,450	232.77	54.29
45	40,750	615.33	173.19	31,450	474.90	133.66	22,150	334.47	94.14
50	47,450	752.08	237.25	37,800	599.18	189.00	27,650	433.25	133.25
55	52,350	861.16	293.16	42,550	699.95	238.28	32,750	538.74	183.40
60	57,300	968.37	346.67	47,400	801.06	286.77	37,500	633.75	226.88
65	61,850	1,070.00	393.93	51,850	897.00	334.43	41,850	724.00	269.93
70	65,900	1,169.73	454.71	55,800	990.45	385.02	45,700	811.18	315.33
75	69,750	1,255.50	498.71	59,500	1,071.00	425.42	49,250	886.50	352.14
80	73,300	1,337.73	542.42	62,850	1,147.01	465.09	52,400	950.30	387.76
85	76,700	1,418.95	586.76	66,000	1,221.00	504.90	55,300	1,023.05	423.05
90	80,050	1,500.94	632.40	69,000	1,293.75	545.10	57,950	1,086.56	457.31

By the use of the sample plots, which showed the number of trees of different sizes on an acre, and table VI, which gives the value of the lumber from different sized trees, the f. o. b. value of the lumber per acre was obtained, and is given in the third column of table XIX. By dividing these total f. o. b. values by the total volume in board feet in the second column, the f. o. b. value per thousand board feet of lumber obtained from stands of different ages was determined, and is given in the second column of table XX.

TABLE XX.—VALUE OF WHITE PINE.

Age.—Years.	Value per thousand board feet, f. o. b.	Value per thousand board feet, stumpage.
20	$12.25	$1.40
25	12.45	1.60
30	12.70	1.95
35	13.15	2.80
40	14.15	3.30
45	15.10	4.25
50	15.85	5.00
55	16.45	5.60
60	16.90	6.05
65	17.30	6.45
70	17.75	6.90
75	18.00	7.15
80	18.25	7.40
85	18.50	7.65
90	18.75	7.90

To obtain the stumpage values, it was assumed that the lumber from the average 50-year-old stand is worth $5 per thousand board feet standing, and that the total cost of manufacture, from the stump to the car, averaged $7 a thousand. Both of these assumptions are fair averages, and rather conservative. Assuming, then, that $12 a thousand represents the lumberman's total expenses, this sum was deducted from $15.85, the f. o. b. value per thousand feet of 50-year-old lumber, which left $3.85 as the lumberman's profit. Since there is no good reason why the lumberman should make a greater profit from a 60 or 70-year-old stand than from a 50-year-old stand, and assuming that the total cost of manufacture remains $7 a thousand, $10.85 was deducted in every case from the f. o. b. values of the lumber, and the third column of table XX was obtained, showing the stumpage value per thousand board feet of lumber gotten from stands of different ages.

These figures were then used in getting the stumpage value per acre in the yield table, the fourth column of table XIX. Where the total cost of manufacture is more than $7 a thousand, the additional cost should be subtracted from the stumpage value, while in the more favorable localities where the cost of manufacture is less than $7, the difference should should be added.

Financial Rotation for White Pine.

The practical application of the yield tables is in determining the proper rotation for a forest, that is, the age at which the forest should be cut, by foretelling the yield to be expected from it at any time.

The standing trees in a forest may be considered as a capital, and the yearly growth in lumber as the interest on that capital. Considered from a purely financial point of view, whenever this interest falls below the rate which may be earned by the money into which the timber can be converted, the forest should be cut. This rate of current annual increase in value is given in the third column of table XXI.

TABLE XXI.—RATE OF CURRENT ANNUAL INCREASE IN VOLUME AND VALUE, PER ACRE.—WHITE PINE.

Increase in age.	Quality I.		Quality II.		Quality III.	
	Current annual increase in volume.	Current annual increase in stumpage value.	Current annual increase in volume.	Current annual increase in stumpage value.	Current annual increase in volume.	Current annual increase in stumpage value.
Years.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
From 20 to 25	11.7	14.1	12.2	14.5	13.6	15.9
25 30	11.4	14.0	11.7	14.3	12.4	15.0
30 35	9.8	13.8	10.0	14.0	10.5	14.4
35 40	5.9	12.7	9.4	13.2	7.6	14.3
40 45	3.9	8.8	4.6	9.5	5.9	10.8
45 50	3.0	6.2	3.7	6.9	4.4	7.6
50 55	2.0	4.2	2.4	4.6	3.4	5.6
55 60	1.8	3.3	2.2	3.7	2.7	4.2
60 65	1.5	2.8	1.8	3.1	2.2	3.5
65 70	1.3	2.6	1.5	2.8	1.8	3.1
70 75	1.1	1.8	1.3	2.0	1.5	2.2
75 80	1.0	1.7	1.1	1.8	1.2	1.9
80 85	.9	1.6	1.0	1.6	1.1	1.7
85 90	.85	1.5	.9	1.5	.9	1.6

This table shows that if money can be invested at 4 per cent. compound interest it does not pay to hold a stand of timber on Quality I after it is 50 to 55 years old; it may be kept two or three years longer if it grows on Quality II; and it must be cut between the fifty-fifth and sixtieth year, if it is on Quality III. In the same way the proper rotation can be determined, assuming any other rate of interest. Thus, if money is valued at 3 per cent., the forest should not be left longer than the sixtieth, the sixty-fifth, or seventieth year, according to the site quality. The lower the rate per cent. at which money is valued, the longer the timber may be left standing; and, on the other hand, the higher the rate per cent. demanded the earlier the forest must be cut.

The rate of current annual increase in volume is given in the above table for the purpose of comparison with the corresponding increase in value. It shows the effect that the improvement in quality of lumber with age has on the length of rotation. If there were no improvement in quality, the current annual increase in value and in volume would be identical, and with money valued at 4 per cent. the time to cut the forest would be hastened by ten years.

This table does not definitely determine when the forest should be cut. It simply indicates the age beyond which it is unprofitable to let the trees grow. To find the proper rotation it is necessary to know all the items entering into the cost of producing the crop, and the rate of interest that the owner demands on the money invested. To illustrate how such calculations are made several tables were constructed assuming different values of land, various costs of planting, a certain outlay in protection and taxes, and three different rates of interest. These tables show the practicability of planting white pine under certain conditions.

Tables XXII to XXV are based on Quality II, which approximates the average conditions in the region studied.

TABLE XXII.—FINANCIAL ROTATION FOR WHITE PINE.

[Money valued at 4 per cent.—Value of land, $5 per acre; cost of planting, $7 per acre.

Rotation.	Gross returns.	Expenses.							Net profit at end of rotation.
		Taxes.			Cost of producing crop.			Total expenses at end of rotation.	
	Stumpage value of lumber at end of rotation.	Taxes on timber.		Taxes on land accrued to end of rotation.	Interest on value of land accrued to end of rotation.	Cost of planting carried to end of rotation.	Cost of protection accrued to end of rotation (10 cents per acre per year).		
		Annual for each 5-year period.	Accrued to end of rotation.						
Years.	*Per acre.*	*Per acre.*	*Per acre.*	*Per acre.*	*Per acre.*	*Per acre.*	*Per acre.*	*Per acre.*	*Per acre.*
20	$4.41	$0.029	.....	$0.28	$5.96	$15.34	$2.98	$24.56	—$20.15
25	9.44	.063	$0.16	.52	8.33	18.66	4.16	31.83	—22.39
30	19.98	.266	.58	.81	11.22	22.70	5.61	40.87	—20.89
35	41.52	.554	2.09	1.35	14.73	27.62	7.37	53.16	—11.64
40	82.50	1.100	5.55	2.00	19.01	33.61	9.50	69.67	12.83
45	133.68	1.782	12.71	2.80	24.21	40.89	12.10	92.71	40.95
50	189.00	2.520	25.12	3.77	30.53	49.75	15.27	124.44	64.56
55	238.28	3.177	44.20	4.94	38.23	60.52	19.13	167.02	71.26
60	286.77	3.824	70.98	6.37	47.60	73.64	23.80	222.39	64.38
65	334.43	4.459	106.80	8.12	58.99	89.59	29.50	293.00	41.43
70	385.02	5.134	154.41	10.24	72.86	109.00	36.42	382.93	2.09
75	425.42	5.672	215.66	12.81	89.73	132.62	44.86	495.68	—70.26
80	465.09	6.201	293.08	15.95	110.25	161.35	55.12	635.75	—170.66
85	504.90	6.732	390.15	19.77	135.22	196.31	67.60	809.05	—304.15
90	545.10	7.268	511.13	24.41	165.60	238.84	82.81	1,022.79	—477.69

There are four main headings in this table: the rotation, the gross return, the expenses, and the net profit.

1. The rotation is given in five-year periods.

2. The gross return is simply the stumpage value of the lumber at the end of the rotation. In managed stands there will be in addition a certain return from thinnings. This is discussed farther on. It is assumed in these calculations that the price of lumber will remain the same. Since lumber values tend to rise the results here given are conservative.

3. The expenses fall into two general classes: taxes, and the cost of producing and protecting the crop. All expenses were carried forward with compound interest to the end of the rotation.

(a) In considering the outlay in taxes it was assumed that the tax is uniformly at a rate of two cents on a dollar on a two-thirds valuation, that the value of the land remains the same throughout the rotation, and that the growing timber is revalued at the end of every five years, as the law requires. Further, since the table applies to planted stands, a deduction was made for the abatement in taxes allowed by the law of 1903.*

The third column in the table shows what the yearly tax on the timber would be during each five-year period, while the next column shows what the taxes would amount to at the end of each rotation, accrued with compound interest. The fifth column gives the taxes on land accrued to the end of each rotation.

(b) The items under the cost of producing the crop are the interest on the value of the land, compounded annually, the cost of planting carried forward to the end of the rotation, and the cost of protecting the crop, for which 10 cents per acre per year was allowed. This last item is purely arbitrary, but was accepted as a fair average.

4. The total expenses are obtained by adding the various items in columns four to eight, inclusive, for any rotation, and this deducted from the gross returns for that rotation gives the net profit (or loss, indicated by a minus sign).

*See page 204.

The point at which the net profit is highest represents the age at which it pays best to cut the timber, the financial rotation of the crop. In table XXII this point falls at the fifty-fifth year.

Tables XXIII and XXIV were constructed in the same way as table XXII, but different rates of interest were taken.

TABLE XXIII.—FINANCIAL ROTATION FOR WHITE PINE.

[Money valued at 3 per cent.—value of land, $5 per acre; cost of planting, $7 per acre.]

Rotation.	Gross returns.	Expenses.							Net profit at end of rotation.
		Taxes.			Cost of producing crop.			Total expenses at end of rotation.	
	Stumpage value of lumber at end of rotation.	Taxes on timber.		Taxes on land accrued to end of rotation.	Interest on value of land accrued to end of rotation.	Cost of planting carried to end of rotation.	Cost of protection accrued to end of rotation (10 cents per acre per year).		
		Annual for each 5-year period.	Accrued to end of rotation.						
Years.	*Per acre.*	*Per acre.*	*Per acre.*	*Per acre.*	*Per acre.*	*Per acre.*	*Per acre.*	*Per acre.*	*Per acre.*
20	$4.41	$0.029	.....	$0.26	$4.03	$12.64	$2.69	$19.62	—$15.21
25	9.44	.063	$0.15	.47	5.47	14.66	3.65	24.40	—14.96
30	19.98	.266	.51	.73	7.14	16 99	4.76	30.13	—10.15
35	41.52	.554	2.01	1.20	9.07	19.70	6.05	38.03	3.49
40	82.50	1.100	5.27	1.74	11.31	22.83	7.54	48.69	33.81
45	133.66	1.782	11.95	2.37	13.91	26.47	9.27	63.97	69.69
50	189.00	2.520	23.31	3.10	16.92	30.69	11.28	85.30	103.70
55	238.28	3.177	40.40	3.95	20.41	35.58	13.60	113.94	124.34
60	286.77	3.824	63.71	4.93	24.46	41.24	16.30	150.64	136.13
65	334.43	4.459	94.16	6.07	29.15	47.81	19.43	196.62	137.81
70	385.02	5.134	132.83	7.39	34.59	55.43	23.06	253.30	131.72
75	425.42	5.672	181.23	8.92	40.90	64.25	27.26	322.56	102.86
80	465.09	6.201	240.20	10.70	48.21	74.49	32.13	405.73	59.36
85	504.90	6.782	311.36	12.76	56.68	86.35	37.79	504.94	—.04
90	545.10	7.268	411.25	15.16	66.50	100.10	44.33	637.34	—92.24

TABLE XXIV.—FINANCIAL ROTATION FOR WHITE PINE.

[Money valued at 5 per cent.—Value of land, $5 per acre; cost of planting, $7 per acre.

Rotation.	Gross returns.	Expenses.							Net profit at end of rotation.
		Taxes.			Cost of producing crop.			Total expenses at end of rotation.	
	Stumpage value of lumber at end of rotation.	Taxes on timber.		Taxes on land accrued to end of rotation.	Interest on value of land accrued to end of rotation.	Cost of planting carried to end of rotation.	Cost of protection accrued to end of rotation (10 cents per acre per year).		
		Annual for each 5-year period.	Accrued to end of rotation.						
Years.	*Per acre.*	*Per acre.*	*Per acre.*	*Per acre.*	*Per acre.*	*Per acre.*	*Per acre.*	*Per acre.*	*Per acre.*
20	$4.41	$0.029	.....	$0.30	$8.27	$18.57	$3.31	$30.45	—$26.04
25	9.44	.063	$0.16	.57	11.93	23.71	4.77	41.14	—31.70
30	19.98	.266	.55	.92	16.61	30.25	6.64	54.97	—34.99
35	41.52	.554	2.18	1.54	22.58	38.61	9.03	73.94	—32.42
40	82.50	1.100	5.85	2.33	30.20	49.28	12.08	99.74	—17.24
45	133.66	1.782	18.55	2.34	39.98	62.90	15.97	135.69	—2.03
50	189.00	2.520	27.15	4.66	52.34	80.27	20.93	185.82	3.68
55	238.28	3.177	48.50	6.28	68.18	102.45	27.27	252.77	—14.49
60	286.77	8.824	79.57	8.38	88.40	130.75	35.86	342.46	—55.69
65	334.48	4.459	122.68	11.07	114.20	166.88	45.68	460.51	—126.03
70	385.02	5.134	181.22	14.49	147.13	212.98	58.85	614.67	—229.65
75	425.42	5.672	268.34	18.86	189.16	271.83	75.72	823.91	—398.49
80	465.09	6.201	378.78	24.44	242.81	346.98	97.14	1,085.05	—619.96
85	504.90	6.732	511.48	31.57	311.27	442.78	124.60	1,421.71	—916.81
90	545.10	7.268	689.71	40.66	398.65	565.11	159.44	1,858.57	—1,308.47

The three tables given above all assume the value of land to be $5.00, and the cost of planting $7.00 an acre. Table XXV was made to show where the financial rotation would fall with different values of land and different costs of planting, but with all other factors as in the above tables.

TABLE XXV.—FINANCIAL ROTATION FOR WHITE PINE.

Money valued at.	Value of land, $3.00 per acre.						Value of land, $5.00 per acre.						Value of land, $10.00 per acre.					
	Cost of planting per acre.						Cost of planting per acre.						Cost of planting per acre.					
	$5.00		$7.00		$10.00		$5.00		$7.00		$10.00		$5.00		$7.00		$10.00	
	Financial rotation.	Net profit.	Financial rotation.	Net profit.	Financial rotation.	Net profit.	Financial rotation.	Net profit.	Financial rotation.	Net profit.	Financial rotation.	Net profit.	Financial rotation.	Net profit.	Financial rotation.	Net profit.	Financial rotation.	Net profit.
	Yrs.		*Yrs.*		*Yrs.*		*Yrs.*		*Yrs.*		*Yrs.*		*Yrs.*		*Yrs.*		*Yrs.*	
3%	65	$169.56	65	$155.90	65	$135.41	65	$151.47	65	$137.81	60	$118.45	60	$108.51	60	$96.73	60	$89.05
4%	60	111.01	55	92.52	55	66.58	55	88.55	55	71.26	55	45.32	55	35.37	50	30.26	50	8.94
5%	50	53.40	50	30.47	No rotation.		50	26.61	50	3.68	.....	.....	No profitable rotation.					

It must be remembered that in all of the above tables of rotation the net profit represents the amount earned in addition to the demanded rate of interest on the investment. Furthermore, the above figures are very conservative for planted and managed forests, which would give a higher yield than the unmanaged stands on which the yield tables are based. In addition there will be certain returns derived from thinnings, if the forest be properly managed.

In taking the sample plots for the yield tables, the trees that should be removed in thinnings were recorded separately, and the results from the plots falling within the average quality of locality were worked up into table XXVI. Since trees less than five inches in diameter are not cut into boards, their volume is given in cubic feet. The total volume to be removed in thinning is also given in cubic feet.

TABLE XXVI.—YIELD FROM THINNING FULLY-STOCKED, UNMANAGED WHITE PINE STANDS.

Age.	Yield per acre.		
	Trees 5 inches or more in diameter.	Trees less than 5 inches in diameter.	Total.
Years.	*Bd. ft.*	*Cu. ft.*	*Cu. ft.*
25	750	750	900
30	3,300	600	1,380
35	5,600	450	1,680
40	7,500	300	1,900
45	8,900	150	2,040
50	9,900	.....	2,100

In applying the above table it should be remembered that the yield from thinnings is strictly additional, the ultimate yield being actually greater because of the accelerated growth of the trees left for the final crop.

APPENDIX.

APPENDIX.

PRINCIPAL USES OF THE COMMERCIALLY IMPORTANT TREES.

White Pine.—Box boards, pail and fish barrel stock, match blocks, sash and blind stock, boat boards, refrigerator stock, common lumber, shingles.

Chestnut.—Ties, posts, poles, piles, furniture, coffin stock, interior finish.

Red Oak.—Furniture, interior finish.

Spruce.—Pulp, dimension lumber, piano boards.

White Ash.—Car and wagon stock, agricultural implements, furniture, interior finish, tool handles.

Sugar Maple.—Chair stock, flooring, bobbin stock, dowels, staves, veneer, crutches, dimension lumber, maple sugar.

Paper Birch.—Bobbin and spool stock, shoe pegs, dowels.

Yellow and Black Birch.—Chair stock, bobbin and spool stock, dowels, staves, veneer, crutches, dimension lumber.

Popple.—Pulp, excelsior, box boards.

Hemlock.—Dimension and common lumber, box boards, tanbark.

Beech.—Chair stock, staves, bobbin stock, dowels, cordwood.

Red Maple.—Chair stock, cordwood.

White Oak.—Ties, posts, wagon stock.

Hickory.—Wagon stock, agricultural implements, tool handles.

Basswood.—Boxes, excelsior.

Red Pine.—Box boards, dimension lumber.

Pitch Pine.—Rough box boards, cordwood.

Balsam Fir.—Pulp, box boards, excelsior.

Tamarack.—Ties, posts, poles.

A. MILL TABLES AND VOLUME TABLES.*

WHITE PINE.

TABLE XXVII.—VOLUME TABLE FOR WHITE PINE.—WATERLOO AND HENNIKER, AGE 50 YEARS.

Diameter breasthigh.	Height—Feet.						Basis.
	30	40	50	60	70	80	
Inches.	Volume of used length with bark.—Cubic feet.						Trees.
5	1.6	2.4	3.1	.....	.....	.....	15
6	2.3	3.5	4.3	5.1	.....	.....	61
7	3.4	4 8	5.8	7.0	8.3	.....	98
8	4.6	6.2	7.5	9.0	10.3	.....	138
9	5.9	7.7	9.5	11.3	13.5	15.5	152
10	.....	9.2	11.7	14.0	16.7	19.0	131
11	.....	10.3	14.0	16.3	20.0	22.7	101
12	.....	12.6	16.3	19.3	23.3	26.5	72
13	.....	14.5	18.5	23.0	26.3	30.2	68
14	.....	.....	21.0	26.0	30.5	34.2	25
15	.....	.....	.....	29.3	34.7	38.3	12
16	.....	.....	.....	32.4	38.3	42.5	13
17	.....	.....	.....	.....	43.0	47.0	.....
							Total.....884

*The volume tables in cubic feet of the used length of the tree may be readily reduced to cords by dividing the volume of the tree by the number of cubic feet allowed to the cord. It is common practise to allow 100 cubic feet to the cord.

TABLE XXVIII.—VOLUME TABLE FOR WHITE PINE.—SOUTH SUTTON, AGE 75 YEARS.

Diameter breasthigh	Height—Feet.								Basis.
	40	50	60	70	80	90	100	110	
Inches.	Volume of used length with bark—Cubic feet.								Trees.
7	4.5	6.2	8.0	.....	.....	.....	.....	.....	4
8	5.6	8.0	10.1	12.0	.....	.....	.....	.....	19
9	7.0	9.9	12.5	15.0	.....	.....	.....	.....	21
10	8.6	12.0	15.1	18.0	21.0	23.9	26.2	.....	23
11	10.4	14.2	18.0	21.5	25.1	28.5	31.4	.....	24
12	12.5	16.5	20.9	25.2	29.4	33.8	37.0	.....	41
13	14.8	19.0	24.0	29.0	34.0	38.5	43.0	.....	29
14	17.8	21.7	27.4	33.1	39.0	44.0	49.4	54.5	36
15	.....	24.5	31.0	37.5	44.0	50.0	56.1	62.3	27
16	.....	27.8	35.0	42.2	49.4	56.0	63.0	70.2	37
17	.....	30.2	39.0	47.2	55.0	60.7	70.8	78.5	40
18	.....	33.0	43.5	52.5	61.0	69.5	77.5	86.5	37
19	.....	.....	48.5	58.0	67.0	76.5	85.0	95.0	30
20	.....	.....	54.0	63.5	73.5	83.5	93.0	103.5	26
21	.....	.....	59.5	69.0	80.0	91.0	101.0	112.0	16
22	.....	.....	65.0	75.0	87.0	98.5	109.5	121.0	14
23	.....	.....	.....	81.0	94.5	106.5	118.5	130.5	12
24	.....	.....	.....	87.5	102.0	115.0	128.0	140.5	5
25	.....	.....	.....	94.5	109.5	123.5	138.0	151.5	9
26	.....	.....	.....	101.5	118.0	132.5	148.0	163.0	6
27	.....	.....	.....	109.5	126.0	142.0	158.5	175.0	3
28	.....	.....	.....	117.5	134.5	151.5	169.0	187.0	2
29	.....	.....	.....	.....	.....	161.0	180.0	200.0	1
30	.....	.....	.....	.....	.....	170.5	191.0	218 0	3
									Total.....465

TABLE XXIX.—VOLUME TABLE FOR WHITE PINE.—BAND-SAW.—BROOKLINE.—AGE, 70 YEARS.

Diameter breasthigh.	Height—Feet.					Basis.
	60	70	80	90	100	
Inches.	Volume of used length with bark.—Cubic feet.					Trees.
7	7	9	.....	.....	.....	5
8	9	12	15	.....	.....	18
9	12	15	18	.....	.....	19
10	15	18	22	.....	.....	35
11	18	22	26	.....	.....	34
12	22	26	30	35	.....	46
13	26	30	34	39	.....	30
14	30	34	38	43	.....	37
15	34	38	42	48	.....	37
16	38	42	47	54	.....	28
17	42	46	52	60	.....	23
18	.....	.....	58	66	75	24
19	.....	.....	64	73	83	20
20	.....	.....	70	80	91	12
21	.....	.....	76	87	100	9
22	.....	.....	83	94	109	4
23	.....	.....	.....	102	117	3
24	.....	.....	.....	111	126	3
25	.....	.....	.....	120	135	2
26	.....	.....	.....	130	145	.....
						Total...889

TABLE XXX.—VOLUME TABLE FOR WHITE PINE.—AGE, LESS THAN 60 YEARS.

Diameter breasthigh.	Height—Feet.							Basis.
	30	40	50	60	70	80	90	
Inches.	Volume—Board feet.							Trees.
5	8	11	15	.....	.....	.....	.....	7
6	15	20	24	28	.....	.....	.....	40
7	21	28	35	42	.....	.....	.....	71
8	27	37	47	55	.....	.....	.....	102
9	34	47	58	70	65	.....	.....	176
10	42	57	72	87	107	130	.....	152
11	.....	68	86	105	128	155	.....	180
12	.....	80	102	125	152	182	.....	96
13	.....	90	120	145	175	210	245	102
14	.....	.....	140	170	205	240	280	38
15	.....	.....	160	195	235	275	315	22
16	.....	.....	180	225	265	310	355	34
17	.....	.....	.....	255	300	350	395	14
18	.....	.....	.....	.....	335	385	440	8
19	.....	.....	.....	.....	370	425	485	6
20	.....	.....	.....	.....	.....	470	535	1
								959

TABLE XXXI.—VOLUME TABLE FOR WHITE PINE.—AGE, LESS THAN 60 YEARS.—VOLUME OF USED LENGTH.

Diameter breasthigh.	Height—Feet.							Basis.
	30	40	50	60	70	80	90	
Inches.	Cubic feet.							Trees.
5	2.0	2.8	2.7	.....	.....	.....	.....	7
6	2.9	3.7	4.4	5.3	.....	.....	.....	40
7	4.0	5.0	6.0	7.5	.....	.....	.....	71
8	5.0	6.5	8.0	9 7	.....	.....	.....	102
9	6.2	8.0	10.0	12.1	14.3	.....	.....	176
10	7.2	9.6	12.1	14.7	17.4	20.2	.....	152
11	.....	11.1	14.2	17.4	20.8	24.3	.....	130
12	.....	12.6	16.3	20.3	24.2	28.3	.....	96
13	.....	14.0	18.5	23.5	28.0	32.5	37.0	102
14	.....	.....	21.0	26.5	31.5	37.0	42.0	88
15	.....	.....	23.0	29.5	35.5	41.5	47.0	22
16	.....	.....	25.5	33.0	39.5	46.0	52.5	34
17	.....	.....	.....	36.0	43.5	51.0	57.5	14
18	.....	.....	.....	.....	47.5	55.5	63.5	8
19	.....	.....	.....	.....	52.0	60.0	69.0	6
20	.....	.....	.....	.....	.....	64.5	75.0	1
								959

TABLE XXXII.—VOLUME TABLE FOR WHITE PINE.—AGE, LESS THAN 60 YEARS.—TOTAL VOLUME, INCLUDING BARK, STUMP AND TOP.

Diameter breasthigh.	Height—Feet.							Basis.
	30	40	50	60	70	80	90	
Inches.	Cubic feet.							Trees.
5	2.4	3.0	3.4	.....	.....	.....	.....	7
6	3.4	4.3	5.0	6.0	.....	.....	.....	40
7	4.6	5.7	6.7	8.0	.....	.....	.....	71
8	5.8	7.3	8.8	10.6	.....	.....	.....	102
9	7.2	9.0	10.9	13.0	15.6	.....	.....	176
10	8.5	10.7	13.0	15.7	18.8	21.9	.....	152
11	.....	12.5	15.3	18.5	22.2	25.7	.....	130
12	.....	14.5	17.7	21.6	25.8	29.7	.....	96
13	.....	16.5	20.5	25.0	29.5	34.0	38.0	102
14	.....	.....	23.5	28.5	33.5	38.5	43.0	88
15	.....	.....	26.5	32.5	38.0	43.5	49.0	22
16	.....	.....	30.0	36.0	43.0	49.0	54.5	34
17	.....	.....	.....	40.0	48.0	54.5	61.0	14
18	.....	.....	.....	.....	53.0	60.5	68.0	8
19	.....	.....	.....	.....	58.5	66.0	75.0	6
20	.....	.....	.....	.....	.....	72.0	82.5	1
								959

TABLE XXXIII.—VOLUME TABLE FOR SECOND-GROWTH WHITE PINE.—AGE, 60 YEARS AND UP.

Diameter breasthigh.	Height—Feet.								Basis.
	50	60	70	80	90	100	110	120	
Inches.	Volume—Board feet.								Trees.
7	43	.....	.....	.....	.....	.....	.....	.....	3
8	53	60	66	.....	.....	.....	.....	.....	19
9	64	75	85	95	.....	.....	.....	.....	19
10	77	92	106	123	140	.....	.....	.....	22
11	91	110	130	152	173	.....	.....	.....	33
12	108	130	155	182	208	228	245	.....	47
13	.....	154	181	217	245	270	293	.....	33
14	.....	178	212	250	282	312	348	.....	48
15	.....	203	245	285	326	362	406	.....	37
16	.....	230	279	328	370	415	470	.....	54
17	.....	261	314	370	420	471	540	.....	52
18	.....	298	353	412	470	531	610	688	60
19	.....	338	395	460	527	598	682	763	37
20	.....	380	440	509	580	660	750	840	34
21	.....	429	486	555	633	720	820	918	20
22	.....	.....	535	599	096	779	887	990	16
23	.....	.....	.....	639	732	834	958	1,065	19
24	.....	.....	.....	676	779	889	1,030	1,135	8
25	.....	.....	.....	711	823	942	1,105	.....	12
26	.....	.....	.....	749	866	994	1,180	.....	11
									584

TABLE XXXIV.—VOLUME TABLE FOR SECOND-GROWTH WHITE PINE.—AGE, 60 YEARS AND UP.—VOLUME OF USED LENGTH.

Diameter breasthigh.	Height—Feet.								Basis.
	50	60	70	80	90	100	110	120	
Inches.	Cubic feet.								Trees.
7	6.0	7.5	.....	.....	.....	.....	.....	.....	3
8	8.8	9.8	11.5	.....	.....	.....	.....	.....	19
9	10.7	12.7	14.6	.....	.....	.....	.....	.....	19
10	13.3	15.7	18.0	20.4	.....	.....	.....	.....	22
11	15.9	18.7	21.5	24.6	.....	.....	.....	.....	33
12	18.6	22.0	25.4	28.9	32.9	.....	.....	.....	47
13	.....	25.5	29.5	33.5	38.0	.....	.....	.....	33
14	.....	29.5	34.0	38.5	43.5	48.5	.....	.....	48
15	.....	33.5	38.0	43.5	48.5	54.5	.....	.....	37
16	.....	37.5	43.0	48.5	54.5	60.5	66.5	.....	54
17	.....	41.5	47.5	54.0	60.5	67.5	75.5	.....	52
18	.....	45.5	52.5	59.5	67.0	74.5	84.5	94.0	60
19	.....	49.5	57.5	65.5	74.0	82.5	93.5	104.0	87
20	.....	54.0	62.5	71.5	80.5	91.0	102.5	114.5	34
21	.....	.....	68.0	78.0	88.5	100.0	112.0	125.0	20
22	.....	.....	73.0	84.0	96.0	109.0	122.0	135.5	16
23	.....	.....	78.5	90.0	104.0	118.0	132.5	146.5	19
24	.....	.....	.....	96.5	112.0	128.0	143.0	157.5	8
25	.....	.....	.....	102.5	120.5	137.5	153.0	168.0	12
26	.....	.....	.....	109.0	128.5	147.0	163.0	178.0	11
									584

TABLE XXXV.—VOLUME TABLE FOR SECOND-GROWTH WHITE PINE, AGE 60 YEARS AND UP.

[Total volume, including bark, stump, and top.

Diameter breasthigh.	Height—Feet.								Basis.
	50	60	70	80	90	100	110	120	
Inches.	Cubic feet.								Trees.
7	6.7	8.0	.....	.....	.....	.....	.....	.....	3
8	9.3	11.0	12.5	.....	.....	.....	.....	.....	19
9	12.8	14.1	16.0	.....	.....	.....	.....	.....	19
10	15.2	17.5	19.6	22.8	.....	.....	.....	.....	22
11	18.3	20.8	23.5	26.7	.....	.....	.....	.....	33
12	21.5	24.4	27.6	81.5	85.6	.....	.....	.....	47
13	.....	28.0	32.0	86.5	41.0	.....	.....	.....	33
14	.....	32.0	86.5	41.5	47.0	53.0	.....	.....	48
15	.....	36.0	41.5	47.0	53.0	60.0	.....	.....	37
16	.....	40.5	46.5	58.0	59.5	67.0	75.0	.....	54
17	.....	44.5	51.5	59.0	66.0	74.0	88.0	.....	52
18	.....	49.0	57.0	65.0	73.0	82.0	92.0	103.0	60
19	.....	54.0	62.0	71.0	81.0	90.5	101.5	118.5	87
20	.....	58.5	67.5	77.5	88.5	99.5	111.5	124.0	34
21	.....	.....	72.5	84.5	96.5	109.0	121.5	134.5	20
22	.....	.....	78.0	91.0	104.5	118.0	181.5	145.5	16
23	.....	.....	83.0	98.0	112.5	127.5	141.5	156.5	19
24	.....	.....	.....	104.5	121.0	137.0	152.0	167.0	8
25	.....	.....	.....	111.5	129.5	146.5	161.5	178.0	12
26	.....	.....	.....	118.5	138.0	155.0	171.5	188.5	11
									584

Sixty per cent. of the lumber cut from the trees on which table XXXVI is based was round-edged stuff, while the remaining 40 per cent. was squared. Seventy per cent. of the lumber was cut into 1-inch boards, and the rest into $2\frac{1}{8}$-inch plank.

TABLE XXXVI.—VOLUME TABLE FOR SECOND-GROWTH WHITE PINE, ALL AGES COMBINED.

Diameter breasthigh.	Height—Feet.										Basis.
	30	40	50	60	70	80	90	100	110	120	
Inches.	Volume—Board feet.										Trees.
5	8	12	15	.....	.....	.....	.....	.....	.....	.....	7
6	13	20	23	27	29	.....	.....	.....	.....	.....	41
7	18	28	34	39	44	.....	.....	.....	.....	.....	75
8	24	36	45	53	62	.....	.....	.....	.....	.....	128
9	32	44	56	69	81	93	.....	.....	.....	.....	156
10	41	53	70	85	102	119	138	.....	.....	.....	177
11	.....	68	84	103	126	147	168	189	200	.....	164
12	.....	78	100	125	151	177	200	228	245	.....	146
13	.....	84	117	148	180	210	238	270	298	.....	137
14	.....	95	137	178	210	248	277	312	348	.....	91
15	.....	105	158	200	241	282	321	362	406	.....	61
16	.....	.....	181	230	277	323	370	415	470	.....	88
17	.....	.....	209	261	318	362	421	471	540	.....	70
18	.....	.....	238	297	352	411	475	531	610	688	68
19	.....	.....	270	336	398	460	530	598	682	768	44
20	.....	.....	302	379	436	506	583	660	750	840	35
21	.....	.....	.....	425	480	558	634	720	820	918	23
22	.....	.....	.....	.....	522	597	681	779	887	990	16
23	.....	.....	.....	.....	566	639	727	834	958	1,065	19
24	.....	.....	.....	.....	.....	674	769	889	1,030	1,135	9
25	.....	.....	.....	.....	.....	706	809	942	1,105	1,205	12
26	.....	.....	.....	.....	.....	787	846	994	1,180	1,275	11
											1,578

TABLE XXXVII.—VOLUME FOR SECOND-GROWTH WHITE PINE, ALL AGES COMBINED. VOLUME OF USED LENGTH.

Diameter breasthigh.	Height—Feet.										Basis.
	30	40	50	60	70	80	90	100	110	120	
Inches.	Cubic feet.										Trees.
5	1.8	2.2	2.7	.....	.....	.....	.....	.....	.....	.....	7
6	2.8	3.6	4.3	5.2	.....	.....	.....	.....	.....	.....	41
7	3.9	5.0	6.2	7.4	.....	.....	.....	.....	.....	.....	75
8	5.0	6.4	8.0	9.6	12.0	.....	.....	.....	.....	.....	128
9	6.0	7.8	9.8	12.0	14.5	.....	.....	.....	.....	.....	156
10	7.0	9.3	11.8	14.6	17.4	20.2	.....	.....	.....	.....	177
11	.....	10.8	14.0	17.2	20.5	24.0	.....	.....	.....	.....	164
12	.....	12.5	16.2	20.0	24.2	28.2	32.0	.....	.....	.....	146
13	.....	14.0	18.5	23.5	28.0	32.5	37.0	.....	.....	.....	137
14	.....	16.0	21.5	26.5	32.0	37.5	42.5	48.5	54.0	59.5	91
15	.....	.....	24.5	30.5	36.5	42.5	48.5	54.5	60.5	67.0	61
16	.....	.....	28.0	34.5	41.5	48.0	54.5	61.0	68.0	74.5	88
17	.....	.....	31.5	39.0	46.5	53.5	61.0	68.0	75.5	83.5	70
18	.....	.....	35.5	43.5	52.0	59.5	68.0	76.0	84.5	93.0	68
19	.....	.....	.....	48.5	57.5	66.0	75.0	84.0	93.5	103.0	44
20	.....	.....	.....	54.0	63.5	73.0	83.0	92.5	103.5	114.0	35
21	.....	.....	.....	59.5	69.5	80.0	90.5	101.5	113.0	125.5	23
22	.....	.....	.....	.....	75.5	87.0	98.5	110.5	123.5	137.0	16
23	.....	.....	.....	.....	82.0	93.5	106.0	119.5	133.5	148.5	19
24	.....	.....	.....	.....	88.0	100.5	113.5	128.5	143.5	159.5	9
25	.....	.....	.....	.....	.....	.....	121.0	137.5	153.0	169.5	12
26	.....	.....	.....	.....	.....	.....	128.5	146.0	161.5	178.0	11
											1,578

TABLE XXXVIII.—VOLUME TABLE FOR SECOND-GROWTH WHITE PINE, ALL AGES COMBINED.

Diameter breast-high.	Total volume, including bark, stump and top.										
	30	40	50	60	70	80	90	100	110	120	
Inches.	*cu.ft.*	*cu.ft.*	*cu.ft.*	*cu.ft.*	*cu.ft.*	*cu.ft.*	*cu.ft.*	*cu.ft.*	*cu.ft.*	*cu.ft.*	*Trees.*
5	2.3	3.0	3.6	.....	.....	.....	.....	.....	.....	.....	7
6	3.0	4.3	5.1	6.0	6.5	.....	.....	.....	.....	.....	41
7	4.1	5.7	6.9	8.2	9.2	.....	.....	.....	.....	.....	75
8	5.4	7.1	8.8	10.5	12.2	13.9	15.8	.....	.....	.....	128
9	6.9	8.8	10.9	13.0	15.4	17.8	20.2	.....	.....	.....	156
10	8.6	10.5	13.1	15.8	18.9	21.9	25.0	.....	.....	.....	177
11	.....	12.8	15.5	18.7	22.5	26.1	29.9	.....	.....	.....	164
12	.....	14.8	18.0	22.0	26.4	30.8	35.0	40.1	45.9	.....	146
13	.....	16.8	20.7	25.8	30.4	35.4	40.1	45.8	52.0	.....	137
14	.....	.....	23.7	29.1	34.8	40.2	45.8	51.7	58.8	.....	91
15	.....	.....	27.0	33.1	39.2	45.8	51.9	58.0	65.8	.....	61
16	.....	.....	30.7	37.5	44 3	51.0	58.1	65.1	78.7	.....	88
17	.....	.....	35.0	42.8	49.9	57.0	65.1	78.1	82.5	.....	70
18	.....	.....	40.0	47.6	55.5	68.9	72.2	82.0	92.1	104.2	68
19	.....	.....	.....	53.0	60.2	70.9	80.0	91.0	102.1	114.8	44
20	.....	.....	.....	.....	67.1	78.1	88.1	100.2	112.2	125.6	35
21	.....	.....	.....	.....	73.1	85.7	96.7	109.2	122.1	136.3	23
22	.....	.....	.....	.....	79.1	93.1	105.8	118.1	131.7	146.7	16
23	.....	.....	.....	.....	.....	101.0	118.6	127.0	140.5	156.1	19
24	.....	.....	.....	.....	.....	108.6	121.8	135.8	149.8	165.5	9
25	.....	.....	.....	.....	.....	115.8	129.8	144.2	159.0	174.6	12
26	.....	.....	.....	.....	.....	122.7	137.8	153.1	168.5	188.2	11
											1,578

CHESTNUT.

TABLE XXXIX—VOLUME TABLE FOR SPROUT CHESTNUT. —ASHUELOT.

Diameter breasthigh.	Height—Feet.					Basis.
	50	60	70	80	90	
Inches.	Volume of used length, including bark,—cubic feet.					Trees.
7	5.4	7.4	.....	.....	.....	7
8	6.3	8.3	9.1	.....	.....	37
9	7.1	9 6	11.9	13.7	.....	100
10	8.1	11.0	14.0	16.3	18.8	109
11	9.1	12.8	16.0	19.1	22.6	95
12	.....	14.9	18.2	22.0	26.5	61
13	.....	17.2	20.5	25.2	30.7	43
14	.....	.....	22.9	28.8	35.1	27
15	.....	.....	25.4	32.6	40.0	13
16	.....	.....	28.0	36.8	45.0	12
17	.....	.....	30.8	41.0	50.9	7
18	.....	.....	33.8	45.7	57.0	4
19	.....	.....	.....	50.3	.....	2
20	.....	.....	.....	55.1	.....	.....
						517

TABLE XL.—VOLUME TABLE FOR SPROUT CHESTNUT.—PISGAH.

Diameter breasthigh.	Height—Feet.					Basis.
	60	70	80	90	100	
Inches.	Volume of used length, including bark—cubic feet.					Trees.
8	7.7	8.5	9.7	.....	.....	3
9	10.0	11.1	13.0	14.4	.....	15
10	12.4	14.1	16.4	18.0	.....	52
11	15.0	17.3	20.0	22.0	25.4	67
12	18.0	20.9	24.0	26.5	30.2	104
13	21.1	24.7	28.0	31.0	35.1	117
14	24.4	28.3	32.0	35.7	40.0	103
15	28.0	32.7	36.5	40.6	45.1	74
16	32.0	36.8	41.0	45.6	50.3	52
17	36.0	40.8	45.9	50.8	56.1	31
18	39.9	45.0	51.0	56.1	62.0	23
19	43.7	49.5	56.4	62.0	68.3	11
20	.....	54.0	62.0	68.0	74.8	5
21	.....	.....	68.1	74.4	81.3	1
						678

B. Log Rules.—In making the mill scales, the tally of lumber cut from each log was kept on a separate sheet. It was thus possible to construct a series of log rules based on actual mill cut. Such log rules are here given. In using them it must be remembered that they are reliable only for a run of logs including butt, top, and intermediate logs.

White Pine.—Sixty per cent. of the lumber cut from the logs on which these rules are based was round-edged stuff, and the remaining 40 per cent. was squared. Seventy per cent. of the lumber went into 1-inch boards, while the rest was cut nto 2½-inch plank.

TABLE XLI.—LOG RULE FOR SECOND-GROWTH WHITE PINE.—SOUTHERN NEW HAMPSHIRE.

[Cut into both square and round-edged boards; circular saw, ¼-inch kerf.]

Diameter inside bark at small end of log.	Length of log—Feet.			Total basis, 5,177 logs.
	10	12	14	
	Basis, 613 logs.	Basis, 1,915 logs.	Basis, 2,649 logs.	
Inches.	Contents—Board feet.			
3	5	7	9	167
4	8	10	12	429
5	13	15	17	530
6	18	21	24	606
7	24	28	33	613
8	30	36	42	542
9	38	46	52	456
10	47	56	65	395
11	56	68	80	290
12	66	81	97	248
13	77	96	115	202
14	89	112	134	168
15	102	130	155	144
16	.....	149	176	104
17	.....	169	198	97
18	.....	189	222	64
19	.....	211	247	40
20	.....	235	275	41
21	.....	260	304	17
22	.....	284	333	11
23	.....	.....	364	9
24	.....	.....	398	4

TABLE XLII.—LOG RULE FOR SECOND-GROWTH WHITE PINE.—SOUTHERN NEW HAMPSHIRE.

[Cut into both square and round-edged boards; circular saw, 1/4-inch kerf.]

Diameter outside bark at middle of log.	Length of log—Feet.		
	10	12	14
Inches.	Contents—Board feet.		
5	7	8	10
6	10	13	16
7	15	19	23
8	22	27	31
9	28	34	40
10	35	43	50
11	44	53	63
12	53	64	77
13	61	76	91
14	70	88	106
15	82	104	125
16	95	119	144
17	109	136	163
18	.....	155	184
19	.....	173	204
20	.....	293	226
21	.....	211	247
22	.....	235	273
23	.....	256	298
24	.....	281	228
25	.....	304	355
26	.....	.....	384

TABLE XLIII.—RELATION BETWEEN DIAMETER INSIDE BARK AT SMALL END AND DIAMETER OUTSIDE BARK AT MIDDLE OF 14-FOOT LOG.—WHITE PINE.

Diameter inside bark at small end of log.	Diameter outside bark at middle of log.	Diameter outside bark at middle of log.	Diameter inside bark at small end of log.
Inches.	*Inches.*	*Inches.*	*Inches.*
.....	.....	5	3.2
.....	.....	6	4.4
3	4.8	7	5.5
4	5.7	8	6.7
5	6.5	9	7.7
6	7.4	10	8.7
7	8.3	11	9.7
8	9.3	12	10.7
9	10.3	13	11.6
10	11.3	14	12.5
11	12.4	15	13.5
12	13.4	16	14.4
13	14.5	17	15.3
14	15.6	18	16.3
15	16.6	19	17.2
16	17.7	20	18.1
17	18.8	21	19.0
18	19.9	22	19.9
19	21.0	23	20.8
20	22.1	24	21.8
21	23.2	25	22.7
22	24.3	26	23.6
23	25.4	.....	.....
24	26.4	.....	.....

Hardwoods.

Practically all of the lumber cut from the logs on which the hardwood rules are based was $1\frac{1}{8}$-inch round-edged boards. The log rule for the 12-foot length is based on actual mill tally, while the rules for the 10- and 14-foot lengths were constructed by subtracting and adding $\frac{1}{6}$ of that scale, respectively.

TABLE XLIV.—LOG RULE FOR SECOND-GROWTH HARDWOODS.—SOUTHERN NEW HAMPSHIRE.

[Cut into 1⅛-inch, round-edged boards; circular saw, ¼-inch kerf.]

Diameter inside bark at small end of log.	Length of log—Feet.		
	10	12	14
Inches.	Contents—Board feet.		
4	6	8	10
5	9	11	13
6	13	16	19
7	18	22	26
8	25	30	35
9	32	39	46
10	42	51	60
11	54	65	76
12	68	82	96
13	83	100	117
14	100	120	140
15	117	141	165
16	137	165	193
17	160	192	224
18	185	222	259

Based on 1,831 12-foot logs.

TABLE XLV.—LOG RULE FOR SECOND-GROWTH HARDWOODS.—SOUTHERN NEW HAMPSHIRE.

[Cut into 1⅛-inch, round-edged boards; circular saw, ¼-inch kerf.]

Diameter outside bark at middle of log.	Length of log—Feet.		
	10	12	14
Inches.	Contents—Board feet.		
6	9	11	13
7	13	15	17
8	18	21	24
9	25	29	33
10		37	42
11	42	49	56
12	52	61	70
13	64	75	86
14	78	91	104
15	92	107	122
16	108	126	144
17	123	143	163
18	141	165	189
19	160	187	214
20	180	210	240

Based on 1,881 12-foot logs.

TABLE XLVI.—RELATION BETWEEN DIAMETER INSIDE BARK AT SMALL END AND DIAMETER OUTSIDE BARK AT MIDDLE OF 12-FOOT LOG. SECOND GROWTH HARDWOODS.

Diameter inside bark at small end of log.	Diameter outside bark at middle of log.	Diameter outside bark at middle of log.	Diameter inside bark at small end of log.
Inches.	*Inches.*	*Inches.*	*Inches.*
4	5.1	6	4.9
5	6.1	7	5.9
6	7.1	8	6.9
7	8.1	9	7.9
8	9.1	10	8.8
9	10.2	11	9.8
10	11.2	12	10.7
11	12.3	13	11.6
12	13.4	14	12.5
13	14.6	15	13.4
14	15.7	16	14.8
15	16.9	17	15.1
16	18.0	18	16.0
17	19.2	19	16.8
18	20.4	20	17.6

TABLE XLVII.—LOG RULE FOR SPROUT CHESTNUT, SOUTHERN NEW HAMPSHIRE. CUT INTO 1½-INCH ROUND-EDGED PLANK.

Diameter outside bark at middle of log.	Length of log, 12 feet.	Basis.
Inches.	Contents—Board feet.	Logs.
8	21	4
9	33	5
10	43	97
11	50	197
12	59	229
13	71	162
14	82	117
15	95	60
16	108	32
17	122	14
18	136	9
19	150	1
20	165	....
21	185	1
22	209	1
		929

LIST OF TREES FOUND IN SOUTHERN NEW HAMPSHIRE.

CONIFEROUS SPECIES.

Common Name.	Scientific Name.
Balsam fir	*Abies balsamea.*
White cedar	*Chamaecyparis thyoides.*
Red cedar	*Juniperus virginiana.*
Juniper	*Juniperus communis.*
Tamarack	*Larix laricina.*
Black spruce	*Picea mariana.*
Red spruce	*Picea rubens.*
Red pine	*Pinus resinosa.*
Pitch pine	*Pinus rigida.*
White pine	*Pinus strobus.*
White cedar (arborvitae)	*Thuja occidentalis.*
Hemlock	*Tsuga canadensis.*

BROADLEAF SPECIES.

Boxelder	*Acer negundo.*
Moosewood	*Acer pennsylvanicum.*
Red maple	*Acer rubrum.*
Silver maple	*Acer saccharinum.*
Sugar maple	*Acer saccharum.*
Mountain maple	*Acer spicatum.*
June-berry	*Amelanchier canadensis.*
Black birch	*Betula lenta.*
Yellow birch	*Betula lutea.*
Paper birch	*Betula papyrifera.*
Gray birch	*Betula populifolia.*
Blue beech	*Carpinus carolinana.*
Chestnut	*Castanea dentata.*
Blue dogwood	*Cornus alternifolia.*
Scarlet haw	*Crataegus coccinea.*
Beech	*Fagus atropunicea.*
White ash	*Fraxinus americana.*
Black ash	*Fraxinus nigra.*
Witch hazel	*Hamamelis virginiana.*
Mockernut hickory	*Hicoria alba.*
Pignut hickory	*Hicoria glabra.*

Bitternut hickory.....*Hicoria minima.*
Shagbark hickory.....*Hicoria ovata.*
Butternut .....*Juglans cinerea.*
Black walnut.....*Juglans nigra.*
Black gum.....*Nyssa sylvatica.*
Ironwood .....*Ostrya virginiana.*
Sycamore .....*Platanus occidentalis.*
Popple .....*Populus grandidentata.*
Popple .....*Populus tremuloides.*
Wild red cherry.....*Prunus pennsylvanica.*
Black cherry.....*Prunus serotina.*
Choke cherry.....*Prunus virginiana.*
Mountain ash.....*Pyrus americana.*
White oak.....*Quercus alba.*
Scarlet oak.....*Quercus coccinea.*
Chestnut oak.....*Quercus prinus.*
Scrub oak.....*Quercus pumila.*
Red oak.....*Quercus rubra.*
Black oak.....*Quercus velutina.*
Dwarf sumac.....*Rhus copallina.*
Staghorn sumac.....*Rhus hirta.*
Poison sumac.....*Rhus vernix.*
Black locust.....*Robinia pseudacacia.*
Willow .....*Salix (sp.).*
Sassafras .....*Sassafras sassafras.*
Basswood .....*Tilia americana.*
White elm.....*Ulmus americana.*
Slippery elm.....*Ulmus pubescens.*