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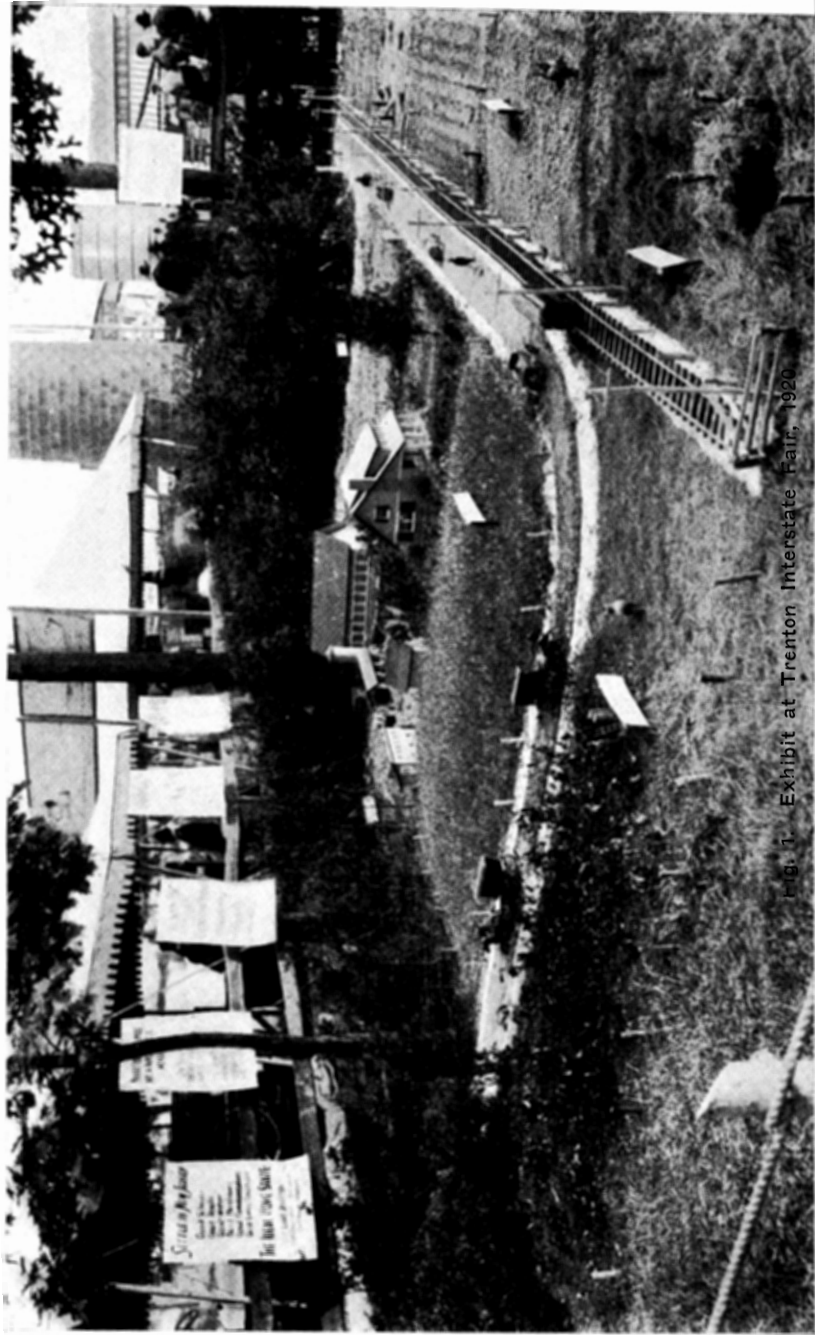


Fig. 1. Exhibit at Trenton Interstate Fair, 1920.

REPORTS OF THE
DEPARTMENT OF CONSERVATION AND DEVELOPMENT
STATE OF NEW JERSEY

ANNUAL REPORT

For the Year Ending June 30,
1921

Department of Conservation and Development

Administering

GEOLOGY, SOILS, WATER RESOURCES, FORESTRY,
FOREST FIRE SERVICE, STATE MUSEUM,
TESTING LABORATORY, STATE
PARKS, LAND REGISTRY



TRENTON, N. J.
PUBLISHED BY THE STATE
1921

Letter of Transmittal

To His Excellency, Edward I. Edwards, Governor.

Sir—I have the honor to submit for your information, and for transmittal to the Legislature as required by law, the annual report of the Department of Conservation and Development for the fiscal year ending June 30, 1921. It includes reports by the Board, the State Geologist, the State Forester, the State Firewarden, and by the office of Land Registry and Publicity.

By direction of the Board of Conservation and Development.

Very respectfully yours,

ALFRED GASKILL,

Director.

State House, October 17, 1921.

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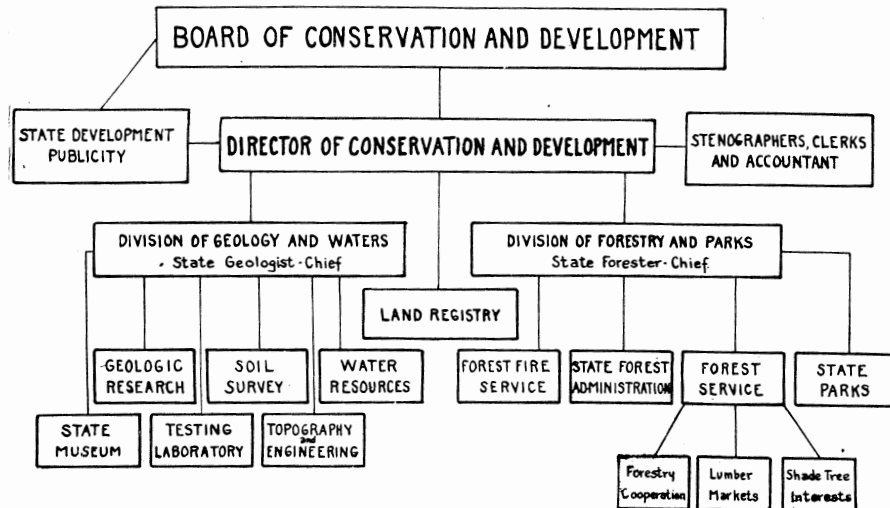
The Department of Conservation and Development

OFFICE, STATE HOUSE ANNEX, TRENTON.

The Board of Conservation and Development

W. EDWIN FLORANCE, President,New Brunswick
 PERCIVAL CHRYSIE,High Bridge
 JOHN L. KUSER,Bordentown
 HOWARD F. McCONNELL,Montclair
 SIMON P. NORTHRUP,Newark
 JOHN A. WATERS,Gloucester City
 HENRY CROFUT WHITE,North Plainfield
 OWEN WINSTON,Gladstone

ALFRED GASKILL, Princeton,*State Forester and Director*
 HENRY B. KÜMMEL, Trenton,*State Geologist*
 M. W. TWITCHELL, Trenton,*Assistant State Geologist*
 J. VOLNEY LEWIS, New Brunswick,*Consulting Geologist*
 H. T. CRITCHLOW, Trenton,*Water Engineer*
 CHARLES P. WILBER, Trenton,*State Firewarden*
 W. M. BAKER, Trenton,*Assistant Forester*
 A. D. LA MONTE, Bound Brook,*Assistant Forester*
 R. B. GAGE, Trenton Junction,*Chemical Engineer*
 KATHRYN B. GREYWACZ, Trenton,*Acting Museum Curator*
 EDWARD C. STOVER, Jr., Trenton,*Publicity Agent*
 LAWRENCE G. GILLAM, Mount Holly,*Chief, Land Registry*
 L. L. LEE,*Senior Soil Classifier*
 WILLIAM LINDSAY, Trenton,*Assistant State Firewarden*
 JOSEPH E. ABBOTT, Toms River,*Division Firewarden*
 LEONIDAS COYLE, Bridgeton,*Division Firewarden*
 LEROY S. FALES, Newton,*Division Firewarden*



Report of the Board of Conservation and Development

In reporting upon its activities for the year ending June 30, 1921, the Board is able to record a considerable accomplishment in the conservation and development of the State's resources. Somewhat through its efforts the exceptional advantages and attractions of New Jersey are becoming known and appreciated.

The fourteenth Federal census again shows New Jersey leading in population growth, though the strong tendency toward the cities must be considered not altogether satisfactory because it evidences neglect of our food-producing advantages, of our recreational attractions and of the opportunities, industrial and social, to be found in our suburban and rural communities. The chief concern of the Department is that all these shall be developed to the utmost.

Some of the Department's projects are still in abeyance, lacking the necessary appropriation. It will continue to be the effort of the Board to induce the people of New Jersey to invest reasonable sums in betterments which can be shown to promise multiple returns. In particular the State must stimulate the production from our own soils of a larger part of the food that our own people need. It must also develop in much greater measure the exceptional recreational facilities that, in woods and hills as well as by the seashore, are offered the people of the Nation.

One of the most significant accomplishments of the year is the securing of a material increase in appropriations with which it will be possible to carry through next year several projects that have long been pending.

The more important of the manifold Departmental activities are summarized in this report of the Board; fuller details are given in the reports of the administrative officers that accompany it.

MEMBERSHIP

The only change in the Board was caused by the resignation of Mr. William E. Tuttle, Jr., who was appointed by the Governor to be Commissioner of Banking and Insurance. Appreciation of his service was made in the following minute:

Resolved, That the Board of Conservation and Development learns with the keenest satisfaction of Mr. Tuttle's appointment to be State Commissioner of Banking and Insurance. It congratulates him upon this evidence of public confidence, and congratulates the people of the State upon securing so able an official. At the same time it regrets his loss to the Department which presumably must be suffered. He has performed noteworthy service as a member of the Board and will be greatly missed."

In September Mr. Howard F. McConnell, of Montclair, was appointed to the vacancy.

Mr. W. Edwin Florance was elected President for the year beginning July 1, 1921.

PERSONNEL

With the curtailment of war activities, the disturbances suffered in the Departmental force have been greatly lessened, vacancies have been filled, temporary appointees replaced, and the organization placed upon an efficient basis. The difficulty, long experienced, of finding competent technical men for the State service at the compensation allowed, though less acute than it has been, is with us always. The Board urges as strongly as it can such modification of the Civil Service and salary schedules as may be necessary to attract to the State the highest grade of technical service. Such a policy is economy, not extravagance.

Counting in new appointments made immediately after July 1, 1921, there are now on the roster of the Department 92 persons, 33 more than last year. These figures include 23 who are on the pay-rolls of co-operating departments or of the Federal Government.

UNSUITABLE OFFICES

Record is again made of the extremely unsatisfactory and inadequate provision for the work of the Department. The old house on State Street, in which the principal part of its activities is carried on, is inconvenient, uncomfortable, and unsanitary. Official records of great value are exposed to danger of loss by fire. The outlook for adequate office facilities, and accommodation for the State Museum, appears to be almost as remote as it has been for five years. The Board cannot too strongly emphasize the absence of all real economy in this situation.

LEGISLATION

No new legislation was sought at the last session of the Legislature. Several bills, which, if enacted, would have materially hampered the Department, were successfully opposed.

MOSQUITO CONTROL

In the failure of the Legislature to accept and provide funds for its program for mosquito control the Board has suffered its keenest disappointment. Year by year the conviction has grown that New Jersey's greatest burden is the mosquito pest, and year by year has increased the assurance that that burden can be thrown off at no great cost and within a short time. The argument and the proof are based upon the facts that nine-tenths of all our mosquito troubles are known to be caused by the species bred on our 296,000 acres of salt marsh, and capable of flying, or being wind-borne, as far as forty miles inland, and that one-third of the whole marsh area has been practically freed of mosquito breeding by approved methods. Unfortunately the relief near these cleared marshes is only partial because the mosquitoes bred on adjacent uncleared areas can fly so far.

The work already done has been carried on mainly at the cost of eleven county mosquito extermination commissions, whose aggregate appropriations for the year of this report were \$273,948; the State appropriation was only \$16,500. As most of the county commissions quite properly devote their attention and money largely to

local mosquito control, the salt marsh work progresses slowly. At the present rate it will take fifteen years to finish the job. Why hold back the State's development so long? Moreover, the task properly is one for the State, not for the counties, because the insects know no boundaries and those bred in Bergen or Union are quite likely to trouble the people of Essex or Hudson.

New Jersey's repute suffers wherever people read because her mosquitoes, though actually no more plentiful or more annoying than those in many places, have become a by-word and a joke. At the same time the State is applauded as a leader wherever mosquito control is discussed or undertaken. This is our opportunity. By a State expenditure of no more than \$200,000 a year for five years, a total of less than one million dollars, and the employment of penal labor, the burden that rests upon our people, and the discredit in which we stand, can be removed at a stroke.

It has been asserted that the world-wide publicity that would be given such an undertaking would be worth more than the whole cost. Carefully made estimates promise an increase in ratables, due solely to mosquito elimination, of 500 million dollars within twenty years. Industrial enterprises, farm, suburban and resort growth actually wait upon this hoped-for relief. It is our firm belief that no development project ever presented to the people of a State offers such great and such sure returns as this.

UNTAXED LAND

The Board is constrained again to call attention to the fact that apparently one-eighth of all the land in the State is not assessed for taxation. This situation was brought out in the "Report on Undeveloped Lands" submitted to the Governor in 1917, and though some comment was made at the time, nothing has been done to change the situation.

It is recognized that most of the land which thus escapes bearing its share of the public burden is that of least value, yet the failure of some communities to make assessment of all property impartially must be construed as one reason why so much of our territory is considered worthless. If the taxing bodies themselves are not interested, the situation offers to the State an opportunity to provide the revenue with which to maintain efforts and agencies to develop the neglected areas.

GOOD ROADS

As a necessary and obvious means to the fullest State Development, improved highways stand first. New Jersey's accomplishment is highly creditable, yet it is the belief of this Board that a program of highway extension which shall serve every section of the State and every interest is demanded.

It may be assumed that the present State highway system will satisfy the need for communication between established centers. To bring the rural sections, and a large part of New Jersey always will be rural, to the highly developed condition of which it is capable other roads, varying in character with the requirements, must be provided.

It is our belief that the State should cultivate motor truck travel as well as pleasure travel, not by placing the burden of construction and upkeep upon our citizens alone, but, in the main at least, upon the users of the roads. So large a part of the traffic within our borders is foreign, and competes with public carriers, that reason and equity demand that the cost be covered by a carefully considered license or tax system.

And our highways should be not merely well constructed thoroughfares, adequate for the traffic demand, but be made attractive and pleasant under a plan of shade tree maintenance. This involves relatively little planting, for natural growth will serve better in most situations. In places where the roads traverse woodlands the road borders should be kept free of litter and inflammable brush.

The Department embraces every opportunity to co-operate with the Highway Department and with local agencies.

LAND REGISTRY AND PUBLICITY

The effort to awaken interest, beyond the State borders as well as within them, in New Jersey's exceptional opportunities has been justified by results. The publication of "New Jersey for Progressive Farmers" and the expenditure of less than \$1,000 within two years, for advertising in agricultural papers, has turned a tide of inquiry toward our farm lands that is rising steadily. Practically every agricultural paper in the country has published one or more articles about

New Jersey, through which millions of people have learned something about us, entirely without cost to the Department. The advantage at home will appear in increased land values and in a stimulated food production.

As detailed in the report of the Chief of the Land Registry (p. 89), the effort to attract farmers is showing important results, not the least of which are discovered in the action of several foreign nation associations looking toward colonizing their nationals.

Concurrently with the continuation of the farm propaganda has been begun an attempt to stimulate interest in our industrial opportunities. A publication dealing with this subject was issued after the close of the year. It contains much definite information regarding New Jersey's resources, its industrial and social status, and the attractions offered newcomers. It is planned that this publication shall be followed by another dealing with the State's playground advantages. Our seacoast may need no advertising, though it is still far from being fully developed; the pine sections for winter tourists, and the lake and mountain sections for year-round vacationists, are unknown except to a few.

It is regrettable that the appropriation available for extending this publicity work is so limited. Other states find that it pays to trumpet their attractions in a reasonable way. With advantages such as ours, advertisement should not be necessary, though it remains a fact that even a majority of our own people are so uninformed regarding the State that advertisement must be resorted to. The Board considers the obligation to make New Jersey known one of the most important that it has undertaken.

WATER RESOURCES

The expectation that this feature of the Department's responsibility would become increasingly important, chiefly because of the rapid growth of the communities in the metropolitan section, has been fully realized. Much satisfaction is found in the fact that the policy of the Board with respect to water diversions has been sustained in every instance where one of its decisions has been reviewed by the courts.

Diversion applications.—The applications for permission to divert potable water which have come before the Board are detailed on pages

42 to 46. In one case only—that of the Borough of Verona—was there any contest. It is agreeable to record that early in July, shortly after the close of the fiscal year, a contract was concluded between Verona and Essex Fells on the lines suggested in the Board's decision.

Excess diversion tax.—The Board again fixed the minimum rate of \$1 per million gallons as the basis of the tax for water diversion during the calendar year 1920, under the operation of Chapter 252, P. L. 1907, and on February 10 certified to the Comptroller that a total of \$28,805.14 was then due the State. Record of the amounts paid and due on this account, including back charges, is made at page 46.

Water supply fund.—By the establishment of this fund provision is made for all necessary investigations and activities connected with the State's potable waters, without calling upon the Legislature for money. Some effort was made at the last session to modify the law (Chapter 252, P. L. 1907) under which this fund is provided, but without success. It would seem to be extremely unwise to alter so simple a means of providing for this important line of work. On July 1, 1921, the sum accumulated in this fund amounted to \$75,666.99, from which expenditures are authorized in the sum of \$33,300.

Water study.—After the close of the fiscal year, but as soon as the appropriation became available, a contract was entered into with Hazen, Whipple & Fuller, of New York, for a comprehensive study of the State's potable water resources, with a view to determining as conclusively as may be how much water we have, where it is, and how it can best be made available. A feature of this undertaking will be to find an acceptable estimate of the probable needs of the metropolitan section for the next fifty years. At recent hearings before the Board, reputable engineers have exhibited a woeful lack of agreement upon this point.

Stream gaging.—Another important activity, worked up during the year and now to be undertaken from the fund provided, is the establishing of a number of gaging stations upon our more important streams. In co-operation with the U. S. Geological Survey and with property owners and interested citizens, at least 20 stations will be set up during the current year and the number increased as opportunity and means are found. All installations will be permanent with provision to accumulate the most trustworthy data.

Dam inspection.—Another activity long deferred but soon to be undertaken is a systematic inspection of the dams within the State, to the end that their safety may be assured.

Underground waters.—A large part of the potable water used in New Jersey is derived from sub-surface sources. The records of the Department, secured from borings all over the State, provide an exceptionally valuable means of forecasting the probability of success in any new venture. Those records are always available. The report covering this subject, referred to last year, approaches completion.

FORESTRY

As the discussion of a "National Forestry Policy" progresses there is not a little satisfaction in finding that what New Jersey has done, and sought to do, during the past fifteen years is recognized as basic; that is, that permanent forests yielding a continuous crop should utilize land of low value near the points of consumption, rather than far off, and that the fundamental requirement for any forestry anywhere is forest fire control.

There probably is some fallacy in the argument that the country will need in the future as much lumber per capita as it has used in the past. And there surely is much ungrounded fear that the United States cannot produce what is required either of lumber or of paper. The essential point is that idle lands in our State, and in every State, shall be made to produce timber trees. The advantage will accrue to the owners of the land and to the public; the forests will satisfy the needs and contribute to the pleasure and comfort of everyone. To state our position concretely: New Jersey's two million acres of woodland should, and can, be made to produce the greater part of the ordinary lumber that our people need, and that now is largely imported, by converting our ragged, blackened woodlands into forests of living green. To accomplish this, mainly through fire control, is the Department's effort.

The report of the Forester (p. 53) describes our situation and recites definite accomplishments, the most significant recent one being the employment of a forester by the trustees of the estate of Joseph Wharton, thereby putting 100,000 acres in South Jersey under practical forest management. This step has accomplished, without cost



Figs. 2 and 3. Forests like these are possible in most parts of New Jersey if cutting is regulated and fires controlled.

to the public, what many States have done, or are seeking to do, through the purchase and maintenance of State Forests.

State Forests.—The total area of six State Forests (see p. 62) including Swartswood Lake, is 17,064 acres. All continue to be valuable in demonstrating the methods of practical forestry, the timber is growing satisfactorily, and the annual income, though still insignificant, promises soon to reach a point at which it will cover the maintenance cost. After that it will yield a profit. The Board sees no reason to depart from its policy of advocating the acquisition of State Forests only as demonstration areas, and as public playgrounds. It is held to be wiser to encourage and help forest owners to develop their properties than to buy up great tracts of woodland to be maintained by the State solely for lumber production.

Forest fires.—The report of the State Firewarden (p. 71) records an exceptionally destructive season and reveals a serious weakness in our Forest Fire Service. The normal conditions that obtained during the greater part of the year proved the organization reasonably effective; when a prolonged drouth came in the latter half of June, the service failed. The fact that the service would fail, must fail, in an emergency has long been recognized. The remedy is entirely clear. If our forests are to be guarded long enough to produce timber, we must have a Fire Service capable of dealing with any emergency that is likely to arise. The Board will do its utmost to secure the appropriations that are necessary to make effective the recommendations of the Firewarden and give the State a really efficient Forest Fire Service. There is no need for any radical modification of the present organization. It requires only a greater number of responsible State wardens to control and direct the semi-volunteer township wardens upon which the service depends, and quite evidently must depend in the main. The record up to June gave hope of a positive advance in that it disclosed evidence of some increased concern for the welfare of the forests. In parts of the State, chiefly in the north, fires have become rare even in dry seasons. The organization continues to do notably good work in apprehending and penalizing a large proportion of those who are responsible for causing fire. The Federal Government has recognized our effort and our need by increasing its contribution from \$2,500 a year to \$6,550, though unfortunately its use is restricted to North Jersey. The State must provide a proportionate increase for South Jersey. There is only a

measurable satisfaction in realizing that we have perhaps the most efficient State Forest Fire Service in the Union, since it still is far short of what is required.

Shade trees.—The record covering shade tree interests is encouraging. The list of Shade Tree Commissions (p. 64) grows, though regretfully a number have become inactive. The foresters of the Department have been kept busy giving help and advice. In consequence of the early wet spring many shade tree troubles developed, though few serious losses occurred. The employment of an arborist to devote his whole time to co-operation with shade tree interests is becoming imperative. It is impossible now to perform adequately all that is properly required of the Department. The recommendation also is renewed that highway authorities, State and County, make provision for proper tree shade along every improved road. This can be accomplished with a relatively small amount of planting by utilizing native growth. Tree lines should not be continuous but broken at intervals and diversified by strips of parking where natural conditions are favorable. The initial cost will average not over \$400 a mile of road, and upkeep less than \$50 per mile per year.

Gipsy moth.—The Legislature, having wisely appreciated the gravity of the invasion of our territory by the gipsy moth, provided the necessary appropriation. The work of control has gone forward actively under the direction of the Department of Agriculture, with the co-operation of this Department wherever it could be of service. The indications are that New Jersey will again prove her ability to handle a crisis of this kind.

MEMORIAL FOREST PARK

The recommendation that the State establish on the Kittatinny Mountain in Sussex and Warren Counties a great forest park as a memorial to its sons who made the supreme sacrifice in the Great War has made some progress. By a bill (Senate 260) it was provided that the High Point property in Sussex County should be acquired, the improvements devoted to a hospital or home, and the wild land transferred to this Department as a part of the proposed Memorial Park. The Board agrees with the Governor that the need for, or value of the proposed home or sanitarium, is questionable, while adhering to its recommendation that the available wild land within

the area marked out in 1918 shall be acquired by degrees, and a park created for the benefit of the whole people.

New Jersey needs a playground in the hills, easy to reach, roomy, and with its natural attractions disturbed as little as possible. Various states and cities are providing camping grounds in attractive localities. New Jersey can match the best at a low cost. The Kittatinny Mountain is a series of wild, rough ridges completely forested and extending from the New York line to the Delaware Water Gap, a distance of 36 miles. It varies in width from three to five miles and in height from 600 feet to 1,800 feet. Within its limits are the best trout streams in the State and many places suitable for camping parties. Yet it is all within three hours of Newark or Jersey City by train or motor.

In proposing that New Jersey's memorial to her fallen soldiers take the form of a forest park, the thought is that there shall be created out of the heart of the home State a monument that shall not be subject to decay, but be everlasting. The plan lends itself easily to the erection of Organization, or Post, memorials of many kinds—monuments of stone or bronze, shelter houses, observation towers, so built and so dedicated that the region shall become a place of pilgrimage.

The State now owns 7,231 acres of the land desired and a lake of 560 acres. To increase that to approximately 40,000 acres will cost not over \$250,000, and the purchases should be distributed over a number of years. The maintenance cost of the whole area need not exceed \$10,000 a year, and after no more than 20 years will be nothing at all, as the timber yield of the forest will then easily cover all necessary expense.

The project is further commended by the practical assurance that the establishment of such a park will tend to redeem that part of the State from its present depressed condition and bring its farms and villages greater activity, and greater value in the tax list.

WASHINGTON CROSSING MEMORIAL

The Legislature having appropriated \$10,000 "For the purchase of the McKonkey Ferry House and the development of not more than ten acres of the State park at Washington Crossing" the Board has taken steps to start this long deferred project.

Charles W. Leavitt, Landscape Engineer, has prepared an attractive plan conformable with the language of the appropriation act; negotiations are under way for the acquisition of the McKonkey Ferry House and a small tract of land about it; and the Chosen Freeholders of Mercer County are planning to make the necessary highway changes.

The Leavitt plan contemplates a park of nine acres described by its author thus:

“This land extends north from the Pennington Road about 1,260 feet on both sides of the State Highway and paralleling it, in a strip approximately 350 feet wide. The whole plot, as it should, has the effect of bordering the river bank. It commands the land to the east, over which the troops started their Trenton march after landing, but, more important, it commands the river and the river banks on both sides, and the McKonkey Ferry House.

“My design provides an entrance to the park at the intersection of the Pennington Road with the State Highway, which is the first warning coming up from Trenton of the crossing, and here I propose a treatment of Colonial gates and walls with a commemorative tablet.”

Through the park a road 18 feet wide curves to the crest of the bluff where an Overlook is provided; thence it falls, past the Ferry House, to the upper, or Lambertville gate. Appropriate shrubbery and plantations are proposed. And having in mind the possibility of a National bridge spanning the river, provision is made to convert the Overlook to a bridge approach without affecting the integrity of the park.

The appropriation now available will secure the Ferry House property and provide for a beginning in the development of the park; more money is needed to acquire the three front lots to which the State never has taken title, and which are necessary to the completion of any project. After that should come the acquisition of the strip between the highway and the canal, included in the landscapist's plan but not within the scope of the appropriation, and then of the land between the railroad and the river, concerning which Mr. Leavitt observes “it seems most essential, from an historic and sentimental standpoint, that the park, as a memorial, in addition to the ten acres just described, should include intact the land down to the water's edge for the whole park frontage for as far as New Jersey was concerned, the water's edge and the ferry house were the stage on which this most important drama was enacted. Already bungalows and

other undesirable buildings are creeping down the river bank. Yet it is the very essence of the memorial that the shore should be kept as in Washington's day. To date the State has not acquired the shore. That should be the next legislative action."

With reference to how far the State should go in this project this Board again asks the will of the Legislature. As the law now stands the Department must have in mind the ultimate creation of a park of "not to exceed 350 acres" (P. L. 1919, p. 349) and must hold, subject to provision for its development, the ninety odd acres of land, out of the 100 acres bought in 1913, not required to carry out the present plan. Upon this point Mr. Leavitt remarks, "I can see no objection to disposing of the property the State owns lying to the east of this acreage. It is superfluous from the historic standpoint of the actual crossing, and the cost of upkeep would necessarily be high for so great an area."

STATE MUSEUM

An inevitable consequence of the curtailment of the Museum room reported last year has been the suspension of special exhibits and a material decrease in the attendance. The Board feels obliged strongly to protest against this abridgement of an important educational influence. There remained only to develop to the utmost that branch of the Museum's activities having to do with visual instruction by providing material to be loaned to the schools. The facilities offered have been used to the limit of the organization's capacity. No less than 42,856 lantern slides, 1,500 motion picture reels, and 2,078 loan collections of various sorts were circulated. Reports made from the schools and the associations using the material show that a total of 1,168,000 people attended the presentations.

But one conclusion can be drawn from this record, namely, that there is a positive need for this service in the State's educational system; that the State Museum has laid a fine foundation for a much more elaborate provision; and that the neglect of the opportunity to utilize this power to the fullest is unfortunate in every respect. The Board renews its recommendation that provision be made for the extension of this work, and for adequate quarters for the exhibition of much Museum material that now is stored away.

TESTING LABORATORY

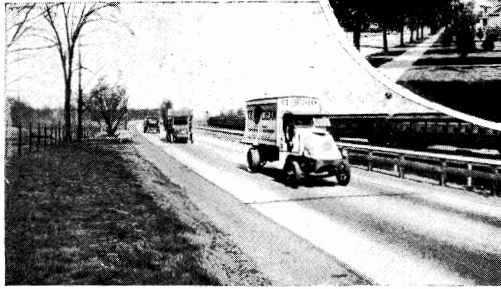
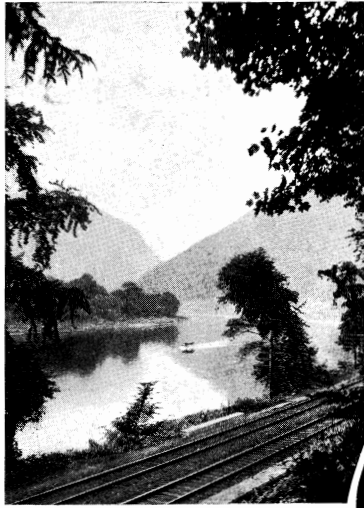
This organization continues to devote the greater part of its activities to the work of the Highway Department. With a very complete equipment, the laboratory ranks as one of the best in the country, and its work is of so high a character that there is little room for question concerning the quality of the materials used in State road construction.

Late in the year agreement was made with the State Purchasing Agent and with the Department of Institutions and Agencies by which coal and certain kinds of construction material will be purchased on the basis of laboratory tests. It has long been the desire of the Board that the laboratory should broaden its field of activity, since there can be no doubt that purchases made upon carefully drawn specifications and precise tests of deliveries are the true basis upon which to conduct the State's business.

Some consideration has been given the question of undertaking tests for county and municipal construction and purchasing departments. The only difficulty lies in providing the necessary working force, to satisfy a very irregular and variable demand.

SOIL SURVEY

The surveying, mapping, and describing the soils of the State, begun in 1909 approaches completion. This year 530 square miles of the Trenton area and 70 miles of the Salem area have been covered and the report on the Millville area published. There remains only to finish the field work on the Trenton and Salem areas and to publish the reports of Chatsworth, Trenton and Salem areas. It is expected that all this will be done by the end of 1922. If, however, it should be desirable to publish a general soil map of the entire State on one sheet, some additional work must be done in Bergen and Essex Counties.



Figs. 4 to 9. A group of pictures from "Industrial Opportunities in New Jersey."

MINING

The fact, recently disclosed, that, on an areal basis, New Jersey ranks third in mining, serves to draw attention to this important group of our resources. Although this Department has investigative and advisory powers only it strives constantly to aid in the development of many unutilized deposits. The Geologist's report, page 28, and the statistics of production, page 97, record important details.

SHARK RIVER IMPROVEMENT

Through a settlement with the Title Guaranty and Surety Company by which \$11,000 was paid to the State on account of the bond given by the defaulting Bay Dredging and Contracting Company this undertaking, begun in 1912 by the old Geological Survey, prosecuted under many difficulties and practically concluded in 1918, has finally been wound up. A complete financial statement is filed with the Comptroller of the Treasury.

PUBLICATIONS

By statutory mandate the Board is required to make an annual report, and also to publish the most important of its findings and recommendations for the information of the public. In the conviction that the printers' art is the most effective means of presenting facts, advantages and opportunities to those who want to, or should, know them, there have been issued from time to time in attractive form a variety of what is believed to be valuable publications. The list for 1921, printed at page 96, is short because money to extend it has been denied. A much greater effort in this direction is desirable, and, with an appropriation, entirely possible as material is not lacking.

There is ground for complaint of the delayed printing of annual reports. Instead of being ready for the Legislature the Departmental Report for 1920, submitted October 6, 1920, was not delivered until July 26, 1921. The Report for 1919, submitted October 1, 1919, was not delivered until June 7, 1920. Any publication of this character loses much of its value by being so belated.

NEEDS

The creation of a water supply fund (p. 13) provides for several important projects that have been urged in earlier reports. There remain a number of others so material to State welfare that the Board recognizes an obligation to keep them before the Legislature and the public. It is urged that at the earliest possible date provision be made for the following:

1. Control of salt marsh mosquitoes with penal labor, for which an appropriation of not more than \$200,000 a year for five years is needed. (See page 9.)

2. A material strengthening of the Forest Fire Service. An appropriation of only \$56,000 for next year and \$36,000 a year thereafter, more than now is provided, will maintain an efficient service. (See page 15.)

3. Provision having been made to purchase the McKonkey Ferry House, a moderate appropriation should be made annually to carry the Washington Crossing Park project to completion. \$25,000 for next year is recommended. (See page 17.)

4. The proposal that a Memorial Forest Park be created in Sussex and Warren Counties has met with much approval. An appropriation of \$40,000 will set the undertaking well on its way. (See page 16.)

5. Two more Assistant Foresters are urgently needed; one to advise with and help shade tree interests, the other to stimulate the development of private forests on a commercial basis. \$4,600 a year will maintain both. (See page 16.)

6. The State Museum has developed under many difficulties a scheme of visual instruction that is serving well the educational agencies, largely those in suburban and rural communities. Adequate housing and increased facilities are almost imperative. An additional appropriation of \$5,000 will do much. (See page 19.)

7. The Department's effort to make New Jersey known has been so successful that an extension of this undertaking, with a provision for printing of not less than \$5,000 a year for several years promises most positive results. (See page 21.)

Recognizing the need for economy at this time, and that the Legislature has been generous in its provision heretofore, the Board will refrain from asking for money for all the projects here enumerated.

It is convinced, however, that everyone is in the interest of true conservation, and that each truly represents an investment rather than an expenditure. Notwithstanding her rapid growth and manifold interests, many portions of New Jersey are backward and undeveloped. A bright future is hers for the seeking.

THE BOARD OF CONSERVATION AND DEVELOPMENT

By W. EDWIN FLORANCE,

President.

Financial Statement

FOR THE FISCAL YEAR ENDING JUNE 30, 1921

RECEIPTS

Appropriations—	
Salaries	\$57,450.00
Traveling expenses	12,980.00
Blanks, stationery, printing and office equipment	6,420.00
Postage	1,600.00
Incidentals	4,040.00
State's share of forest fire bills	10,800.00
Fuel and power	950.00
Insurance	325.00
Tax lieu on State forests	345.00
Repairs—Laboratory and State forest buildings	260.00
New laboratory equipment	700.00
Maintenance of Washington Crossing Park	455.00
Refunds for loss of loan material from State Museum	11.80
For services of C. C. Vermeule in case State of New Jersey vs. Title Guaranty and Surety Company	252.60
Total	\$96,589.40

DISBURSEMENTS

ADMINISTRATION

Salaries—Clerical	\$6,779.22
Traveling expenses—Board members	120.30
Printing, stationery and blanks	1,977.98
Postage	1,599.43
Telephone and telegraph	634.83
Express and freight	235.71
Books, instruments and equipment	419.41
Insurance	267.12
Incidentals	120.29
Total	\$12,154.29

LAND REGISTRY AND PUBLICITY

Salaries	\$4,580.00
Traveling expenses	781.73
Special printing (not forms)	2,771.76
Advertising and exhibits	846.19
Total	\$8,979.68

CONSERVATION AND DEVELOPMENT.

25

DIVISION OF GEOLOGY AND WATERS

Geologist, Assistant Geologist and Special Assistants	
—Salaries	\$8,341.67
Traveling expenses	866.37
Water Supply—Salaries	3,060.00
Traveling expenses	469.09
Soil Survey—Salaries	3,600.00
Traveling expenses	2,275.42
Testing Laboratory—Salaries	5,400.70
Equipment and supplies	2,375.78
Museum—Salaries	3,986.50
Traveling expenses	74.06
Equipment and supplies	1,376.38
Printing maps	720.00
Incidentals	110.67
Total	\$32,656.64

DIVISION OF FORESTRY AND PARKS

Foresters (including Director)—Salaries		\$7,772.90
Traveling expenses	1,049.63	
Firewardens—Salaries	10,695.33	
Traveling expenses	6,800.09	
Fire service equipment	201.56	
Township fire bills	10,276.26	
Maintaining State forests—Salaries and labor	3,641.21	
Supplies and equipment	394.14	
Tax lieu	330.08	
Incidentals	125.60	
Total		\$41,286.80
For services of C. C. Vermeule in case State of New Jersey vs.		
Title Guaranty and Surety Company	252.60	
Reverted to State Treasury	1,259.39	
		\$96,589.40

LAND PURCHASE ACCOUNT

Balance of appropriation	\$85.05
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WATER SUPPLY FUND

(Available only under an appropriation.)

Balance July 1, 1920	\$1,743.87
Receipts from July 1 to June 30, 1921.....	73,923.12
Total	\$75,666.99

CASH ACCOUNT

RECEIPTS

Balance on hand July 1, 1920	\$297.64	
Sale of maps and reports	1,412.45	
Rentals and sales from State forests and parks	703.50	
Fire penalties	2,145.15	
Miscellaneous	40.35	
		\$4,599.09

DISBURSEMENTS

Paid to State Treasurer—		
From sales, rentals, etc	\$2,105.97	
From fire penalties	682.03	
Paid township treasurers from fire penalties	1,362.41	
Court fees	28.59	
Balance on hand June 30, 1921	420.09	
		\$4,599.09

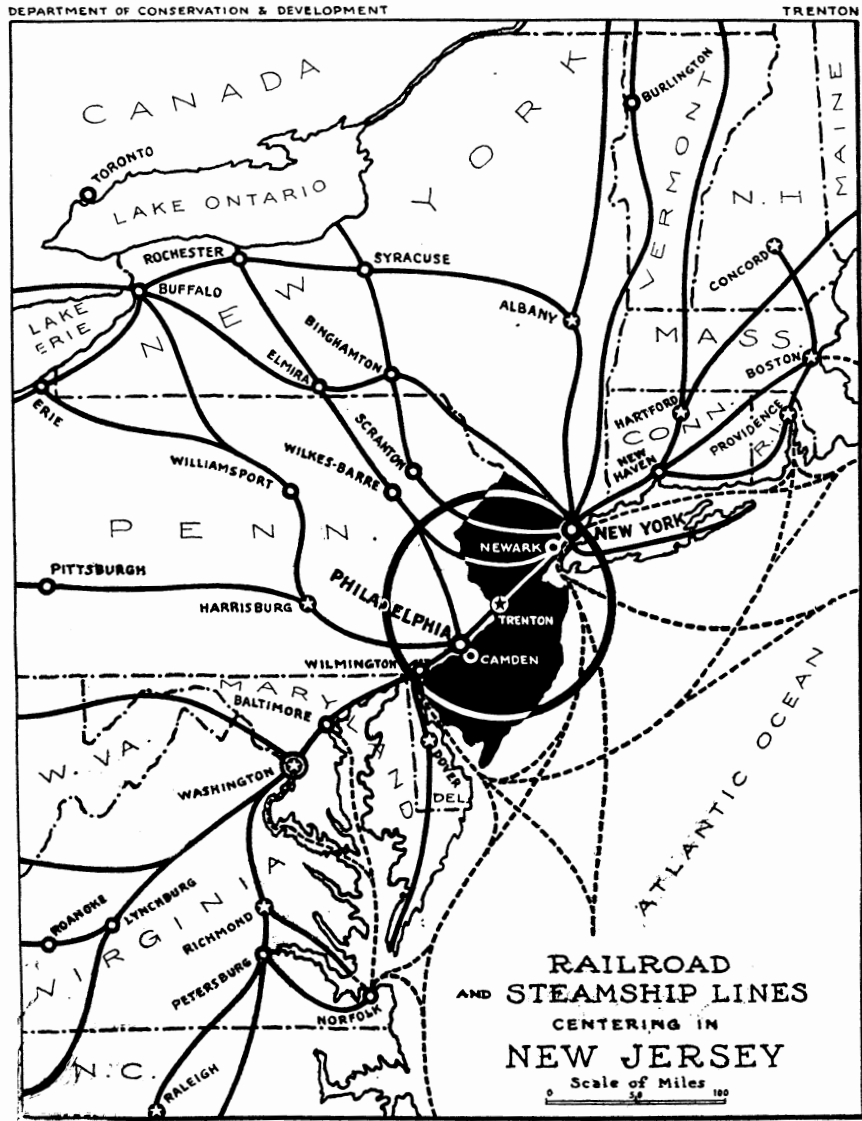


Fig. 10. One-third of the people in the United States live within the lines of this map, and ten million within the circle representing a sixty-mile radius from Trenton.

Report of the State Geologist

HENRY B. KÜMMEL

The work of the Division of Geology and Waters, including the Testing Laboratory and the State Museum, for the year 1920-1921, is summarized in the following paragraphs:

TOPOGRAPHY AND ENGINEERING

Bench marks.—No new lines of levels were run during the year, but the manuscript of a report listing the marks previously established was forwarded to the State Printing Board for publication. Late in the year this was authorized, and the report will be ready for distribution to engineers and others some time in the autumn of 1921.

Revision of topographic maps.—The stock of several atlas sheets has become so far depleted as to necessitate new editions in the near future. Of these sheets, Nos. 24 and 26 had not been revised for a number of years, whereas there had been many changes in the culture. This was particularly true of sheet No. 26, which covers the metropolitan district about Newark and Jersey City and extends from Perth Amboy on the south to Paterson on the north. The changes on sheet No. 24—Warren and Hunterdon Counties—were not extensive, except in the immediate vicinity of a few cities.

The revision of sheet No. 26 was undertaken by Loren P. Plummer, Jr., but was not completed during the year, lack of funds for this work necessitating its temporary suspension before completion. The changes on sheet No. 24 were made by the State Geologist and the revised map was sent to the engraver near the close of the year.

In co-operation with the State Highway Department, copy for a new edition of the State Highway Map was prepared and the edition printed. It is recognized that the present map does not show the information most desired by automobilists, inasmuch as it indicates the

agencies by which the various roads have been improved—not the character of the improvement and the present condition of the road. Arrangements have been made for the preparation of a new map which will show the type of improvement. The State Highway Department will furnish the data and prepare the copy and this Department will undertake its printing and distribution.

New maps needed.--A number of atlas sheets of the State topographic maps are at present out of print, and the stock of others is very low. Several of these should be revised before new editions are printed. Neither the money nor the experienced help necessary to accomplish this promptly are at present available. If the money were in hand, the men might be found. For several years the appropriations for map work have been at a minimum, considerably below the average needed to keep a stock of all maps on hand and to make the needed revisions from time to time. *Unless our appropriations for this work are considerably increased for several years, the sale of these maps will be much curtailed.*

Increased prices.—For thirty years the standard price of atlas sheets has been 25 cents—a figure which covered the cost of paper and printing, with a small margin for postage. During recent years, however, the expense of new editions has greatly increased, so that the actual cost of the more recently published maps in editions of 1,000 has been considerably more than this, although the average cost of all the maps in stock for a time permitted the old price to be retained.

However, it became necessary on January 1, 1921, to raise the price of all standard sheets to 40 cents, and of the sheets covering the entire State to 50 cents.

MINING AND MINERAL INDUSTRY

Mineral statistics.—The collection of statistics for 1920 relating to the industry has been continued co-operatively with the United States Geological Survey. For the year 1919 the data were collected under the auspices of the United States Census Bureau, and the delay in the compilation of final results was so great that the figures were not available for inclusion in the last annual report. They will, however, be given with the figures for 1920 in the present report.

The total value of the mineral products in New Jersey in 1919 was \$56,788,967, and in 1920, \$82,134,233. This was an increase of

\$25,345,266. The summary figures published on page 103 give the details.

This work is in the immediate charge of the Assistant State Geologist, who has compiled the data given on page 97. Incidental to the work has been correspondence with the co-operating Survey, the answering of numerous inquiries in regard to the output of various products, the rank of the State and lists of producers, assistance in the preparation of press bulletins, and visiting various producers who would not otherwise report their production.

Development of resources.—No small part of the work of the State Geologist and Assistant State Geologist has been in answering inquiries regarding the occurrence of raw materials. Closely allied to this is the examination of specimens submitted. The Department cannot and does not undertake the chemical or mechanical analyses of specimens for private parties, except in cases where their analysis would furnish information of immediate value to the Department. It is, however, the practice to examine specimens submitted and give an opinion as to their probable value, and, where desirable, advise as to further steps to be taken regarding the deposits. During the past year such inquiries have covered clay, sand, greensand marl, iron ore, zinc ore, ground quartz, diatomaceous earth, serpentine, feldspar, limestone, manganese ore. Some inquiries can be readily answered. Other requests for information necessitate considerable search through the records and publications of the Geological Survey. It is not always easy to determine to what extent the information thus given is influential in establishing a new industry or strengthening one already established, or preventing an unwise expenditure of money in fruitless prospecting. From the standpoint of true conservation of resources, it is, of course, as important to discourage unwise exploitation, which is doomed to failure, as it is to encourage enterprises with solid foundations.

The Department does not concern itself with the commercial and financial sides of the problem, however important these may be. Its advice relates solely to the character of the raw materials, its probable abundance, availability, etc.

The most important developments which have come to the Department's attention, regarding which advice was furnished, are the utilization of a new clay near Trenton; of a limestone deposit near Carpentersville to produce various high-grade calcium salts, as well as

ordinary lime, hydrated lime, etc.; of greensand marl for softening waters in place of the natural and synthetic zeolites used in recent years in certain water-softening processes.

SOIL SURVEY

The Soil Survey, carried on in co-operation with the Bureau of Soils of the United States Department of Agriculture, is providing a detailed inventory of the soil resources of New Jersey, area by area. The progress of the work is shown by the accompanying map (Fig. 11). Reports and maps of the Sussex, Freehold, Camden, Belvidere and Millville areas have been published; those for the Bernardsville and Chatsworth areas are in course of publication, and will probably be issued in advance of this report. The Trenton and Salem areas are being surveyed.

The cost of making a soil survey is small. The entire expense of surveying an area of 800 square miles, exclusive of printing the map and report, is less than the cost to build one-fourth of a mile of concrete road. For the year 1919-1920 the cost was 1.8 cents per acre surveyed, and for 1920-1921, it was 2.6 cents. During the year ending June 30, 1921, 530 square miles of the Trenton area were surveyed and 70 square miles of the Salem area. At the close of the year there remained 134 square miles in the Trenton area unsurveyed, and 460 square miles in the Salem area.

The value of a soil survey has been set forth in a recently published bulletin from which the following quotation is made.¹

“Such a survey is valuable to the individual farmer because it classifies the agricultural and non-agricultural land. It divides the soils which are adapted to general farming or grazing from those which are suited to various specialized crops, and it gives an idea of their relative value. The soil survey also classifies lands suitable for forestry purposes. It indicates swamp lands capable of reclamation, the dry lands suitable for dry farming, and the arid soils which may be profitably irrigated. As experiment stations conduct fertility tests on the different soils and include the results in soil survey reports, the farmer may utilize these in determining the natural fertility and needs of

¹The Value of the Soil Survey. Bulletin II. Published by the American Association of Soil Survey Workers, Madison, Wis.

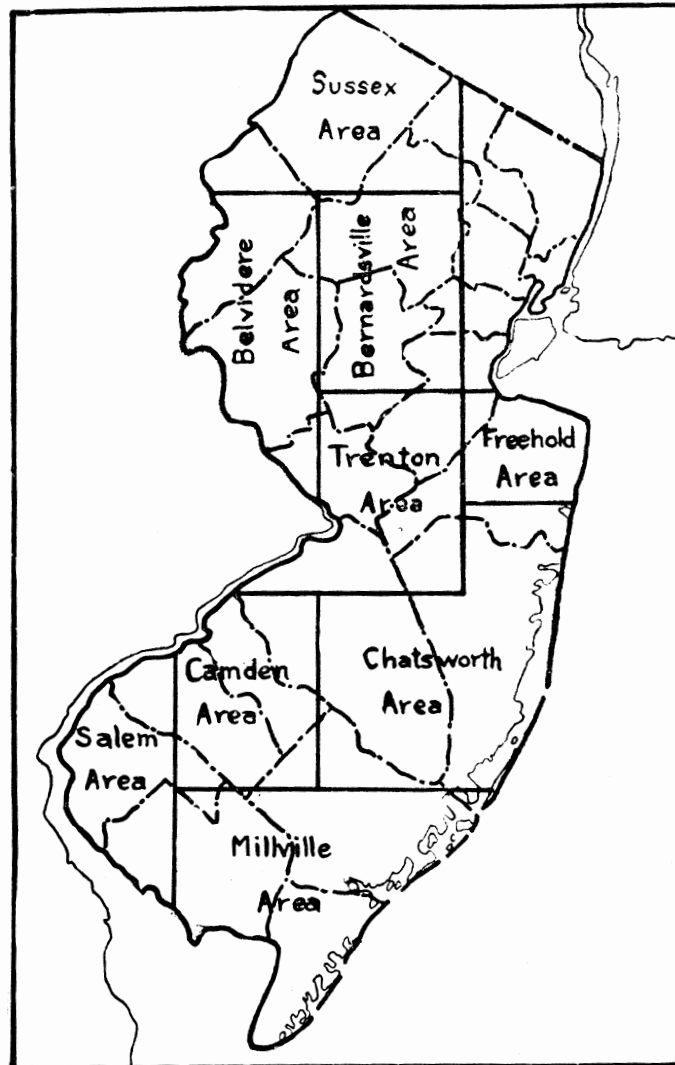


Fig. 11. Map showing progress of the Soil Survey. Reports on the Sussex, Freehold, Camden, Belvidere and Millville areas have been published. Reports on the Bernardsville and Chatsworth areas are awaiting printing. The Trenton and Salem areas are being surveyed.

the soil, what crops to raise, and how to treat and manage the different soils on his own farm.

"Farmers looking for new locations, and city folks wanting to buy farms find the soil survey maps and accompanying reports to be what they need first to consult. Real estate dealers, land appraisers, and bankers making farm loans can use the soil surveys in determining land values. Colonization agents find the soil surveys useful in locating settlers in new territory.

"Road engineers use the soil maps in locating roads and in finding suitable road building material. Various manufacturing industries, such as canners, makers of clay products and cement, find the surveys useful in selecting locations for factories. The soil maps indicate deposits of materials of industrial importance, such as gravel, sand, shale, tile, brick and pottery clays, limestone, and marl.

"High schools and colleges giving instruction in agriculture are using the soil surveys in dealing with soil and crop problems. County agricultural agents and agricultural extension specialists find constant use for the information contained in the soil survey maps and reports.

"Soil experts of the experiment stations, by knowing the soils of each county as shown on the soil maps, can be of great service to the farmer in helping to solve his soil problems. The maps also help in improving methods of farm management and in determining the cost of crop products. They are of great value in the establishment of drainage districts and in planning drainage systems for individual farms.

"In all fertility and crop production investigations the experiment station workers find constant use for soil maps and reports.

"Without a soil survey the location of representative fields for soil fertility tests is guess work, and the results secured cannot be fully utilized unless the locations and extent of similar soil areas in the other parts of the State are definitely known.

"Another unusual but very important use which is being made of soil surveys is in connection with the large life insurance companies. They use these maps in making public health and sanitary surveys and they find them very valuable in investigations bearing upon the health and well being of the people in particular communities.

"The detail survey is made by the soil experts going over every section of land at intervals of about one-fourth mile. They carefully inspect every forty acres and show soil variations on the map as

small as from five to ten acres. Two men work together. With a soil auger they examine the surface and subsoil to a depth of three feet. In some instances borings are made to a depth of six feet. Representative samples of each type are collected and sent to the laboratory for analysis.

"A report accompanying each soil map fully describes the properties of the soil and subsoil, topography, water supply, and drainage conditions, crop adaptation, general fertility, systems of farming, and methods of soil management followed. There is also included a general discussion of the agricultural development of the county, farm improvements, important products, markets, transportation facilities, and the general condition of the community."

Probably not all the uses above specified are made of every report and soil map issued, as conditions vary in different states, but every report issued serves some of the above uses. There is certainly every reason to believe that this work will prove as valuable in New Jersey as in any other state.

There is a distinct advantage in carrying it on in co-operation with the National Bureau of Soils. Not only does the larger bureau furnish workers and share in the expense of the field work, but it also publishes the report and maps and makes the physical analyses. Moreover, it supervises the execution of the work on the technical side, establishes the standards, and sees to it that the classifications are made uniform with those of other states, in so far as the soils are alike.

The personnel of the field workers during the season of 1920-1921 and the dates of field work were as follows: Department of Conservation and Development, L. L. Lee in charge, July 1 to December 24, 1920; April 12 to June 30, 1921. William Seltzer, July 1 to December 24, 1920; April 12 to June 30, 1921. Bureau of Soils, E. B. Deeter, July 1 to November 24, 1920; G. M. McVey, July 1 to September 15, 1920; C. B. Manifold, October 1 to December 22, 1920; May 10 to June 30, 1921; R. T. A. Burke, May 3 to June 30, 1921.

Six hundred square miles were mapped. This was nearly 200 square miles less than in the previous year, due chiefly to greater complexity of the soil problems, but in part to the fact that the Bureau of Soils found it necessary to assign to New Jersey several new men without experience in mapping these types of soil.

THE STATE MUSEUM¹

General statement.—During the past year, the time and energy of the Museum staff have been confined chiefly to lending material to schools, libraries, community centers, and other organizations of the State. This work had made remarkable strides within the last few years, but this year the amount of service rendered has been the greatest of all. It is interesting to know that the approximate total number of people reached during the year by the circulation of material and the exhibits at the Museum was 1,168,000.² These figures alone are the most conclusive evidence of the growing appreciation of the value of the Museum to the public. A fine foundation for this educational work has been laid; and it is hoped that, with more workers, funds, and equipment, still greater progress can be made in the near future, for there is still a great deal that has not yet been accomplished or even begun.

Permanent and special exhibits.—The regular permanent exhibits on natural history, geology, and industries of the State were on display during the year. No special exhibits were held because of the limitation of space, and because of the necessity of the staff's devoting its entire time to the increased demands for lending matériel. Two exhibits were added to the Museum's collections: an exhibit of Bird-of-Paradise feathers, aigrettes, and Goura pigeon-feathers, confiscated by the United States Government and presented to the Museum by the National Audubon Society; and a collection of Florida shells exhibited by Thomas Sommer, age, 11 years.

Loan collections.—The loan material is composed of various types of collections such as lantern slides, motion-picture films, industrial-process charts, cases of natural history specimens, stereographs, health charts, mounted pictures, and special exhibits. Over 2,000 orders for this material were filled during the year, and were studied by over one million pupils. This is double the circulation of last year.

¹Paragraphs relating to the State Museum have been prepared chiefly by Mrs. Greywacz, Acting Curator.

²The above figure represents the total persons reached, but does not mean that number of different people.

Lantern slides.—Through the courtesy of various State Departments, manufacturers, railroad companies, and other organizations, many lantern slides, valued at about \$2,500, were added by gift and loan to the Museum's collection. Many slides were also purchased, including new subjects as well as duplicates, or better views of old slides already catalogued. About 145 lantern-slide lecture sets, with accompanying manuscripts, giving a paragraph descriptive of each slide, were available for use. These sets covered subjects on industries, geography and travel, physical geography, natural history, forestry, agriculture and gardens, classical lectures, history, great world war, anatomy lessons, health and hygiene, literature, and miscellaneous subjects. The lecture sets were most popular and were in constant demand, as they are great time savers for the teachers. The development of the circulation of lantern slides can be seen readily from the records for the past four years, given below:

	1917-1918	1918-1919	1919-1920	1920-1921
Slides circulated	3,671	7,314	27,662	42,856
Approximate attendance at showings of lantern slides				318,488

Motion-picture films.—This is only the second year that the Museum has loaned motion-picture films, but this has already become one of the most important branches of its educational work. About 125 films, valued approximately at \$15,000 were loaned to the Museum for a period of a year by the Bureau of Commercial Economics, New Jersey Departments of Child Hygiene and Labor, United States Departments of Labor and Interior, the Ford Motor Company, and other industrial organizations. These films covered subjects on industries, geography and travel, safety first, health and hygiene, agriculture, and Americanization. More than four times as many films were circulated this year as last year, as is shown below:

	1919-1920	1920-1921
Number of reels circulated.....	336	1,500
Approximate attendance at showings of films		817,397

Miscellaneous collections.—New and duplicate material has been prepared and purchased throughout the year in order to meet the demands for industrial-process charts, natural-history cases, geological

models, mounted pictures, and the charts on health and agriculture. A series of new wood charts was made, showing specimens of the cross-section, bark, and wood of each tree described, along with a picture of its foliage, a distribution map and explanatory labels on identification, range and habit of growth, importance and uses, and its value in forestry. These charts are loaned in groups of four with a general one, telling how a tree grows, the general classification of trees, and some facts about New Jersey forests. Such charts will be made up for about twenty different kinds of trees. The stereographs purchased last year proved to be a successful experiment, so both new and duplicate subjects will be added. They were found to be especially helpful to the schools which have no facilities for showing motion-picture films and lantern slides.

Number of loan collections circulated:

	1917-1918	1918-1919	1919-1920	1920-1921
Charts, industrial and agricultural	189	500	755	849
Natural history cases	9	29	56	91
Mounted pictures	448	866	1,121	2,078

Special school work.--This was the first year that the Museum carried on its lending work through the summer months. Weekly shipments of material were sent to the State Summer Schools at Rutgers College, New Brunswick, Collingswood, Newton, and Ocean City, and to summer camps at High Bridge, Franklinville, Frenchtown, and Andover. In this way, the lending collections were in constant use almost the entire year. A special exhibit of lending material and a Museum representative were sent to a three-day convention of New Jersey teachers held at Newark in October, at which time it was brought to the attention of these delegates that the New Jersey State Museum was ready to co-operate with them in every possible way. The material exhibited there was highly approved by them. At the State conference of teachers of vocational agriculture held at New Brunswick, October 25-30, a talk on "How the New Jersey State Museum can co-operate with the teachers of agriculture" was given by Mrs. Greywacz, and the uses of some of the exhibits were demonstrated at that time. Splendid co-operation existed between these teachers and the Museum throughout the year.

The Cleveland School of Education and the Western Reserve University conducted a course in visual instruction from June 20 to

July 20, 1921, to which the Museum was asked to send a collection of its typical exhibits, so that they could be studied by teachers of Cleveland and representatives from Museums and other institutions throughout the United States. It is gratifying to know that this material was the least criticised of all the collections studied, and the Museum was commended for the work it is doing. Another phase of work carried on by the Museum was the lending of special exhibits to libraries and community centers.

Attendance.—The attendance at the Museum for the year has decreased greatly as compared with the years when special exhibits and class work were held.

<i>Month</i>	<i>Attendance</i>
July	1,096
August	1,260
September	1,160
October	906
November	1,058
December	918
January	1,214
February	1,092
March	1,332
April	1,082
May	1,038
June	1,259
	13,415
Average attendance per day	47
Average attendance per month	1,117
Attendance for the year	13,415
People reached by circulation of lending material	1,155,385
Total number of people reached by museum	1,168,800

Needs.—The needs of the Museum are many. Were it not so, it would be failing in its functions. A State Museum should serve the people of the State along many lines, and, therefore, there can be no limit to the needs of a living State Museum in a State as full of activity as New Jersey. The present Museum needs many things—adequate rooms, funds for material, funds for workers, but beyond and above these there is one supreme need—the need of a better appreciation by State officials and the Legislature of what the State Museum can do for the State. Given this, all other needs will be adequately met.

TESTING LABORATORY

Mr. R. B. Gage, Chemical Engineer, has continued in charge of the Testing Laboratory. The work performed during the past fiscal year has exceeded in volume and variety that of any previous year, and, as heretofore, has been chiefly for the State Highway Department. This increase was not unexpected, for, as the laboratory becomes better equipped and its force more efficiently qualified to perform their duties, it is natural that additional demands will be made upon it.

Moreover, as the advantages to be gained by using only standardized materials in all kinds of construction work are more fully recognized, it is to be assumed that additional requests will be made upon the laboratory for assistance, particularly by municipalities not having sufficient volume of work to justify the establishing of a laboratory of their own. Requests of this kind have increased in number during the past year, but in many cases it was impossible to give any assistance on account of the volume of work then in the laboratory being all that the force was able to handle.

Furthermore, there is a question as to how far the facilities of the State's laboratory can be placed at the disposal of municipalities of the State, even though payment is made for services rendered. If a sufficient volume of steady work of this character could be assured, it might be possible to handle it by the employment of additional help, to be paid from the funds so received, provided such use of funds is legal. But with the regular force fully occupied with State work, and no regular volume of municipal work assured, it is impracticable to hire temporarily the trained assistants needed. It is recognized, however, that, if in highway work, county authorities can have tested the materials used in the county-built roads (as distinct from State-aid roads), it will be of great benefit to the State at large. It is desirable that some method of co-operation shall be worked out.

In May this Department was asked by the Department of Institutions and Agencies to test in the laboratory all coal to be purchased during the coming year for the various State institutions. A plan of co-operation was agreed upon by which that Department pays the salary of the necessary assistant and the cost of special supplies. As this work will last for only a few months during the summer, while

deliveries of coal are being made, it was necessary to find some other source of revenue from which to meet the salary of the extra man when not engaged on coal analyses. For it must be clearly recognized that capable men of the required training cannot be taken on and laid off like day laborers. In this case, the difficulty has probably been met by a tentative agreement that the Bureau of Architecture will, hereafter, require that many structural materials to be used in State buildings shall conform to standard specifications and be tested to ensure this conformity. It is believed that this policy will result not only in better construction, by the elimination of inferior material, but in some cases at least, will permit the use of nearby materials, like sand and gravel, at less cost, in preference to similar material brought from a distance.

In its co-operative work with the State Highway Department, some changes in method have been made. Material inspectors employed by the Highway Department have been placed under the jurisdiction of the Director of the laboratory, so that the laboratory force is solely responsible for the proper inspection and approval of materials. These material inspectors are stationed at the points of production of the various kinds of road material, stone, concrete gravel, bituminous and concrete sand, asphalt cement, oils, tars, and Portland cement. They pass upon all material intended for use in any State or State-aid work. They also report daily all materials, accepted or rejected, destination of shipments, quantity, name of consignee, consignor, and manner of shipment. Inspectors working under the jurisdiction of the laboratory are also placed at the different asphalt-paving plants. It is their duty to see that all materials used in the preparation of bituminous paving mixtures are as specified, and that the different mixtures are prepared in the manner required.

All material inspectors are supplied with the equipment that is necessary to make such field tests as may be required to determine roughly the character of the materials and paving mixtures. Since they are responsible for the correct preparation of these paving mixtures, it is very important that they be well trained, experienced men in this line of work, if the use of inferior grades or materials or methods of construction are to be prevented. It is easily possible to lose from \$5,000 to \$10,000 per mile of pavement by permitting the use of inferior grades of materials or methods of construction. Unfortunately, it has been found very difficult to secure men with the

desired experience, character, and ability, at the salaries established for such positions.

Personnel.—The number of employees under the jurisdiction of the head of the laboratory during the construction season ranges from thirty to thirty-five, and about one-half this number during the winter months or non-construction season. Those, temporarily employed, are chiefly the material inspectors, who are stationed in the field at the various points of production or shipment of materials.

In general, during the construction season, the laboratory force is made up as follows:

Chemical Engineer—Head of the Laboratory	1
Senior Testing Engineer	1
Senior Testing Chemist	1
Testing Engineers	2
Junior Testing Chemists	2
Laboratory Assistants	2
Office Force—	
Stenographers	4
File Clerk	1
Materials Classifier and Recorder	1
Janitor	1
Materials Inspectors	18

With the exception of the Chemical Engineer, one chemist, one stenographer, and the janitor, this force is carried on the pay rolls of the State Highway Department, since they are engaged almost solely in highway work.

During the past year, the following additional equipment had been installed in the laboratory:

1	20,000 lb. capacity Timus Olsen Testing Machine
1	De Val Abrasion Machine
1	Talbott-Jones Rattler
1	Dorey Hardness Machine
1	Page Impact Machine for Determining Toughness
1	Large Drying Oven
2	Mechanical Sand Shakers
1	Olsen Briquette Testing Machine
1	Lap Grinder and Saw for Preparing Stone Specimens
1	Ball Mill

Sets of cases have also been installed beneath the benches so that, in a general way, the laboratory is now complete as originally intended.

During the year the following samples were tested:

Portland cement	1,690
Stone	302
Concrete sand	452
Bituminous sand	30
Concrete gravel	186
Road gravel	123
Concrete cubes	567
Asphalt cements	127
Asphaltic oils and tars	261
Bituminous pavement and mixtures	231
Mineral fillers	23
Slag	120
Paving blocks	29
Coals	46
Pipes	10
Steel	7
Miscellaneous materials	25

Each of these materials required several separate determinations, and, in some cases, the tests could not be completed in less than twenty-eight days. Consequently, the number of samples does not give a very definite idea of the quantity of work performed.

There has always been some doubt whether concrete cubes, made of material from the mixer and taken during the construction of a pavement, correctly represent the quality of the concrete in the pavement. To remove this doubt, and to determine whether the required thickness of concrete is being secured in these pavements, a Calyx core drill is now in use. It is mounted on a truck and is so designed that concrete cores from three inches to six inches in diameter can easily be bored from a concrete pavement. It is operated under the direction of the laboratory.

At the close of the year cores have been taken from a few pavements only, and, while no general conclusions can be drawn, the results secured so far show that, in some cases an excess of concrete has been used, while in others, the pavement is thinner than required; also that considerable damage has been done concrete pavements by not exercising care to keep the ingredients used in the concrete separated from the sub-base material upon which it was deposited.

It is hoped that with this equipment the cause of the premature failures that have in a few instances developed in concrete pavements can be determined and eliminated in future construction. This line of investigation should be completed during the present construction season.



Figs. 12 to 14. The State Forests contain many attractive spots for camping and tramping.

During the past year, the laboratory has been inspected by engineers and chemists from municipalities, other states, and the United States Government. It appears to be the unanimous opinion of those who have made these examinations that the laboratory is one of the best designed and equipped in the eastern part of the United States.

OIL PROSPECTING

The belief that oil exists in New Jersey in commercial quantities still persists, and efforts to find it continued through the year, but with no success. The rig used at Prospertown was moved to Jackson's Mills, Monmouth County, and drilling there was in progress at the end of the year, but so far without the results hoped for. On the basis of this endeavor several oil companies have been incorporated and efforts are being made to sell stock. In view of this activity in soliciting funds from the general public, it may be well to reiterate what has been said in previous reports, that in the opinion of the State Geologist there are no known facts nor any well-founded hypothesis, which warrant the belief that oil will be found in commercial quantities in this State. The attempt to find oil here, if made at all, should be undertaken only by those who can afford the loss, which will probably result.

GEOLOGY OF NEW JERSEY

In 1915 the Geographical Survey published, as Bulletin 14, a summary of the geology of New Jersey. The report has been in great demand and the supply has been practically exhausted. In the meantime, additional information in this and neighboring states has made clear some of the obscure problems. Moreover, it is probable that the brevity with which facts were set forth in Bulletin 14 added something to the difficulty of the question discussed. The time, therefore, seems opportune not merely for a republication of Bulletin 14, but for a new report, which in large measure should be rewritten. Considerable progress has been made in the preparation of the revised manuscript and it is hoped it will be ready for publication this year.

PERMITS FOR THE DIVERSION OF WATER

Acting under the provisions of Chapter 252, Laws of 1907, and Chapter 304, Laws of 1910, which relate to the diversion of water for potable purposes, the Board received six applications during the year, as listed below. The application of the Borough of Verona is worthy of special mention in that it emphasized the importance of economical development of water supplies, and the advantage of water-supply districts over separate municipal plants for certain groups of adjacent communities. The testimony taken on the Bayonne application emphasized the need for additional water supply in the North Jersey Metropolitan District.

James E. Hullfish.—The plans of James E. Hullfish to take an additional water supply of 24,000 gallons daily from springs near the village of Lawrenceville, Mercer County, for augmenting the present supply to the village, were filed on July 7, 1920, and approved by the Board on September 14, 1920, subject to the usual conditions.

Borough of Verona.—The plans of the Borough of Verona were disapproved after hearings on December 9 and 16, 1920. Owing to the importance of the principles involved in this application, the decision of the Board is quoted in full:

IN THE MATTER OF THE APPLICATION	}	DECISION.
OF THE BOROUGH OF VERONA.		
Filed November 24, 1920.		
Decided February 10, 1921.		

Before the Board of Conservation and Development.

On November 24, 1920, the Borough of Verona filed its application for the approval by this Board of its plan for obtaining a new water supply from underground waters within the borough limits. Notice of the application was given and hearings held as required by law, at which all parties interested were given opportunity to be heard. The petitioner, by its officials and counsel, appeared in support of said application, and the Borough of Essex Fells, by its officials and counsel, in opposition thereto.

Before granting any application for a sub-surface supply this Board must find that the plan submitted is justified by public necessity or reasonably anticipated public use; that it will not interfere unduly with the opportunity of other municipalities to obtain for themselves a water supply by taking waters needed for their use; and that the taking will not unduly injure public or private interests. Although favorable findings on all three of these points are necessary for affirmative action, an adverse finding on any one of them makes it necessary to deny the application.

The present water supply of Verona is from a high-level service plant located in the Borough of Essex Fells, which also supplies portions of Essex Fells, Caldwell and North Caldwell. At the present time Verona uses about 75 per cent of the total output. The water is pumped from four wells having an approximate elevation of 500 feet, through 8,500 feet of 6-inch pipe to a high-

service reservoir located on a hill near the boundary between Essex Fells and Verona, the normal water elevation being about 650 feet. The water flows into the main portion of Verona through two 6-inch pipe lines, which connect into a 10-inch and 12-inch line in Bloomfield Avenue. There is also a low-level service which supplies Roseland, Essex Fells, Caldwell and North Caldwell. The two services are intercommunicating and are now owned by the Borough of Essex Fells, which acquired title in July, 1920, from the Essex Fells Electric Light and Water Company, a private corporation. Verona purchases the water wholesale under a contract which expires July 1, 1922, paying 18 cents per thousand gallons, a rate fixed by the Public Utilities Commission in March, 1920, and sells it to the inhabitants of the borough. It owns its own distribution system, except that approximately 2,400 feet of the 6-inch supply lines within Verona, and approximately 1,950 feet of 4-inch distribution lines adjacent thereto and also within Verona are owned by Essex Fells.

The water now furnished is of excellent quality, and the wells used are capable of meeting for 50 years all probable demands from the municipalities supplied. The pumping equipment is sufficient to meet all present demands, and, in fact, to furnish practically twice the present daily draft. The service in Verona is, however, not wholly satisfactory. A sudden large flow in the main portion of the borough causes the pressure temporarily to drop so low that it is impossible to obtain water for either domestic or fire purposes in the higher portions of the borough on the east and west. This condition antedates the purchase of the plant by Essex Fells, and still continues. About 300 persons, 10 per cent of the population of Verona, are affected now by this condition. Its cause is lack of sufficient reservoir storage capacity and arterial capacity in the two 6-inch lines from the reservoir to the corner of Bloomfield and Fairview avenues near the center of Verona. These lines are owned in part by Essex Fells and in part by Verona.

Verona now desires to develop a new source of supply within its own territory, which it will own and control, a proposition endorsed by a referendum vote at the last election. It proposes to sink four wells near Peckman's Brook in the central part of the borough erect a pumping station, lay about 2,200 feet of 10-inch pipe (in addition to 1,000 feet already laid), and construct a 250,000 gallon reservoir on the west hill. The plan necessarily involves the abandonment, so far as Verona is concerned, of the present source of supply, and the disuse of a part of the present system, a portion of which was constructed specifically to supply Verona.

In objecting to the proposed plan Essex Fells showed that Verona takes about 32 per cent of all the water pumped by the combined high and low-level services; that approximately \$37,500, or 27.29 per cent of the value of the plant, had been allocated to Verona by the Public Utilities Commission in fixing the rate Verona should pay; that the high-level wells, reservoir, pumping station and several thousand feet of pipe line—partly in Essex Fells and partly in Verona—are used mainly to supply Verona; and that there will be relatively little use for them if Verona ceases to take this water.

Essex Fells proposes to remedy the admitted deficiencies in the present service as follows: The reservoir capacity will be increased from the present 150,000 to 350,000 gallons; the supply system strengthened by laying a new 8-inch pipe from the reservoir to Bloomfield and Fairview avenues in the center of Verona; a new contract entered into at the existing rate for eight years, Essex Fells to pay for the enlarged reservoir and the 8-inch pipe from the reservoir to the Verona distribution system in Bloomfield Avenue, 2,350 feet, and Verona to pay for its extension in Bloomfield Avenue from near Fells Road to Fairview Avenue, about 1,400 feet, and at the termination of the contract, Verona to purchase, at the then valuation, all pipe belonging to Essex Fells which lies within Verona. Essex Fells also proposes as a partial alternative a 500,000 gallon reservoir and a 12-year contract.

Essex Fells contends that its plan will remedy the defects, and is equitable to both boroughs. It claims further that it will be unduly injured if Verona's plan is approved. It, therefore, asks the Board to refuse the application.

The question before the Board is not whether Verona should have an adequate and dependable service. That is conceded. It is also conceded that the present service is not dependable and is sometimes inadequate. The question which this Board is called upon to decide is whether the plan proposed by Verona to obtain the service, which it ought to have, is justified.

Inasmuch as Essex Fells has presented an alternative plan, it has been necessary for the Board to examine in considerable detail the two proposals, analyze their relative efficiency, make comparisons of cost, and consider the time necessary to put them into effect. It has also to consider certain broader questions relating to the prudent and economical development of the water supplies of the State, and their bearing in this case.

The Board finds that Verona's plan will give adequate service on the east heights, but that on the west heights the service will be inadequate unless a connecting pipe line is laid in Oak Ridge Avenue so as to furnish a second supply line to that district; that Essex Fells' plan will give much better service on the west heights than Verona's even after this additional connection is made, and that it will furnish practically as good service on the east heights, provided Verona extends the 8-inch pipe line as proposed; that even if Verona refuses to make this latter improvement, Essex Fells' plan will make conditions on the west hill better than Verona's plan, and will improve the service on the east hill, but will not make it adequate at all times. Essex Fells' proposals contemplate a greater reservoir capacity than Verona's, and hence give 40 per cent greater reserve in case of fire or breakage of the pumps. If the second proposal is adopted, the reserve will be 100 per cent greater.

Verona's estimate of the cost of its plan is \$56,000. In the opinion of the Board this is too low. There should be added the cost of the connections in Oak Ridge Avenue on the west hill required to provide adequate service there. It would seem necessary to add also a sum sufficient to cover the cost of purchasing or duplicating the distribution system on the west hill in Verona, which is now owned by Essex Fells, for if Verona acquires its own supply, it must assume the obligation of furnishing all its citizens with water, and not leave a portion of its territory to be supplied by Essex Fells. The Board has before it no testimony as to the cost of these additional items and it cannot therefore determine the total cost of the Verona plan. After careful consideration, it seems safe to assume, however, that it will be not less than \$68,000, and may be more.

The proposal of Essex Fells calls for an estimated expenditure of \$18,400 by that borough, and the laying of 1,419 feet of 8-inch pipe by Verona at an estimated cost of \$5,500, or approximately \$24,000 in all. From the standpoint of economy, the plan of Essex Fells is to be preferred.

Essex Fells' plan involves a charge of 18 cents per thousand gallons for a contract period of 8 or 12 years. Verona estimates that under its plan the cost will be 17 cents per thousand gallons, but in arriving at this figure, it takes no account of those additions to the capital investment indicated above, which the Board believes to be necessary. The 18 cent payment under the Essex Fells' plan carries a certain amortization of the investment heretofore made in the Essex Fells plant for the benefit of Verona; while the 17 cent rate makes no provision for this but provides for amortization of Verona's proposed new investment only. The Board believes that some equitable provision should be made by the boroughs to cover the full outlay.

The testimony shows that there is need for relief at the earliest possible moment. Essex Fells offers a plan which can be carried out within six months after an agreement between the two boroughs is reached. Verona's plan cannot become operative until the expiration of the present contract July 1, 1922. The plan of Essex Fells, therefore, promises the earlier relief.

In its consideration of this case the Board has also had in mind certain broader aspects of the problem, to which it wishes to refer briefly. It is charged by law with the supervision of the potable water supplies in the State to the end that they may be prudently and economically developed. At present the boroughs of Caldwell, Verona, Essex Fells and Roseland have a common source of supply. Disregarding for the moment municipal boundary lines and local pride, and considering solely the district as a unit having an established water supply system, the Board is strongly of the opinion that the best engineering practice, conservation of capital investment, and economy of operation, demand the improvement of the present system rather than the disintegration, partial abandonment and duplication involved in the Verona plan. If the territory now served by the existing plant were one municipality, it is inconceivable that that plan would be seriously proposed. Even if the present diverse municipal interests are taken into account, it may be doubted whether the Verona plan would have been formulated if the Essex Fells' plan had been presented at an earlier date. This being so, the Board cannot consent to its adoption unless it is clearly established that co-operation on an equitable basis between the boroughs is impossible. The Board believes that such an agreement should, and can, be worked out on the basis of the proposals made by Essex Fells. Since these promise more effective relief, in shorter time, at a less cost than Verona's plan, and do not involve the breaking up of the present system, the Board believes that they are in the interest of both boroughs. It therefore finds that the plan proposed by Verona is not at this time justified by public necessity, and that its consummation will cause undue public injury. It accordingly is disapproved and the application denied.

In so acting, the Board must not be understood as standing in the way of the prompt and effective remedying of the existing inadequate service. Unless Essex Fells shall without delay present to Verona an effective and equitable plan of co-operation, and upon its acceptance by Verona immediately carry it into execution, Verona may renew its application.

In testimony whereof, we, a majority of the members of the Board of Conservation and Development, do hereto set our hands and cause the official seal of the Board to be affixed hereto and attested by its Secretary, this tenth day of February, 1921.

PERCIVAL CHRYSTIE,

President.

HENRY CROFUT WHITE,

OWEN WINSTON,

JOHN A. WATERS,

JOHN L. KUSER,

Members of the Board of Conservation and Development.

Attest:

ALFRED GASKILL,

Secretary.

After the close of the year, a contract was entered into between Verona and Essex Fells in accordance with the above decision.

City of Bayonne.—The application of the City of Bayonne to take a new water supply from the Ramapo River, near Oakland, was filed on February 21, 1921. Because of the many important factors which entered into this case, parties in interest agreed to waive the requirement that the Board make its decision within 90 days of filing the

application. Hearings were held on March 10, April 21, June 9 and July 7, and oral argument was set for September 8, 1921.

Borough of Sea Girt.—The plans of the Borough of Sea Girt to take a new water supply from artesian wells was approved on April 21, 1921, the amount to be diverted under the permit being limited to an average of 500,000 gallons daily during any month.

Borough of Pompton Lakes.—On June 2, 1921, the Borough of Pompton Lakes filed an application to take a new water supply from Ramapo River at Pompton Lakes dam. No hearings had been held up to the close of the year.

Town of Bloomfield.—On June 9, 1921, the town of Bloomfield filed an application to take a new water supply from Ramapo River at Oakland. No hearings had been held up to the close of the year.

EXTENSIONS OF TIME

On account of general adverse conditions for construction work, extensions of time were granted in the following cases: Borough of Wharton, water supply, to September 1, 1921; Borough of Mendham, water supply, to January 6, 1922; Borough of Sayreville, water supply, to May 24, 1922; Borough of Haledon, to complete proposed reservoir, to January 1, 1923; New Jersey Central Power Company, to complete proposed dam near Chester, to January 1, 1922.

EXCESS DIVERSION CHARGES

Charges for 1920.—Under the provisions of Chapter 252, Laws of 1907, and Chapter 304, Laws of 1910, all municipal corporations, corporations, or persons diverting water, either from surface, sub-surface, well or percolating sources, or from any combination of such sources for public water supply purposes, are required to keep accurate records by meter or other approved methods of the amount of water used and to report the same quarterly to the Board, as successor to the State Water Supply Commission. The act of 1907 imposes certain charges for the excess diversion of water from surface sources.

For the year 1920, the Board fixed a rate of \$1 per million gallons, the minimum rate provided by law. Certification to the State Comp-

troller of the amounts due the State, as per the table below, was made February 10, 1921, the amount due from each being equal in dollars to the figures shown in the last column, the total for all being \$28,805.14. Of the sum certified \$22,245.01 was paid before July 1, or within a few days thereafter. The cities of Atlantic City, Newark, Trenton and Sussex are in arrears, and the amounts due from these municipalities have been certified by the State Comptroller to the Attorney General for collection.

EXCESS DIVERSION OF SURFACE WATERS, CALENDAR YEAR 1920

NAME OF COMPANY OR MUNICIPALITY	Total Free Allowance In Million Gallons	Total Diversion in Million Gallons	Excess Diversion in Million Gallons and Charge in Dollars
Acquackanonk Water Co.	1,594.296	2,561.100	\$966.80
Atlantic City Water Dept.	1,375.903	2,025.407	649.50
Boonton, Town of	144.021	237.728	93.71
Bound Brook Water Co.	158.405	316.264	157.86
Bridgeton, City of	498.638	722.863	224.22
Buckhorn Springs Water Co.	68.406	114.180	45.77
Burlington, City of	294.191	382.617	88.43
Butler Water Co.	102.480	228.270	125.79
East Jersey Water Co.	3,323.902	11,357.610	8,033.71
Frenchtown Water Co.	35.686	51.305	15.62
Hackensack Water Co.	7,946.653	10,777.705	2,831.05
Hackettstown, Town of	94.940	189.222	94.28
High Bridge, Borough of	50.581	82.217	31.64
Jersey City, City of	14,054.400	19,588.458	5,534.06
Lopatcong Water Co.	146.400	466.900	320.50
Middlesex Water Co.	640.757	1,491.804	851.05
Millville Water Co.	434.954	458.350	23.40
Monmouth County Water Co.	160.747	262.066	101.32
Montclair Water Co.	1,007.268	1,020.660	13.39
Newark, City of	13,264.450	17,466.100	4,201.65
New Brunswick, City of	939.291	2,476.137	1,536.85
New Jersey Zinc Co.	58.560	68.173	9.61
Newton, Town of	161.845	244.854	83.01
Rahway, City of	556.919	1,144.116	587.20
J. A. Roebling's Sons Co.	42.456	114.837	72.38
Somerville Water Co.	473.360	502.833	29.47
Sussex Water Dept.	48.239	123.155	74.92
Tintern Manor Water Co.	1,150.927	1,507.515	356.59
Trenton, City of	4,937.340	6,571.400	1,634.06
Washington Water Co.	125.575	142.880	17.30
Totals	53,891.590	82,636.726	28,805.14

COLLECTION OF BACK CHARGES

Of the amounts due the State on account of unpaid back charges, the sum of \$35,633.57 was collected from the City of Jersey City, including interest (\$2,272.53); and the sum of \$5,020.46 from the City of New Brunswick. Suit has been instituted in the Mercer County Court to collect the sum of \$14,310.03 from the City of Trenton.

CONSUMPTION FOR THE YEAR 1920

The reports from 204 water supplies throughout the State (which include all the more important systems) show that during the year 1920 a total population of about 2,980,000 persons was supplied with about 340,000,000 gallons of water daily, or at an average rate of 114 gallons daily per person. The following table gives additional information on consumption, etc.:

PUBLIC WATER SUPPLIES IN 1920. (CALENDAR YEAR.)

SOURCE OF SUPPLY	Number of Systems	Population Supplied	Consumption (Gallons daily)	
			Total	Per Person
Surface	49	1,944,944	232,393	119
Underground	136	689,161	71,888	104
Combination	19	345,839	35,784	103
Totals	204	2,979,944	340,065	114

MEASUREMENT OF WATER CONSUMPTION

During the year the work of measuring the consumption of water by a portable meter was continued on a number of systems. A model of a special flow meter was designed and built by the Water Engineer, and tested out in several places. This meter is still in the process of development to meet the needs of small water plants for an inexpensive meter that can be readily installed on their supply mains and measure the total flow without expert attention.

Tests have been made as follows:

July 2 to 10, 1920—Buckhorn Springs Water Company, gravity system.
 July 23 to July 31, 1920—Borough of High Bridge, gravity system.
 August 9 to 11, 1920—Tintern Manor Water Company, pump slippage test.
 August 20 to September 16, 1920—Lopatcong Water Company, checking Venturi meters.
 October 14 to November 8, 1920—Special test on Lopatcong Water Company's supply main to calibrate model of flow meter.
 November 24, 26, December 1, 2, 8, 10, 15—Special tests at Newark Water Department Laboratory on Clifton Street to calibrate flow meter.
 January 3 and March 24, 1920—Special tests at Newark Water Department Laboratory on 8th Street to calibrate flow meter.
 April 20 to 27—Borough of Essex Fells, pump slippage test.

INSPECTION OF DAMS

No plans for dams were approved during the year. Inspections of dams under construction, permits for which had previously been issued, were made as follows: Kennedy Electric Company dam near Long Valley, under repair by order of Board, September 10, 24, 1920; W. R. Morris dam near Newton, under repair by order of Board, November 19, 1920, January 4, 1921; Pocohontas dam at Morristown, under repair by permit, November 19, 1920. Inspections on the progress of the Wanaque dam at Midvale were made on March 31 and May 26, 1921. Contract No. 1, which includes construction of a concrete core wall from surface of ground to bed rock and excavation of diversion channel, was let to W. H. Gahagan, Brooklyn, N. Y., and ground was broken November 23, 1920. On June 30, 1921, the excavation work under the contract was 34 per cent completed.

Plans are under way for an examination into the stability and safety of all existing dams in the State for the purpose of ordering repairs where necessary to protect life and property. To complete this work it is estimated that an annual appropriation of at least \$5,000 should be made for a number of years.

WATER POWER

The Department co-operated with the United States Geological Survey in making an inventory of all developed water powers of 100 horse power and over in New Jersey. This inventory was made throughout the United States. The 32 plants listed in New Jersey have a total of 17,186 horse power installed.

STREAM GAGING

The Department's repeated yearly requests for funds to re-establish the stream gaging, which was abandoned in 1914, was granted by the Legislature of 1921, the appropriation being made from the Water Supply Fund. A co-operative agreement has been made with the United States Geological Survey, whereby that bureau will furnish a district engineer from its force to take charge of this work under the direction of this Department, at the beginning of the fiscal year 1921-22; it will also furnish some equipment for the work.

The importance of this undertaking has been set forth in previous annual reports of the Department. During the past year the demand for accurate stream-flow data has continued unabated. This has shown itself not only in the water-supply cases considered by the Board, but also by the willingness of many water interests throughout the State to co-operate with this Department in re-establishing this work, which has now been made possible. Arrangements have been made with a number of parties whereby they have agreed to equip the gaging stations in their territory and this Department has agreed to maintain and operate them.

The continued support for this work by yearly appropriation for its maintenance and growth is absolutely necessary in order that the records may be uninterrupted for a period of years. A record of the flow of any river for a single year has comparatively little value on account of the wide variation in rainfall and resulting run-off from year to year. Records of 5 to 10 years are of course of much greater value in showing possible extremes of low and high flow, but in such short periods there is no assurance that either the minimum or maximum flow has been shown. These extremes, as well as the continuous records, are needed before our water resources can be prudently and economically developed. At the same time invaluable records will be available for use in the design and construction of engineering works related to stream flow, including water works, water power, flood control, navigation, bridges, etc.

It is planned to equip about 25 stream-gaging stations during the coming year. With the co-operation of the United States Geological Survey and private interests, these stations can be installed and maintained in an efficient manner with the appropriations available. The sum of \$10,000 annually should be appropriated to maintain the work.

An additional appropriation of \$5,000 is urged to permanently equip the more important stations with automatic water state registers. This will insure obtaining reliable and continuous records of the water level instead of being dependent upon the morning and evening daily reading by local gage observers, who may often fail to obtain critical stages, especially during floods, which may occur between the hours of their regular visits.

During the past year this Department has continued to operate the two gaging stations on the South Branch of Raritan River. Observations of gage heights have been obtained throughout the year and discharge measurements made as follows:

High Bridge Station—July 15, August 13 (2 measurements).

Stanton Station—May 13, 1921.

SPECIAL WATER SUPPLY INVESTIGATION

From the appropriation for water supply purposes for the year beginning July 1, 1921, which was made by the last Legislature, the sum of \$15,000 was set aside for a special investigation of the future water supply needs of the North Jersey Metropolitan District and how those needs could best be met. Requests for a special appropriation for such an investigation have been made by the Department in previous years, but have been denied. The firm of Hazen, Whipple and Fuller, Consulting Engineers, New York City, has been engaged to make the investigation and furnish 1,000 copies of their report for distribution by March 15, 1922. As a guide in this work the engineers were asked to consider and answer the following questions:

1. What will be the probable future water-supply needs of the Metropolitan District of Northern New Jersey within say 50 years?
2. To what extent can Raritan, Passaic and Hackensack watersheds meet these needs, and what is the logical allocation of the same?
3. To what extent will the underground waters available to the Metropolitan District meet future needs?
4. Assuming that the above-mentioned sources are not sufficient, can additional supplies be better derived from Upper Delaware River and tributaries (Musconetcong, Paulins Kill, etc.) and Walkill, than from streams in South Jersey?
5. In connection with No. 4, special consideration should be given to the Wharton Tract, which occupies about 100,000 acres on Mullica watershed and has been offered to the State for \$1,000,000.
6. Assuming that the Wharton Tract will be needed for North Jersey, how can the water best be collected and delivered?

7. If the Wharton Tract will be needed, will it be more economical to acquire it at the present time, or to postpone action until such time in the future as the water will be needed?
8. Excepting the Passaic River and tributaries and the Hackensack, what watershed should next be developed to meet the needs of the Metropolitan District, and at what points should it be developed?

UNDERGROUND WATERS

Not only is there great interest in the development of surface supplies, but it is also true as regards underground supplies. Evidence of this is found in the unusually large number of requests for information and advice along this line received by the Department during the past year. Dr. Twitchell, who has charge of this phase of our work, has devoted a large part of his time to special studies regarding the underground water conditions and prospects at various places, in order to give the best helpful advice in response to these requests. These inquiries have come from engineers, manufacturers, hotel proprietors, real estate agents, well drillers, government institutions and private individuals. They have come from all parts of the State and relate both to supplies for large towns or large industrial plants as well as to the needs of the individual farm.

The Department has a card index of about 2,000 well records, accompanied by a locality key map. Additions are constantly being made to this set, which is an invaluable aid to our underground water studies. The report on the underground waters of the State, which has been in preparation for several years past, is nearly completed. Even in its present manuscript form of 450 typewritten pages, it is constantly in use as an aid in the study of special local underground water problems.



Fig. 15. Planted pine 14 years old on a State Forest in Burlington County.



Fig. 16. Cleared roadsides make easy traveling and safeguard the bordering forest.



Fig. 17. The State Forests produce timber and provide pleasant playgrounds.

Report of the State Forester

ALFRED GASKILL

Considerable positive progress in forestry has been made during the year. In some ways the advance surpasses in importance that of any earlier period.

NATIONAL FORESTRY POLICY

The efforts of foresters throughout the country to have established a truly *National* forestry policy, to which all forestry organizations and forest industries can give their support, have culminated in the "Snell Bill" now before Congress, which provides for a close cooperation between the forestry organizations of the Federal and State governments. This bill is supported by the Federal Forest Service, by twenty-four State forestry departments, by many lumber and paper companies, wood-using industries, chambers of commerce, and by a large section of the press. It is opposed by a group advocating Federal domination as expressed in a bill introduced by Senator Capper.

STATE POLICY

The forestry policy which New Jersey has consistently followed for sixteen years is in accord with the more important features of the "Snell Bill," with whose framers the writer frequently was invited to confer.

The program of the Federal Forest Service now lays greatest stress upon forest fire control; that has been and is the foundation of our every effort. Silviculture in any form is wasted effort until the areas under management shall have been made practically fire proof. In New Jersey it is unnecessary to do much forest planting because Nature commonly does it for us. And we hold it better public policy

to encourage and help forest owners to make their lands profitable than it is to take over those lands on behalf of the public. This last principle does not apply to forests that may be used also as parks.

NEW JERSEY'S TIMBER RESOURCES

Standing, apparently, at the threshold of a forward movement in forestry it is well to know what our State has and can expect. The following figures and facts have been compiled with care from many sources, including the intimate knowledge of the State's staff of foresters. Without pretending to be exact they are significant, timely and of value.

Forest regions.—New Jersey has approximately two million acres of woodland, equal to 46 per cent of the total land area. Probably one-quarter of this possesses soils that can be used for agriculture when needed; for the present that need is developing slowly. Our forestry therefore aims to make profitable all the land not used for other purposes.

Broadly considered our forests comprise two distinct regions, with a transition zone: a "hardwood" region of about 750,000 acres lying north and west of a line running from Seabright to Glassboro to Bridgeton; and a "pine" region of about 1,250,000 acres lying south and east of the same line. (See map, p. 62.)

The hardwood region contains mainly deciduous species such as oak, chestnut, maple, hickory, beech, tulip poplar, ash, birch, gum, elm, etc., with small quantities of the conifers—white and pitch pine, red cedar and hemlock.

The South Jersey pine region contains principally pitch pine, shortleaf pine and white cedar, with considerable oak on the better soils. This oak growth is not all scrub as is commonly thought, but consists largely of various tree species which make good timber; it is scrubby because it is often burned. It is estimated that pine occupies 50 per cent of the area; oak and hardwoods, 20 per cent; cedar swamp, 4 per cent, and brush (recently cutover or severely burned land), 26 per cent.

Cutover and burned forest.—Nearly 70 per cent of the whole forest area (1,400,000 acres) has been recently cut over, or so severely burned that the present tree growth, while potentially valuable, is now too small to be merchantable. Of this area, 400,000 acres,

three-fourths of which is in South Jersey, contains few trees large enough even for cordwood; the remaining 1,000,000 acres would yield approximately 7,000,000 cords of wood, both pine and hardwoods, of a size suitable only for fuel, posts, etc.

Merchantable timber.—Approximately 30 per cent of the forest area (600,000 acres) now contain merchantable timber estimated at 1,640,000,000 board feet of saw timber, poles, ties, piling, etc., and 5,000,000 cords of fuel wood. Of this lumber stand, yellow pine will yield 360,000,000 board feet, cedar 100,000,000 board feet, and all hardwoods (with white pine and hemlock) about 1,180,000,000 board feet.

Rank of species.—The various hardwood species rank in abundance as follows: oak, 65 per cent; maple, 10 per cent; hickory, 5 per cent; beech, 4 per cent; tulip poplar, 3 per cent; ash, 3 per cent; birch, 2 per cent; gum, 2 per cent; elm, 2 per cent; other species, 4 per cent. In the same way, the conifers rank as follows: pine, 79 per cent; cedar (red and white), 20 per cent; hemlock, 1 per cent. Of the four native species of pine, pitch pine ranks about 80 per cent; shortleaf pine, 18 per cent; white pine, 1 per cent; scrub pine, 1 per cent. Ranking conifers and hardwoods together we get oak, 47 per cent; pine, 22 per cent; maple, 7 per cent; cedar, 6 per cent; hickory, 4 per cent; beech, 3 per cent; tulip poplar, 2 per cent; ash, 2 per cent; birch, 1.5 per cent; gum, 1.5 per cent; elm, 1.5 per cent; hemlock, 5 per cent; other species, 2 per cent. Chestnut is not included because of its destruction by the blight.

Timber consumption.—New Jersey consumes the equivalent of about 600,000,000 board feet of timber annually, half of which is sawed lumber used in industries and for construction, and half is used in rough form for poles, ties, piling, mine timbers, posts, etc. The present annual output of our sawmills is not over 30,000,000 board feet, or one-tenth of the sawed lumber consumed, leaving nine-tenths to be imported. On the other hand, about two-thirds of the round and rough timber used in the State is produced locally. Very little New Jersey timber is exported. Therefore, of the total annual consumption of timber the equivalent of 230,000,000 board feet (38 per cent) is produced within the State and 370,000,000 board feet (62 per cent) is imported. At present freight rates it costs the people of New Jersey each year not less than \$5,000,000 for freight alone on imported timber.

Timber growth and future production.—There is now cut within the State the equivalent of 230,000,000 board feet a year from our 2,000,000 acres of forest land, equal to 115 board feet per acre a year. An annual production of 300 board feet per acre per year is easily possible once the forests are protected from fire and made productive under forestry management. This totals an amount equal to all our present needs. But we are cutting and burning more than is grown, for not over 600,000 acres contain merchantable timber, and it is from that alone that the present supply is derived. At the rate we are now going our merchantable timber will last less than ten years, and when it is gone there will follow a period of several years; longer or shorter as our present policy determines, during which merchantable timber will be very scarce and probably nine-tenths of all that is used will have to be imported. The way to shorten this period of scarcity is to conserve in every way the volunteer young growth with which Nature so generously provides us. None of these calculations assign any specific value to cordwood because we always have an excess of it. Fuel, however, is an important product of the forest and in rural and suburban sections may be a considerable source of income, or of saving, to any forest owner. There is ample evidence that the present high price of coal tends to an increased use of wood fuel. This tendency is encouraged.

Forest values.—These merchantable timber resources have a present stumpage (standing) value of about \$25,000,000—not including the land, though the assessed valuation probably does not exceed one-quarter that amount including the land. In arriving at this estimate 70 per cent of the total area is regarded as having no actual timber value at present, although as the young growth is the foundation of future forests, it has a decided value. The stumpage value of the yearly cut is about \$2,000,000 and the market value of the sawed lumber, poles, ties, etc., about \$10,000,000.

After ten years the annual cut probably will yield not more than one-quarter as much as it now does. Without considering a possible reduction in the forest area it is reasonable and entirely possible to look forward to a time when our woodlands shall have a capitalized value of more than \$200,000,000; an annual net (stumpage) yield of not less than \$10,000,000 and a return measured as manufactured raw products of \$50,000,000. These figures are not guesses but the result of calculations from known facts. Fire control is the chief factor in bringing them to realization.

FOREST FIRES

Only where forests are reasonably safe from damage by fire is the growth of timber possible and the practice of forestry practicable. This condition has been reached in some sections, mainly in North Jersey—where the owners of large tracts of woodland co-operate with the Forest Fire Service. In South Jersey particularly hazardous fire conditions persist. The report of the State Firewarden (p. 71) clearly shows wherein we have succeeded and where failed. That New Jersey methods have been adopted extensively by other states is a tribute to our effort. Nevertheless the strengthening of the service as recommended by the Firewarden cannot be too strongly urged.

FORESTRY GAINING WITH THE PUBLIC

Much time is given to bringing forestry and its aims before the public. Numerous articles have been prepared for the press and for periodicals devoted to conservation. Widely-read journals, like the New York Evening Post and the Country Gentlemen have devoted considerable space to our forestry activities.

Many forestry lectures have been given before various organizations—including teachers' institutes, Boy Scout meetings, Y. M. C. A. camps, County Boards of Agriculture, and the Short Course Agricultural students at Rutgers College. One of our foresters took part in the annual New York meeting of the American Society of Mechanical Engineers, at which a Forest Products section was organized.

The Department's annual exhibit at the Trenton Interstate Fair always produces much favorable comment. This year it included a miniature reproduction of a rural section with farm buildings, fields, improved highways, etc., and a tract of woods illustrating the proper removal from the woodlot of wood needed on the farm, the damage done by forest fires, the recreational advantages of woodland, and similar features. (See fig. 1.)

FORESTRY BY PRIVATE OWNERS

More woodland owners than ever before have asked for advice and assistance. Besides the many inquiries that have been answered by correspondence, the foresters have inspected the properties of nearly fifty woodland owners, and have made recommendations regarding the harvesting and marketing of timber crops, relieving crowded young stands by thinning or selective improvement cuttings, and planting young trees on idle or abandoned fields, or upon tracts where fire has killed all reproduction. It is felt that the practice of forestry by private owners is making most satisfactory progress in New Jersey. There can be no doubt that the advantage is public quite as much as private since every undertaking becomes a demonstration to many observers and a stimulus to other owners. (See figs. 18, 19, and 20.)

100,000 acres more under forestry management.—This year saw the success of a long-time effort to have the 100,000 acres of woodland in Burlington, Atlantic and Camden Counties, belonging to the Wharton Estate, put under management. A forester recommended by the State Forester has been installed and will work with the State organization in maintaining fire control and in the production and marketing of lumber. There is much growing forest on this property whose future is made more promising by this undertaking. With this Wharton property under forest management quite 10 per cent of the total wooded area of New Jersey is on a productive basis. What State does better?

LUMBER MARKETS

Forestry demands and creates good markets. It is practical only when, and to the extent that, forest products can be sold at a profit. Though the general business depression has affected the lumber trade and wood-using industries, there is every likelihood that our local products will find a constant local demand. Ordinarily excellent markets for all kinds of wood products are found within the State or at its borders; railroad, electric, water and highway transport facilities are universal. For several years the extensive cutting of blighted chestnut has tended to glut the market at times with certain



Fig. 18. Road signs attract attention of passers-by.



Fig. 19. Results and reasons for work explained.



Fig. 20. Interior of forest after improvement.

DEMONSTRATION OF PRACTICAL FORESTRY IN ESSEX COUNTY.

products, but with the decline of this salvage, cutting, and a steadily decreasing supply of other merchantable stumpage, demand for most kinds of wood is increasing.

Progress has been made in the survey of wood-using industries, timber resources and markets of the State, although the field to be covered is so large and the Department's force of foresters so small, that it has been impossible to give this important and necessary work the attention it deserves. With more foresters a permanent market study branch can be established, to bridge the gap that now exists between timber growers and timber users, thereby providing better market conditions, encouraging closer utilization and reducing waste. The necessity for this undertaking is found in the fact that the whole country is approaching the time when lumber will be sold at prices bearing some relation to the cost of producing it. The virgin stores of the South and far West will continue to control for some years yet; their handicap of high freights will throw the trade to the eastern states whenever those communities are able to furnish the material. New Jersey's advantage is that besides being close to consuming centers her soils and climate produce trees more rapidly than more northerly locations do.

STATE FORESTS

The State Forests, described in detail on page 62, continue to prove their worth in many ways. On some areas the timber growing under fire protection for the past fifteen years or more is approaching merchantable maturity, and now greatly exceeds in value the original cost of the entire tract. Experimental forest plantations, improvement cuttings, thinnings and growth studies demonstrate forestry practice to the public and yield valuable information to the foresters.

Recreation.—Every year more vacationists use the State Forests for camping, fishing and hunting. The Stokes Forest in Sussex County is especially popular; during the past season upwards of 300 persons used the camp sites which have been prepared in attractive locations, besides a larger number of transient tourists, hikers, hunters and fishermen. Trout furnished by the State Fish and Game Commission have been placed in the mountain streams to improve the fishing, and a number of pheasants liberated in several places.

With limited funds at its disposal, the Department has been unable to provide adequately for the maintenance of the Swartswood Lake tract, and some improvements there are badly needed. A small amount of money spent in improving the State approaches to the lake—particularly the attractive Emmons Grove, will do much to increase the public's use and enjoyment of this popular resort. It is to be hoped that the next Legislature will recognize the State's obligation by providing the necessary appropriation.

It is disappointing that the Department's plans for creating the Kittatinny Forest Park have not yet carried. (See p. 16.) Under State ownership this tract of woodland, wild, mountainous and picturesque, yet so easily accessible to the mass of population, would afford vacations at a low cost to thousands of people who enjoy camping and recreation in the woods. Under the simple forestry management proposed it soon would be self-supporting, and not a burden upon State revenue.

Sales and leases.—Revenue from leases and sales on the State Forests increases slowly because the forest was so degraded when acquired. Small sales of cordwood, ties, logs, cedar poles, moss, etc., the removal of which benefits the forests, yielded nearly \$300, in addition to \$420 rental received for the Washington Crossing farm. Two offers to buy or to lease the Grau farm on the Stokes Forest were declined by the Board because it was thought inadvisable to weaken in any way the Department's control of the whole property.

Considerable blight-killed chestnut on the Stokes Forest was sold to tie-cutters, and every effort is making to dispose of the remaining trees before they decay too much to be merchantable.

Development of the State Forests has been hampered by lack of appropriation. If it were possible to use the funds from sales for carrying on necessary work the value of the forests could be greatly increased within a short time. It is recommended that the Legislature be asked to authorize this.

Fire.—The most severe fire loss in recent years occurred on the Bass River Forest during the June drought, when 400 acres of young timber were burned by a fire that extended over nearly 35,000 acres in that vicinity. Fortunately most of the State Forest burning occurred in a protective "back fire," which was not nearly so destructive as the approaching "head fire" would have been. During the same drought, when the entire South Jersey Forest region was threatened,

fifty acres on the Lebanon Forest and two acres on the Jackson Forest were burned by fires that killed reproduction and young growth, but did little damage to maturing timber. No fire occurred on the Mount Laurel, Penn or Stokes Forests, the two last being well guarded by lookouts. (See p. 76.)

Improvements.—With very limited funds it still has been possible to keep up the properties and to make a few improvements. A new fire lookout tower has been erected on Penn Forest, the old telephone line from Chatsworth repaired, and a new agreement made with the telephone company regarding maintenance and service. Minor repairs also have been made on the buildings and other property on several forests, considerable road work done and direction signs set up at all road and trail intersections. Roads and trails cleared of brush not only make the forests more accessible for tourists, campers, and all users but they facilitate the work of the rangers, and aid greatly in fire protection. On the Stokes Forest nearly a mile of new road construction has opened up several attractive new camp sites, and provided a better approach to the Ranger's headquarters. The new county road from New Lisbon to Four Mile increases the security and value of Lebanon Forest; that and Penn Forest will be further advantaged by the extension of the road through Chatsworth to the shore road in Ocean County.

Experiments and studies.—The use of the State Forests for silviculture experiments and studies continues. Measurements of the timber on Mount Laurel Forest show that following the improvement cutting made in 1911, the excellent growth rate of one cord per acre per year has been maintained. The 1912 thinning in a young oak stand on Lebanon Forest has done equally well, demonstrating that unimproved, crowded stands grow about one-tenth as fast. Other similar experimental cuttings have been made in various types of woodland on Stokes Forest. This work could be greatly extended, and the forests thereby much improved, if receipts from sales were available to pay wages.

The plantations made some years ago on Bass River and Lebanon Forests continue to make creditable growth, and have yielded much valuable information. Southern loblolly pine in particular seems to be a rapid growing and valuable species well adapted to South Jersey conditions. The plantations made in 1919 on Stokes Forest have also done well, and were extended last spring by eight thousand more

Norway spruce, Scotch pine and Black locust. A small nursery was started for growing seedlings for future planting. The following briefly describes the location and character of each State Forest:

<i>Bass River Forest.</i> —Ranger, Samuel B. Allen, New Gretna.....	1,633 acres
Is in Burlington County, six miles northwest of Tuckerton, and is typical of the so-called "pine barrens," now recovering from former severe burnings. Considerable cedar swamp is also found on this tract. A number of experimental forest plantations are developing rapidly.	
<i>Jackson Forest.</i> —Ranger, Jacob A. McKaig, Cassville.....	43 acres
Is in Ocean County, ten miles west of Lakewood on the New Egypt road, near Cassville, and carries a forest of nearly pure pine about forty years old. It is used to demonstrate the methods of practical forestry.	
<i>Lebanon Forest.</i> —Ranger, Victor Bush, Pemberton.....	4,812 acres
Is in Burlington County, nine miles southeast of Pemberton, and contains pine, oak and cedar. Several experimental plantations and more recent thinnings are on it, but it is used largely as a demonstration in fire control under particularly difficult conditions. Considerable fire damage has been suffered since the acquisition of the property, but it is in better condition in every way than when it was acquired.	
<i>Mount Laurel Forest.</i> —Ranger, Harvey Darnell, Moorestown....	21 acres
Is an isolated tract of hardwood and pine in Burlington County, three miles southeast of Moorestown. It is peculiarly accessible and susceptible to forest management, and because of very complete and successful thinning and plantings ten years ago, has unusual value as an example of applied forestry.	
<i>Penn Forest.</i> —Ranger, L. E. Terhune, Chatsworth.....	2,764 acres
Is in Burlington County, six miles southeast of Chatsworth. It is a tract of almost pure pine in the heart of the wilderness. The forest on much of it is in better than average condition and affords a pointed example of the value of fire protection in developing timber growth under typical conditions in "The Pines."	
<i>Stokes Forest.</i> —Ranger, Paul B. Haines, Branchville.....	7,231 acres
Is in Sussex County, three miles west of Branchville. It is typical of absolute forest land in North Jersey. Under fire protection it is rapidly developing in value and it has great possibilities as a park. Roads, trails, and camping sites are being provided as fast as facilities permit. Through recent additions the forest is now easily accessible from the highway in Culver's Gap and is available for use by a limited number of camping parties.	
<i>Swartswood Lake.</i> —Ranger, Paul B. Haines, Branchville.....	560 acres
Is in Sussex County, seven miles northwest of Newton. It consists of Swartswood Lake, with an area of 544 acres, and eight adjacent pieces of upland embracing sixteen acres. It is maintained for the use of the public as a park and recreation spot.	
Total	17,064 acres

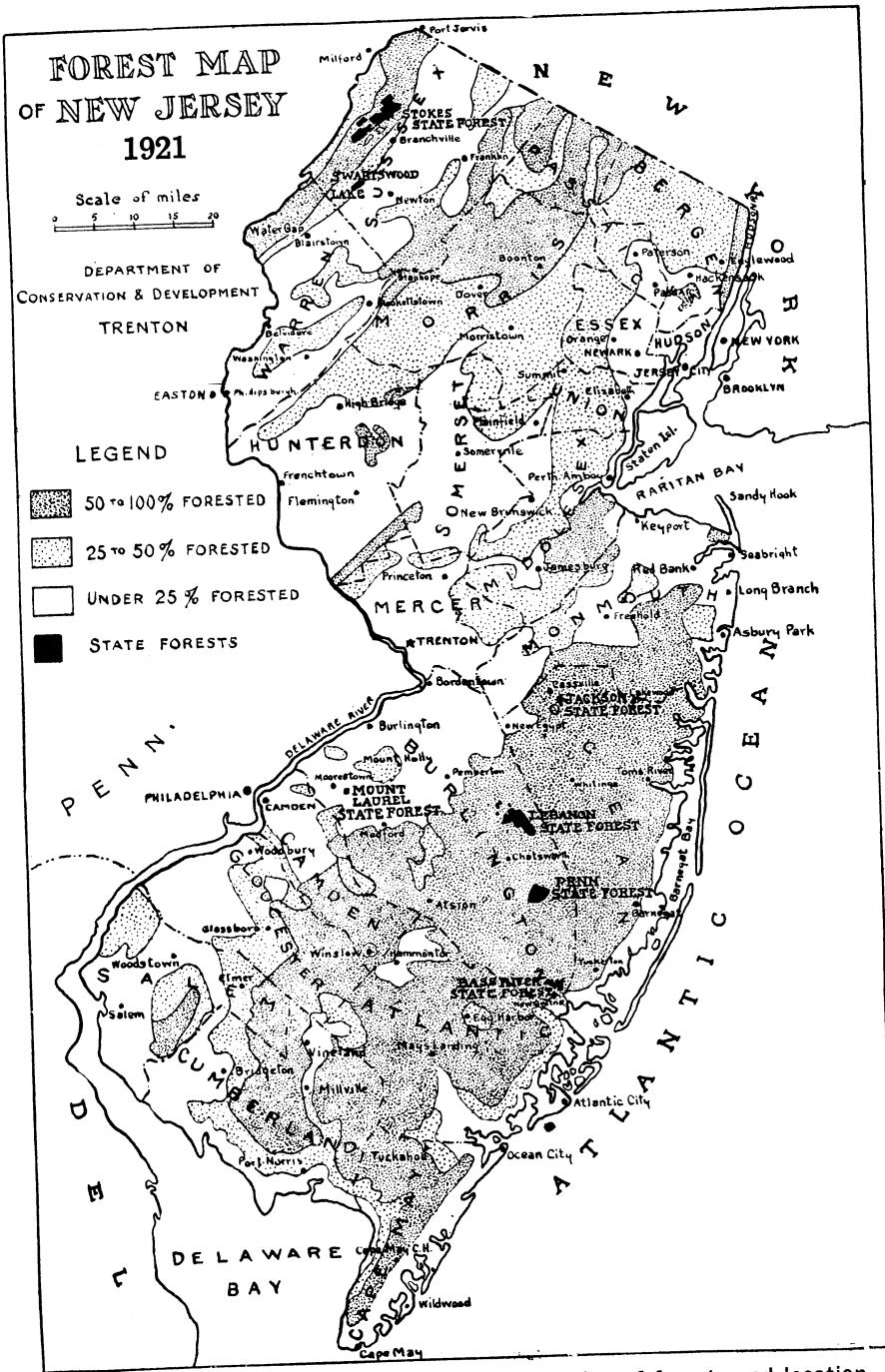


Fig. 21. Map of New Jersey showing distribution of forests and location of State Forests.

SHADE TREES

All over the State interest in, and a growing demand for, more and better cared-for shade trees is manifested. Beautiful shade increases realty values everywhere but it cannot be had unless the trees are given intelligent and systematic care. Many communities have established Shade Tree Commissions under the act of April 14, 1915; regretfully several others have been allowed to lapse. The accompanying table (see p. 64) records the situation in 106 communities reported to the Department.

The Department's foresters have continued to give advice regarding proper care of shade trees, through the mails to all who have sought such information, and by personal visits to municipalities at the request of shade tree commission or similar public organizations. They have been, however, unable to meet all demands, and cannot undertake the more direct and systematic guidance of Shade Tree Commissions that is so much needed. The recommendation that an Arborist be employed for this important work is urgently renewed.

The Shade Tree Commission of Ridgewood, realizing the value of public education and interest in shade tree matters, had the Department's publication, "A Shade Tree Guide," printed in serial form in a local newspaper, and distributed reprints to the public. Other towns took advantage of the opportunity to order reprints of the "Guide" for distribution to interested persons.

The Forester has again laid before the State Highway Commission a strong appeal for the incorporation in its highway program of a provision for the maintenance of roadside shade, partly by planting, but chiefly by caring for native growth. Our municipalities upon the whole are doing well on behalf of their trees; much credit will accrue to road authorities, and much comfort and pleasure to road users, if our open highways are shaded where they now are windswept and sunburned, and their borders trimmed up and parked where they traverse wild woodland. The cost is insignificant; not more than \$400 a mile at the outset and \$100 a year per mile for upkeep. It is impossible to believe that so small an outlay for so great a return is not justified.

SUMMARY OF SHADE TREE COMMISSIONS IN THE STATE, AND THEIR ACTIVITIES

<i>Community</i>	<i>Commission Appointed</i>	<i>Appropriation for 1920</i>	<i>Principal Lines of Work Followed</i>	<i>Special Needs</i>	<i>Executive</i>
Allendale	1912	\$200.00	Pruning, planting.	Improvement of park.	C. H. Quackenbush.
Arlington	1909 (2)				
Asbury Park	1913	750.00	Planting.	Funds for spraying, pruning.	Geo. W. Pittenger.
Atlantic City	1913 (5)	200.00 (4)	Spraying.	Successful trees.	L. A. Steinbricker, Com'r.
Audubon	1915	100.00	Pruning.	Replacing.	Wm. E. Robinson.
Bayonne	1920	12,000.00 (4)	Spraying.	Funds.	H. Hickey, City Forester.
Belleville	1912	900.00	Spraying, planting, pruning, cultivating.	Money for planting.	D. S. Tielon.
Belmar	1911 (2)				
Bergenfield	1920	300.00	Planting, pruning.		
Beverly	1912 (2)			Money for planting.	John A. Smith.
Bloomfield	1909	5,500.00 (4)	Pruning, planting.		
Bogota	1911	500.00	Planting, pruning, spraying.	Spraying, surgery.	C. E. Jameson, Sec. M. W. Stryker.
Bordentown					
Bound Brook	1911	700.00	Mostly pruning.		R. S. Gillespie, Chm.
Bradley Beach		100.00 (4)		Funds.	
Bridgeton	1919	650.00	Removal of bad trees, planting.	Planting.	David C. Jones.
Caldwell	1920	400.00	Trimming, removing dead trees.	Planting and replacing.	Howard E. Wright.
Carlstadt	1911	175.00	Planting, pruning.	Insect control.	Oskar Macher.
Cedar Grove	1915	300.00	Planting, pruning.	Funds.	
Chatham	1909	200.00	Planting, pruning.	Funds.	Harry O. B. Page.
Cranford		1,500.00	Spraying, trimming, replacing.		S. H. Lane, Chm.
Dover	1911	500.00 (4)	Pruning.	Park development.	P. C. Buck, Pres.
Dunellen	1886 (3)		Trimming, cultivating, surgery.	Replacing gas-killed trees.	Geo. T. Bache.
East Orange	1904	13,000.00	Planting, spraying, pruning.		Ernest H. Bennett, Sec.
East Rutherford	1907	600.00	Planting, pruning.	Funds for spraying, planting.	Wm. H. Lenk.
Egg Harbor City	1920	300.00	Planting, pruning, removing.	Funds.	C. E. Hall, Pres.
Elizabeth	(3)	4,000.00 (4)	Spraying.		
Elwood	1921			Protection.	Karl Berselin, Sec.
Emerson	1914	100.00	Planting.	Protection from gas leaks.	Chas. Dulba, Chm.
Franklin	1920	700.00 (4)	Park improvement.		J. T. Downs.

SUMMARY OF SHADE TREE COMMISSIONS IN THE STATE, AND THEIR ACTIVITIES—Continued

<i>Community</i>	<i>Commission Appointed</i>	<i>Appropriation for 1920</i>	<i>Principal Lines of Work Followed</i>	<i>Special Needs</i>	<i>Executive</i>
C Freehold	1916	800.00	Removing dead trees, pruning.	Planting, skilled labor.	Fred B. Howell, Pres. Wm. McAlpine.
	1910	2,000.00 (4)	.....	.....
Garfield	1919	500.00	Trimming.	Planting.	C. L. Johnson, Pres. J. H. Phillips, Sec.
Garwood	1910	1,500.00 (4)	Pruning, replacing old trees.	Funds.	
Glen Ridge	1912	250.00	Planting, pruning.	.....	Joseph H. Applegate. Thomas L. Peck.
Glen Rock	1919 (6)	3,000.00	Spraying, pruning.	More authority.	
Hackensack	1911 (2)	.....	.....	.....	C. O. Davis, Pres. Paul Hueck, Pres.
Haddonfield	1916	300.00	Pruning, planting.	.....
Haddon Heights	1913 (2)	.....	.....	.....	J. M. Basset, Sec. E. C. Stripples.
Haledon	1921	300.00	.....	Insect control.	
Hammonton	1914	50.00	Pruning.	Attention to present trees.	A. K. Goodrich. Jos. S. Cortelyou.
Harrington Park	1911	300.00	Planting, park control.	.....
Hasbrouck Heights	1909	140.00	Pruning.	.....	S. S. McCann, Pres. A. V. Davis.
Haworth	1913 (2)	.....	.....	.....
Hawthorne	1916	100.00	.....	Planting.	E. H. Daly, Sec.
Hightstown	1919	.....	.....	.....
Hillside	(5)	.....	.....	.....	E. F. Keeler, Pres. Geo. Jennings.
Hoboken	1913	200.00	Planting, pruning.	Funds for park work.	
Hobokus	1910	2,511.85	Planting, care of young trees.	Funds.	A. Harry Moore. B. E. Alden.
Irvington	1910 (5)	46,000.00 (4)	Planting, spraying, removing.	Public interest and support.	
Jersey City	1910	4,583.00 (4)	Pruning, planting, spraying.	Nursery.	W. A. Kennedy. Archibald D. Davis, Sec.
Kearny	1918 (3)	300.00	.....	Planting, spraying.	
Leonia	1921	.....	.....	Pruning, planting.	Peter Schrener. F. A. Schneider.
Lakewood	1914 (2)	.....	.....	.....
Lodi	1913	1,500.00	Spraying, planting, pruning.	.....	Harry Hentz, Jr., Bor- ough Forester.
Lynhurst	1907	1,000.00	Spraying, pruning.	Permanent grades on which to plant.	
Madison .....	.....	.....	.....	.....	Rudolph Deinert. S. Byram Smith, Sec.
Matawan	1915 (2)	.....	.....	Planting.	
Maywood	1911	100.00	Spraying, planting, pruning.	Funds, public support.	Alfred L. Ellis.
Merchantville	1912	.....	Spraying, planting, pruning.	Funds to care for old trees.	
Metuchen	1908	300.00	Spraying, planting, pruning.	.....

SUMMARY OF SHADE TREE COMMISSIONS IN THE STATE, AND THEIR ACTIVITIES—Continued

<i>Community</i>	<i>Commission Appointed</i>	<i>Appropriation for 1920</i>	<i>Principal Lines of Work Followed</i>	<i>Special Needs</i>	<i>Executive</i>
Montclair	1909	27,050.00 (4)	Planting, spraying, pruning.	Funds.	Ernest C. Hinck.
Moorestown	1915	500.00	Spraying, pruning.	.....	Dr. Joseph Stokes.
Morristown	1910 (2)	.....	.....	.....	.....
Mount Holly	1914	.....	.....	Public support.	Dr. Chas. Harker, Pres.
Newark	1904 (7)	30,000.00 (4)	Spraying, planting, pruning.	Protection, public support.	Carl Bannwart, Supt.
New Providence	1920	.....	(Not yet organized.)	.....	.....
North Plainfield	1911	.....	Pruning, removing trees.	.....	J. Y. Barrett, St. Com'r.
Nutley	1912	800.00	Pruning, fertilizing, planting.	Funds for planting.	E. H. Dickessen, Chm.
Oaklyn	1918	300.00	Planting, pruning.	Public interest and support.	Samuel Sayre.
Orange	1917 (2)	1,000.00	Pruning.	.....	.....
Passaic	(1)	7,000.00	Pruning, spraying, planting.	Planting.	John R. Johnson.
Palmyra	1913 (2)	.....	.....	.....	F. W. Land, Pres.
Paterson	1921 (1)	.....	Pruning, spraying, planting.	.....	Robt. McCoove.
Pennington	1915 (1)	200.00 (4)	Beautifying park.	Funds, tree surgery.	Geo. W. Sarborough, Sec.
Perth Amboy	1916 (5)	2,500.00	Trimming.	Funds for planting.	M. L. Brown.
Plainfield	1907	2,500.00	Pruning.	More funds.	Andrew J. Gavett, Sec.
Point Pleasant	1910 (2)	.....	.....	.....	.....
Pompton Lakes	1914	.....	Inactive at present.	.....	J. J. Barthoff.
Rahway	1910	950.00	Planting, pruning, tree surgery.	Expert supervision of work.	Eugene Miller, Sec.
Ramsey	1911	.....	.....	.....	Wm. Schroeder.
Ridgefield	1910 (7)	.....	.....	Planting.	J. A. Kiel, Tree Warden.
Ridgefield Park	(2), (7)	.....	.....	Funds to develop park.	C. L. Lensner.
Ridgewood	1915	2,700.00 (4)	Planting, pruning, fertilizing.	.....	.....
River Edge	1913	.....	Pruning, removing dead trees.	Planting.	Wm. Grenor.
Riverton	1911	250.00	Pruning, spraying.	Planting.	C. B. Lewis.
Roosevelt	1917 (2)	.....	.....	.....	Clarence Connors, Pres.
Roselle	1910	500.00	Planting, pruning.	Funds.	N. C. Hofe.
Roselle Park	1911	600.00	Planting, pruning, establish- ment of nursery.	Pruning, old trees.	Oscar Peck.
Rutherford	1909	4,000.00	All kinds.	.....	H. H. Edwards, Pres.
Somerville	1915	400.00	Pruning.	Planting.	Cramer Fisher.

SUMMARY OF SHADE TREE COMMISSIONS IN THE STATE, AND THEIR ACTIVITIES—Continued

<i>Community</i>	<i>Commission Appointed</i>	<i>Appropriation for 1920</i>	<i>Principal Lines of Work Followed</i>	<i>Special Needs</i>	<i>Executive</i>
South Orange	1903	1,400.00	Pruning, spraying.	Funds.	L. J. Conbett.
Summit	(3)		Spraying.		
Tenafly	1910		Spraying, planting, pruning.	Funds.	H. Frank Lock.
Totowa	1914		Spraying, planting, pruning.		M. A. Zeek.
Trenton					Geo. W. Page, Director.
Union	1917 (2)				
Verona	1912	150.00	Pruning.	Funds.	Wm. H. Williams.
Vineland	1906	350.00	Pruning, replacing.	Funds.	Walter H. Blake, Sec.
Wallington	1906 (2)				
Westfield	1905	1,168.00	Planting, pruning.		Supt. of Parks.
West Orange	1918				Jos. Manda.
Westwood	(2), (3)				
Wharton	1914 (2)	150.00 (4)	Grading, pruning.		L. K. Harrison, Pres.
Woodbine	1912 (2)				
Woodbury	1910	450.00	Spraying, trimming.	Planting.	D. F. Hendrickson.
Wood Ridge	1910	400.00	Planting, pruning.	Funds.	Christian Madison.

- (1) Park Commission has charge of shade trees.
- (2) Formerly had commission—no report in 1921.
- (3) Work carried on by committee of council.
- (4) Part devoted to park work.
- (5) Commission government—under Dept. Parks and Public Property.
- (6) No Shade Tree Commission—Improvement Commission.
- (7) Shade Tree Commission extinguished by adoption of commission government.

TREE PESTS

Gypsy moth.—Since this infestation was discovered a year ago control efforts have been prosecuted energetically under the supervision of the State Department of Agriculture, and with a special State appropriation of \$112,000 for the fiscal year 1921, and \$125,000 for the fiscal year 1922, these sums being supplemented by Federal funds. The dry weather during the spring and early summer greatly facilitated the work. Seventy-five tons of arsenate of lead, making 2,700,000 gallons of spray, have been spread by 12 high-power spray machines over 2,400 acres of woods, park and orchards, and 35,000 trees have been banded. With a liberal appropriation available, control work will be energetically pushed next fall in the confident expectation that New Jersey will be spared the experience of New England and the pest be practically held within the area first infested, the neighborhood of Somerville, if it cannot be exterminated.

Japanese beetle.—The work of controlling this pest in Burlington County progresses and the infestation has been confined to a relatively small area.

General.—The early spring following an open winter produced a multiplication of the ordinary ills to which shade and other trees are subject. *Plant lice* in particular were unusually plentiful and caused some wilt of foliage, yet did no permanent harm. The later drought of May and June caused a severe strain upon shade trees in unfavorable situations: heavy foliage trees, like sugar maple, Norway maple, and beech, suffered particularly, and some died. The remedy in all such cases is to curtail the crown by careful pruning and feed the roots by fertilizer applications.

No serious infestation of *white pine blister rust* has been discovered in the State, though the disease is progressing rapidly in New England, New York and westward. The *poplar canker* and *poplar blight* diseases of the stems and leaves of poplar trees have been frequently reported. Neither appears to be serious. The usual visitations of *White-marked Tussock moth*, *Web-worm*, *Sycamore Anthracnose*, etc., were experienced in various sections.

In June a press bulletin was issued stating that though many tree pests had been reported, there is nothing serious (except Gypsy Moth) now affecting our shade and forest trees, the *chestnut blight* having almost run its course.



Fig. 22. The Plains, the only part of New Jersey's upland that produces no true forest.



Fig. 23. Fire, not Nature, is the reason for the absence of forest here.

THE PLAINS

For many years the areas in southeastern Burlington and southwestern Ocean Counties known as "The Plains" have given rise to much speculation, and some investigation, concerning the reason for the absence of normally developed tree growth. The Plains are in no sense typical of that portion of the State known as the "pine belt," but are in fact different from every other locality in that the trees, though of the common, local species, chiefly pitch pine and scrub oak, are stunted, or prostrate, and rarely more than six feet high. There are three clearly defined areas—one lying about three miles north of the east branch of Wading River—another about one mile south of the same stream, and a third much smaller, southwest of the first. A recent survey outlined the three acres with reasonable exactness and determined their content at no more than 12,278 acres. This is considerably less than earlier estimates.

The cause of the conditions here found has been variously ascribed to repeated forest fires; to adverse climatic factors; to deleterious soil conditions; to impervious earth strata. The rather desultory studies that the Department has been able to make from time to time fail to support any of these theories as sufficient to cause the conditions observed; yet clearly there is something in the location not yet discovered to account for the retarded character of the vegetation. Superficially the soil is of fair quality yet its unavailability for agriculture is amply established. The Department hopes to solve this problem, partly as a purely scientific one, but chiefly because it is important to determine whether or not this territory must be permanently classed as totally unproductive and valueless.

STATE AID

The Department offers to assist through its foresters anyone, individual or public body, that asks for advice about forests or shade trees. Unfortunately this service is limited by lack of foresters but help can be and is given by mail upon the basis of an intimate knowledge of conditions. In some cases special inspections and advice can be provided for. The cost is nominal. Correspondence is invited.

PERSONNEL

Few changes have been made in the organization of the Division of Forestry and Parks. It now includes the State Forester and two assistant foresters, six rangers in charge of the State forests, a State Firewarden with four Division Firewardens as assistants, seven watchmen for the forest fire lookout towers, and about 400 locally appointed firewardens. Five professional foresters are included in this personnel. From four to ten men also are employed at hazardous times in North Jersey and paid from Federal funds. It was necessary to dismiss the ranger of the Penn State Forest during the winter for a violation of the game law. The vacancy has been filled.

THE FUTURE

Though it is believed that New Jersey's effort in forestry is on a substantial basis, there is abundant room for growth. The needs of the forest fire service are paramount. The next most important provision is for a forester who shall devote his whole time to advising and aiding local shade tree commissions and other tree interests. There is needed, also, another forester to work continuously with the owners of small woodlands with a view to making those lands more productive than they now are. The Federal Government offers to match the State appropriation for this latter undertaking.

Report of the State Firewarden

C. P. WILBER

To conform with the natural division of the fire season, and with similar statistics for the entire country, the tabular and statistical matter following are for the *calendar* year 1920. The general statement of conditions and progress is for the fiscal year July 1, 1920, to June 30, 1921.

THE FIRE SEASON

January and February, 1920, were months of unusually severe winter weather, and this condition continued well into March and April, retarding normal spring development much more than usual. May also was a backward month because of cool weather. Because of these conditions, there were practically no fires until well into March, but the spring season was exceptionally dangerous because of delayed foliation, with dry weather and high winds. The natural reflection of these conditions, concurrent with the regular widespread use of fire for cleaning up in the springtime, is a record of many forest fires during late March, April and May. The fact that 74 per cent of all fires for the year burned in these three months, once more emphasizes the peculiar danger of this season, and the need for more adequate means of meeting a situation which recurs year after year without adequate facilities for its control. (See p. 74.) From June until the end of the calendar year, weather conditions were extremely favorable. Rainfall was plentiful, and was unusually frequent, so that few fires were started, and practically none were serious.

The spring of 1921 was more troublesome than the average, because of dry weather and high winds. The number of fires started was large, and a large number reached serious proportions. Late May and June developed a drouth of abnormal intensity and duration,

and equally unusual because of the season of its occurrence. The fire menace was, of course, cumulative in its severity, reaching its climax at the end of June, during which period a fire season, as severe as any yet on record, developed a condition with which the Fire Service organization, as at present constituted, was inadequate to deal. By general order, issuance of fire permits for any purpose was discontinued throughout the State, but, despite this precaution, with a general public appeal for special caution, special preventive efforts by railroad organizations, and the untiring activity of the firewardens, fires were so numerous that many got beyond control. In this short period, fires, varying in size from 100 acres to 40,000 acres, did damage greater than is usually done in twelve months or more. Only the most heroic work saved many threatened homes, towns and industrial plants from destruction.

FOREST FIRES BY MONTHS, CALENDAR YEAR 1920

<i>Month.</i>	<i>Number of Fires</i>	<i>Per Cent of Total</i>	<i>Month.</i>	<i>Number of Fires</i>	<i>Per Cent of Total</i>
January	2	..	July	14	2
February	1	..	August	1	..
March	135	24	September	6	1
April	197	35	October	10	2
May	137	25	November	22	4
June ..	27	5	December	11	2

NUMBER AND AREAS OF FIRES

(See Tables 1 and 2)

Reports of 554 fires have been received for the calendar year 1920. This is less than the average for the last ten years, and fewer than in the preceding year. Of these, 161 or 29 per cent were stopped before they had burned two acres, 325 or 59 per cent burned less than ten acres, and only 12 per cent burned more than 100 acres. The average area per fire was 64 acres, a lower figure than for any year since the record has been reasonably complete. The total area burned was 35,497 acres, also a new low record. While not minimizing the activity of the Fire Service in helping to bring about these results, it should be stated that (except in the spring months), weather and climatic conditions were abnormally helpful in preventing fire



Figs. 24 to 25. A reason why we have pine scrub instead of fine forests.

throughout the year. Therefore, while the result is extremely gratifying, it does not measure the true status of the organization in its preparedness to meet a serious fire season.

The reported money damage done by forest fire was \$244,942 in 1920, or an average of \$442 per fire. This represents a leak in the public resources that can and should be stopped. The material increase in these figures as compared with the same items in previous years does mean that the loss has been greater, but that the facilities for determining the toll taken by forest fires are improving in accuracy and completeness. In fact the figures given presumably largely understate the actual damage still, though they are more nearly accurate than heretofore.

CAUSES OF FIRES

(See Table 3).

There is practically no record of forest fires in New Jersey from natural causes, such as lightning. This means that people are responsible for the whole trouble. Fires are started sometimes through ignorance, sometimes through carelessness, sometimes through indifference, very rarely by intention, but always because of someone.

During 1920, steam railroad operation has been responsible for 197 fires, or 35 per cent of the total, as against 29 per cent in the preceding year. This situation apparently is largely explained by incomplete or poorly timed work in cleaning railroad fire lines which has since been given attention by the railroad companies. Brush burning, camp fires and similar use of fire started 60 fires, or 10 per cent of the total, a lower proportion than the 15 per cent of last year. Smokers' fires recorded number 39, or 6 per cent, as compared with 15 per cent the previous year. From other miscellaneous causes 35 fires have originated, or 6 per cent of the total. For 223 cases, or 42 per cent of the fires reported, the cause is not definitely known. The great majority of these recorded "unknown" unquestionably would be charged to smokers if the facts were known.

THE FOREST FIRE SERVICE

The outstanding feature of the organization as now constituted is its inadequacy to cope with severe conditions. As long as adequate fire lookout facilities are lacking, so long will fire have opportunity to gain dangerous headway before discovery and attention. As long as reasonable provision for State supervision of the fire-fighting is denied, so long will accident, misunderstanding, poor communication, and lack of co-ordination continue locally to maintain conditions under which fire can and will get beyond the control of a semi-volunteer fire-fighting force. The willingness, activity and efficiency of the local firewarden force has often been referred to and commended. There is now no disposition to, nor justification for, retracting this previous opinion. However, it has been said with equal emphasis heretofore, that under the stress of severe fire conditions of drouth, wind, etc., the present force as organized, could not be expected to be satisfactory. And such conditions are not the exception. Each spring the situation recurs, and in the normal year, is met again during the summer or fall, while periodically a real crisis develops, as, for instance, that just past, in June, 1921. To prevent these setbacks, which undo locally the previous careful and successful protective work of many seasons, there must be an addition to the State's force of wardens, and an adequate lookout service. The present system is not sufficient for any but the more favorable seasons, and a fire-fighting force must be prepared for unfavorable or even abnormal situations. Failure at such periods nullifies to a large degree any long-continued success. An adequate plan and program has been prepared, and is waiting for the possibility of its inauguration in New Jersey's forest fire work. Too great emphasis cannot be laid upon the need for its adoption at once.

Personnel.—The vacancy in the North Jersey Division Wardenship was filled late in 1920, after considerable difficulty in locating a qualified applicant at the salary which it was possible to offer. The work in this territory, which had been carried on too long, and with real inconvenience, from the Trenton office, therefore has been again put upon its normal footing. Complete changes in the local force in several municipalities have strengthened the local organization. These changes, however, represent only 15 per cent of the total of 364

wardens who served in 1920, indicating an increased stability in the organization, the advantage of which is obvious. The work of the Fire Service covered 167 townships in 1920, embracing practically the entire forested area of the State, save where its suburban, park or small isolated woodlot character makes the fire protection problem a minor factor, or where the situation is obviously not a forest problem. The service was extended to but one new municipality, West Point Pleasant, Ocean County, which was created as a new borough by partition from Brick Township.

Education and publications.—Through the initiative of the Fire Service, a special chapter on forest fire prevention was prepared by the Fire Service, and inserted by the National Board of Fire Underwriters in their manual "The Teaching of Fire Prevention," a special edition of which was issued for the State Department of Public Instruction, for use in the schools of the State, in compliance with Chapter 118, laws of 1920, requiring systematic instruction in fire prevention in the schools. In addition to the publication of the annual "List of Firewardens," a booklet "Fighting Forest Fires," dealing with the fire situation, and describing the behavior of and methods of controlling forest fires, has been published. Through the co-operation of the County School Superintendents, and Boy Scout officials, the publication was widely distributed among the school teachers and leaders in boys' work, and the demand within the State was so great that the edition was almost at once exhausted, to the exclusion of a large number of requests from outside New Jersey. The booklet "Fires For Fun," issued a year ago, and likewise immediately exhausted, has been reprinted, and still further distributed. The New Jersey Fire Service originated a movement, and co-operated with the U. S. Forest Service in arranging, for the inserting of forest fire warning notices in all the ammunition boxes packed by two of the largest manufacturers in the country. This provides an extremely valuable means of reaching all sportsmen with a word of caution, which will apparently become more general and therefore more valuable by the action of other companies shortly. Souvenir postal cards were printed for two of the fire lookout stations, and the supply exhausted by the demands of visitors before the close of the 1920 season. In place of a general State fire poster, heretofore distributed by the State's wardens, special posters, dealing with the local situation in detail, has been prepared and distributed in eight townships where the local conditions has been partic-

ularly backward. The work of the Fire Service, and the need for continuous and general public care to prevent forest fire, has been presented in talks to numerous groups of Boy Scouts, Cranberry Growers, Public School Teachers, Summer Campers, etc.

Lookouts.—The seven lookout stations previously in commission, were in operation throughout the season, and have effectively assisted in the control of fire in their respective localities. The number of visitors at these towers has continued to increase as knowledge of them has become more general. The annual registration at each station varied from 100 to 1,000 with the accessibility of the towers. A new wooden tower, erected by the State's employees during the winter, was opened for service on the Penn State Forest in March, 1920, making a badly needed and very valuable point of control in the heart of the eastern Burlington County wilderness. A steel tower has been erected and opened at Blue Anchor, Camden County, making a total of nine active lookouts now in operation. It is still necessary to point out the need for means to install a complete system of fire lookouts, and urge that such provision be made, for the reason indicated on p. 74.

Federal co-operation.—The Federal Forest Service, under the "Weeks Law," has continued the allotment of funds for payment of lookout and patrol salaries. The sum available for the past year has been \$2,500, an increase of \$500 over the previous allotments. Under the terms of the law, the funds are available for use in North Jersey only. At the request of the Federal authorities the funds for this co-operation are now deposited to the credit of this Department in the State Treasury for disbursement by the Fire Service like funds from a State appropriation, thereby materially simplifying the work of administering the funds.

Without these funds, the operation of even the present lookout system would have been impossible. The value of the Federal co-operation is tremendous, not only in the actual fire control resulting, but because of the practical demonstration it makes possible of the efficiency of lookout and patrol as fire preventive measures. The increased number of lookout stations without State provision for manning them, has necessitated the diversion of nearly the whole Federal allotment to lookout maintenance. Therefore, but one patrolman, covering a large territory by motor, was employed for the most dangerous month of the fall season, 1920.



Penn Forest Fire Lookout.



Blue Anchor Forest Fire Lookout.



Figs. 26 to 28. Two new fire lookout towers and a part of the country they guard.

Fire-Prevention Day.—By proclamation of the Governor, October 9 was declared Fire Prevention Day in conformity with its National observance in this way. Through the press and in the public schools special emphasis was laid on forest protection at this time. Similarly the week of May 22-28 was observed as Forest Protection Week in the State and throughout the Country, with still more widespread emphasis upon the need for and possibility of adequate protection for the forest resources.

VIOLATIONS OF THE LAW

(See Tables 4 and 5)

During 1920, responsibility for 278, or 50 per cent of the total fires reported for the year, has been fixed. In 35 cases, technical violations of the permit law have been dealt with. This definite knowledge of how, when and by whom fires start serves a double purpose of pointing out the times, the places and the classes of danger so that preventive measures may be taken to avoid their repetition, and, by reason of the penalties imposed serves of itself as an effective deterrent to careless, ignorant or indifferent use of fire. Of the total violations, 67 per cent were railroad fires, and 33 per cent came from other causes. Of the year's cases, 186, or 67 per cent, have been finally disposed of, and of the 92 cases remaining open from previous years, but 30 remained unsettled on January 1, 1921. The penalties collected during the year 1920, amounted to \$1,813.33, of which the railroads paid \$1,100.12, and other agencies, \$713.21.

TABLE 1—FOREST FIRES IN CALENDAR YEAR 1920 AND IN PREVIOUS YEARS

YEARS	No. of Fires	Total Acres Burned	Acres per Fire	Total Loss	Loss Per Fire
No organized service, incomplete reports					
1872		100,000		\$1,000,000	
1880	54	71,074	1,316	252,240	\$4,671
1885		128,000		1,128,000	
1895	49	66,120	1,349	600,000	12,245
1902	65	98,850	1,520	169,323	2,605
1903	79	85,046	1,076	305,744	3,870
1904	81	41,530	512	193,413	2,388

Organized fire service

1907	167	11,525	69	11,647	70
1908	533	52,978	100	64,536	121
1909	563	93,525	166	133,944	238
1910	611	81,452	133	127,850	209
1911, Forest Fires	289	64,404	122	86,940	165
Embryo Fires†	239				
1912, Forest Fires	214	26,291	48	21,501	39
Embryo Fires†	331				
1913, Forest Fires	311	53,823	77	67,205	99
Embryo Fires†	367				
1914, Forest Fires	396	78,655	92	83,880	99
Embryo Fires†	451				
1915, Forest Fires	549	150,258	147	209,090	207
Embryo Fires†	467				
1916, Forest Fires	269	51,654	88	69,001	118
Embryo Fires†	314				
1917, Forest Fires	486	92,479	106	79,335	90
Embryo Fires†	385				
1918, Forest Fires	567	67,272	85	69,835	88
Embryo Fires*	229				
1919, Forest Fires	443	46,927	77	63,638	105
Embryo Fires*	164				
1920, Forest Fires	393	35,497	64	‡244,942	‡442
Embryo Fires*	161				

† Burned less than 5 acres.

* Burned less than 2 acres.

‡ See page 71.

FIREWARDEN'S REPORT.

TABLE 2—FOREST FIRES BY RELATIVE AREA BURNED, AND BY COUNTIES, CALENDAR YEAR 1920

COUNTY	NUMBER OF FOREST FIRES					Total Embryo Fires (less than 2 acres)
	2-10 Acres	11-100 Acres	101-1,000 Acres	Over 1,000 Acres	Total	
<i>North Jersey—</i>						
Bergen	21	9	1	.....	31	15
Hunterdon .....	.....	1	.....	.....	1	.....
Morris	13	17	6	.....	36	11
Passaic	12	12	2	.....	26	11
Somerset	5	2	.....	.....	7	11
Sussex	5	5	2	.....	12	8
Union	3	2	.....	.....	5	1
Warren	3	3	.....	.....	6	3
Totals	62	51	11	.....	124	60
<i>South Jersey—</i>						
Atlantic	26	31	18	1	76	29
Burlington	11	1	5	1	18	2
Camden	7	6	4	.....	17	9
Cape May	7	9	4	2	22	14
Cumberland	20	21	6	1	48	20
Gloucester	3	8	4	1	16	3
Mercer	1	.....	.....	.....	1	.....
Middlesex	7	5	1	.....	13	2
Monmouth	10	10	3	.....	23	2
Ocean	8	15	4	.....	27	19
Salem	2	3	1	.....	6	1
Fires that burned in more than 1 county, .....	.....	.....	1	1	2	.....
Totals	102	109	51	7	269	101
State totals ...	164	160	62	7	393	161
Per cent of State totals	30	29	11	1	71	29

TABLE 3—FOREST FIRES BY CAUSES AND COUNTIES, CALENDAR YEAR 1920

COUNTY	NUMBER										Totals	
	Locomotive		Brush Burning		Smokers		Miscellaneous		Unknown			
	FF	eF	FF	eF	FF	eF	FF	eF	FF	eF	FF	eF
<i>North Jersey—</i>												
Bergen	10	12	6	1	2	.....	1	.....	12	2	31	15
Hunterdon .....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	1	.....
Morris	10	4	2	.....	8	2	1	1	15	4	36	11
Passaic	14	4	.....	2	5	1	1	.....	6	4	26	11
Somerset .....	.....	.....	2	5	2	2	.....	1	3	3	7	11
Sussex	3	3	2	.....	.....	1	.....	2	7	2	12	8
Union .....	.....	.....	.....	.....	.....	.....	.....	.....	5	1	5	1
Warren	4	2	.....	.....	1	.....	1	.....	.....	1	6	3
Totals	41	25	13	8	18	6	4	4	48	17	124	60
<i>South Jersey—</i>												
Atlantic	32	17	11	.....	6	.....	6	2	21	10	76	29
Burlington	5	1	3	1	1	.....	2	.....	7	.....	18	2
Camden	6	9	.....	.....	.....	.....	1	.....	10	.....	17	9
Cape May	8	7	1	3	.....	1	.....	.....	13	3	22	14
Cumberland	7	3	6	1	1	1	4	7	30	8	48	20
Gloucester	5	1	5	.....	.....	.....	1	.....	5	2	16	3
Mercer .....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	.....
Middlesex	1	.....	.....	.....	.....	.....	.....	.....	12	2	13	2
Monmouth	9	.....	.....	.....	1	.....	2	.....	11	2	23	2
Ocean	7	11	3	2	3	1	1	1	13	4	27	19
Salem	2	.....	2	.....	.....	.....	.....	.....	2	1	6	1
Fires that burned in more than 1 county .....	.....	.....	1	.....	.....	.....	.....	.....	1	.....	2	.....
Totals	82	49	32	7	12	3	17	10	126	32	269	101
State totals .	123	74	45	15	30	9	21	14	174	49	393	161
Per cent of State totals	35	10	7	6	42	71	29					

FF—Forest Fires.

eF—Embryo Fires (less than 2 acres).

TABLE 4—VIOLATIONS OF THE FIRE LAW, CALENDAR YEAR 1920

CAUSE	Pending	Settled	Total
	Jan. 1, 1921	Jan. 1, 1921	
Brush burning and camp fires	19	62	81
Careless smoking .....	.....	3	3
Miscellaneous	2	7	9
Total	21	72	93
Erie R. R.	7	20	27
D., L. and W. R. R.	1	5	6
Morristown and Erie R. R.	1	4	5
N. J. Central R. R.	10	21	31
N. Y., S. and W. R. R.	6	17	23
Penn. R. R.	43	24	67
Reading R. R.	3	21	24
Tuckerton R. R. ....	.....	2	2
Total R. R.	71	114	185
Total all causes	92	186	278
Per cent of total	33	67	.....

TABLE 5—SUMMARY OF PENALTY WORK DONE, CALENDAR YEAR 1920

YEAR OF ORIGIN	Railroad Cases			Cases From Other Causes			Totals		
	Pending Jan. 1, 1921	Settled Jan. 1, 1921	Total	Pending Jan. 1, 1921	Settled Jan. 1, 1921	Total	Pending Jan. 1, 1921	Settled Jan. 1, 1921	Total
1920 cases	71	114	185	21	72	93	92	186	278
1919 cases	17	21	38	3	27	30	20	48	68
1918 cases	8	11	19	1	3	4	9	14	23
1917 cases .....	.....	.....	.....	1	.....	1	1	.....	1
Total	96	146	242	26	102	128	122	248	370
Per cent of total	40	60	.....	20	80	.....	33	67	.....

TABLE 6—FOREST FIRES BY COUNTIES AND TOWNSHIPS, CALENDAR YEAR 1920

COUNTY AND TOWNSHIP	Number		Acres Burned	Loss to Forests and Other Property	Cost to Extinguish	Paid by †		
	Forest Fires	Embryo Fires				Township	State	Offenders
<i>Atlantic County—</i>								
Absecon (City) ..								
Buena Vista	9	1	894	\$5,720	\$191.73	\$74.04	\$74.04	\$45.20
Egg Harbor	15	3	1,489	10,214	362.90	152.45	152.45	58.00
Egg Harbor (City)	2	4	303	2,103	110.55	55.28	55.27	.....
Folsom								
Galloway	19	10	1,824	12,271	454.22	157.83	157.82	140.57
Hamilton	10	5	1,320	9,198	211.10	95.25	95.25	20.60
Hammonton	3	.....	450	3,290	91.50	37.00	37.00	64.00
Linwood .....	.....	1	.....	.....	5.00	.....	.....	5.00
Mullica	11	1	2,229	14,320	175.20	66.34	66.36	67.50
Northfield (City) .	.....	.....	.....	.....	.....	.....	.....	.....
Pleasantville .....	.....	.....	.....	.....	.....	.....	.....	.....
Port Republic .....	.....	.....	.....	.....	.....	.....	.....	20.00
Somers Point .....	.....	.....	.....	.....	.....	.....	.....	.....
Weymouth	8	4	402	2,922	116.50	56.40	56.40	10.00
Total	77	29	8,911	\$60,038	\$1,718.70	\$694.59	\$694.59	\$430.87
<i>Bergen County—</i>								
Franklin	4	5	137	\$771	\$78.80	\$21.90	\$21.90	\$35.00
Hillsdale	9	5	69	491	67.50	24.25	24.25	19.00
Hohokus	2	.....	8	59	12.70	6.35	6.35	.....
Montvale (Boro.)	3	1	73	310	49.10	4.00	4.00	41.10
Oakland (Boro.) .	5	2	42	293	46.50	.....	.....	46.50
Park Ridge (Boro.)	3	1	11	80	19.00	4.50	4.50	10.00
Ridgefield (Boro.)	1	1	5	25	6.00	3.00	3.00	.....
Washington	1	.....	125	760	9.00	4.50	4.50	.....
Woodcliffe Lake ..	3	.....	33	224	25.00	9.00	9.00	7.00
Total	31	15	503	\$3,013	\$313.60	\$77.50	\$77.50	\$158.60
<i>Burlington County—</i>								
Bass River	2	.....	200	\$1,500	\$38.50	\$19.25	\$19.25	.....
Evesham	2	.....	310	1,550	149.45	11.35	11.35	\$126.75
Medford	1	1	4	8,500	44.30	20.15	20.15	10.00
New Hanover .....	.....	.....	.....	.....	.....	.....	.....	.....
Pemberton	4	.....	21	602	24.00	3.00	3.00	18.00
Shamong	2	1	5	50	56.10	28.05	28.05	.....
Southampton	3	.....	361	2,680	38.20	19.10	19.10	.....
Tabernacle	3	.....	954	6,330	50.60	25.30	25.30	.....
Washington	1	.....	200	1,870	54.00	27.00	27.00	.....
Woodland	2	.....	750	3,710	72.80	36.40	36.40	.....
Total	20	2	2,805	\$26,792	\$527.95	\$189.60	\$189.60	\$154.75

TABLE 6—FOREST FIRES BY COUNTIES AND TOWNSHIPS, CALENDAR YEAR 1920—Continued

COUNTY AND TOWNSHIP	Number		Acres Burned	Loss to Forests and Other Property	Cost to Extinguish	Paid by †		
	Forest Fires	Embryo Fires				Township	State	Offenders
<i>Camden County—</i>								
Berlin	1	.....	20	\$150	\$17.60	\$8.80	\$8.80	.....
Chesilhurst (Boro.)	1	1	10	.70	16.60	5.80	5.80	\$5.00
Clementon .....	.....	.....	.....	.....	.....	.....	.....	.....
Delaware .....	.....	.....	.....	.....	.....	.....	.....	.....
Gloucester	6	.....	282	1,104	62.65	29.37	29.38	3.90
Voorhees	1	.....	.....	.....	21.15	10.57	10.58	.....
Waterford	4	2	1,600	8,100	190.10	70.55	70.55	59.00
Winslow	5	6	351	3,470	150.15	62.25	62.25	45.65
Total	18	9	2,263	\$12,894	\$458.25	\$187.34	\$187.36	\$113.55
<i>Cape May County—</i>								
Dennis	3	.....	1,336	\$7,640	\$318.85	\$159.42	\$159.43	.....
Lower	2	2	6	144	20.80	2.90	2.90	\$15.00
Middle	8	11	440	2,868	401.50	53.51	53.51	294.60
Upper	5	1	1,810	7,830	185.33	92.66	92.67	.....
Woodbine (Boro.)	4	1	325	1,220	71.65	35.83	35.82	.....
Total	22	15	3,917	\$19,702	\$998.13	\$344.32	\$344.33	\$309.60
<i>Cumberland County—</i>								
Commercial	1	.....	500	\$3,975	\$62.30	\$31.15	\$31.15	.....
Deerfield	5	.....	112	1,712	63.70	30.10	30.10	\$3.50
Downe	2	.....	2,005	7,050	189.90	94.95	94.95	.....
Fairfield	2	.....	250	1,980	85.90	27.60	27.60	32.00
Hopewell .....	.....	.....	.....	.....	.....	.....	.....	.....
Landis	11	3	597	3,770	182.25	80.50	80.50	.....
Lawrence	1	1	800	6,591	87.80	43.90	43.90	.....
Maurice River	2	2	21	311	33.70	16.85	16.85	.....
Millville (City) ..	25	14	720	4,813	542.90	242.45	242.45	83.00
Total	49	20	5,005	\$30,202	\$1,248.45	\$567.50	\$567.50	\$118.50
<i>Gloucester County—</i>								
Clayton (Boro.) ..	.....	.....	.....	.....	.....	.....	.....	.....
Elk .....	.....	1	.....	\$10	\$4.00	.....	.....	\$4.00
Franklin	13	.....	4,060	31,072	216.35	\$57.87	\$57.88	116.00
Monroe	3	2	135	1,321	29.50	5.50	5.50	18.50
Washington	1	.....	42	221	38.50	19.25	19.25	.....
Total	17	3	4,237	\$32,624	\$288.35	\$82.62	\$82.63	\$138.50

TABLE 6—FOREST FIRES BY COUNTIES AND TOWNSHIPS, CALENDAR YEAR 1920—Continued

COUNTY AND TOWNSHIP	Number		Acres Burned	Loss to Forests and Other Property	Cost to Extinguish	Paid by †		
	Forest Fires	Embryo Fires				Township	State	Offenders
<i>Hunterdon County—</i>								
Alexandria								
Bethlehem								
Clinton								
Delaware								
East Amwell								
Franklin								
Holland								
Kingwood								
Lebanon								
Tewksbury								
West Amwell	1		12	\$136	\$6.20			\$10.00
Total	1		12	\$136	\$6.20			\$10.00
<i>Mercer County—</i>								
Hopewell								
Princeton	1		5	\$35	\$8.00	\$4.00	\$4.00	
Total	1		5	\$35	\$8.00	\$4.00	\$4.00	
<i>Middlesex County—</i>								
East Brunswick ..	2		180	\$970	\$15.50	\$7.75	\$7.75	
Madison	1		40	240	18.50	9.25	9.25	
Monroe	6		333	2,121	52.90	26.45	26.45	
Sayreville	4	2	16	128	28.65	14.33	14.32	
South Brunswick ..								
Spotswood (Boro.) ..								
Total	13	2	569	\$3,450	\$115.55	\$57.78	\$57.77	
<i>Monmouth County—</i>								
Atlantic	5		465	\$4,120	\$104.25	\$5.50	\$5.50	\$93.25
Freehold	7	1	235	1,980	96.60	48.30	48.30	
Howell	10	1	151	2,069	149.90	57.20	57.20	35.50
Middletown								
Ocean	1		7	335	28.00	14.00	14.00	
Shrewsbury	1		36	270	27.50			27.50
Wall								
Total	24	2	894	\$8,774	\$406.25	\$125.00	\$125.00	\$156.25

TABLE 6—FOREST FIRES BY COUNTIES AND TOWNSHIPS, CALENDAR YEAR 1920—Continued

COUNTY AND TOWNSHIP	Number		Acres Burned	Loss to Forests and Other Property	Cost to Extinguish	Paid by †		
	Forest Fires	Embryo Fires				Township	State	Offenders
<i>Morris County—</i>								
Boonton	1		100	\$700				
Chester	2	1	42	310	\$48.00	\$24.00	\$24.00	
Denville	9	4	130	1,101	125.30	40.40	40.40	54.50
Hanover	5	3	446	5,253	153.55	58.48	58.47	36.60
Jefferson	1	1	15	200	45.00	22.50	22.50	
Mendham	1		20	307	8.00			10.00
Montville	2		83	603	33.10	16.55	16.55	
Morris	1	1	70	750	58.70	29.35	29.35	
Mt. Arlington								
Mt. Olive								
Passaic								
Pequanock	2		131	1,158	69.30	34.65	34.65	
Randolph	1		10	90	13.00			15.00
Rockaway	1		200	1,200	35.10	17.55	17.55	
Roxbury	9	1	845	5,232	365.30	118.50	118.50	128.30
Washington	1		20	186	25.70	12.85	12.85	
Total	36	11	2,112	\$17,090	\$980.05	\$374.83	\$374.82	\$244.40
<i>Ocean County—</i>								
Beachwood (Boro.)		1			\$7.00			\$25.00
Berkeley	3	2	16	\$250	43.10	\$19.55	\$19.55	4.00
Brick	1		50	350	27.60	13.80	13.80	
Dover	2	1	53	521	39.20	8.50	8.50	50.00
Eagleswood	3		95	840	88.15	40.08	40.07	16.00
Jackson	8		1,340	7,490	226.45	99.00	99.00	28.45
Lacey		6			35.00	17.50	17.50	
Lakewood	3		53	604	29.00	14.50	14.50	
Little Egg Harbor								
Manchester	7	5	482	3,520	78.10	15.75	15.75	46.60
Ocean		1			4.00	2.00	2.00	
Ocean Gate		1			9.00			9.00
Plumstead								
Pt. Pleasant (Boro.)								
Stafford	2			10	35.40	17.70	17.70	
Union	2		24	193	30.70	15.35	15.35	
Total	29	19	2,113	\$13,778	\$652.70	\$263.73	\$263.72	\$179.05
<i>Passaic County—</i>								
Bloom'gdale (Boro.)								\$10.00
Ringwood (Boro.)	18	5	328	\$2,690	\$383.80	\$116.15	\$116.15	151.50
Wanaque (Boro.)	3	3	25	178	74.50	27.75	27.75	10.00
West Milford	5	3	225	2,124	167.55	36.32	36.33	104.90
Total	26	11	578	\$4,992	\$625.85	\$180.22	\$180.23	\$276.40

TABLE 6—FOREST FIRES BY COUNTIES AND TOWNSHIPS, CALENDAR YEAR 1920—Continued

COUNTY AND TOWNSHIP	Number		Acres Burned	Loss to Forests and Other Property	Cost to Extinguish	Paid by †		
	Forest Fires	Embryo Fires				Township	State	Offenders
<i>Salem County—</i>								
Alloway		1			\$7.00	\$3.50	\$3.50	
L. Alloways Cr. . .								
Pittsgrove	3		113	\$712	28.72	3.05	3.05	\$50.62
Quinton	3		412	3,095	81.10	32.05	32.05	17.00
Upper Pittsgrove .								
Total	6	1	525	\$3,807	\$116.82	\$38.60	\$38.60	\$67.62
<i>Somerset County—</i>								
Bernard	3	4	9	\$345	\$104.30	\$19.50	\$19.50	\$75.00
Bridgewater	2	3	85	811	62.95	31.47	31.48	
Hillsborough								
Montgomery								
North Plainfield ..	1	4	3	29	24.00	12.00	12.00	
Warren	1		2	14	3.00	2.00	2.00	
Total	7	11	99	\$1,199	\$194.25	\$64.97	\$64.98	\$75.00
<i>Sussex County—</i>								
Andover								
Byram	1		6	\$42	\$16.00	\$8.00	\$8.00	
Frankford								
Franklin (Boro.) .								
Green								
Hampton		1			1.00	.50	.50	
Hardyston	5	4	225	1,771	88.25	31.38	31.37	\$25.50
Hopatcong	2	1			56.35	15.15	15.15	30.00
Montague	2		15	630	130.30	65.15	65.15	
Ogdensburg (Boro.)		2			7.00			7.00
Sandyston								
Sparta								
Stillwater								
Vernon	2		52	470	44.30	22.15	22.15	
Walpack								
Wantage	1		500	2,500	29.85	14.92	14.93	
Total	13	8	798	\$5,013	\$373.05	\$157.25	\$157.25	\$62.50

TABLE 6—FOREST FIRES BY COUNTIES AND TOWNSHIPS, CALENDAR YEAR 1920—Continued

COUNTY AND TOWNSHIP	Number		Acres Burned	Loss to Forests and Other Property	Cost to Extinguish	Paid by †		
	Forest Fires	Embryo Fires				Township	State	Offenders
<i>Union County—</i>								
Mountainside	1	1	5	\$30	\$10.50	\$5.25	\$5.25	.....
New Providence ..	1	.....	15	85	8.10	4.05	4.05	.....
Scotch Plains	3	.....	35	287	23.75	11.88	11.87	.....
Springfield .....	.....	.....	.....	.....	.....	.....	.....	.....
Total	5	1	55	\$402	\$42.35	\$21.18	\$21.17	.....
<i>Warren County—</i>								
Allamuchy .....	.....	.....	.....	.....	.....	.....	.....	.....
Blairstown .....	.....	1	.....	.....	\$12.00	.....	.....	\$12.00
Franklin .....	.....	.....	.....	.....	.....	.....	.....	.....
Frelinghuysen .....	.....	.....	.....	.....	.....	.....	.....	.....
Hardwick	1	.....	3	\$26	25.00	\$12.50	\$12.50	.....
Harmony .....	.....	.....	.....	.....	.....	.....	.....	.....
Hope .....	.....	.....	.....	.....	.....	.....	.....	.....
Independence .....	.....	.....	.....	.....	.....	.....	.....	.....
Knowlton	4	.....	87	523	120.60	17.25	17.25	86.10
Mansfield .....	.....	.....	.....	.....	.....	.....	.....	.....
Pahaquarry	1	.....	6	43	6.40	.....	.....	6.40
Washington .....	.....	2	.....	.....	23.75	10.70	10.70	2.25
White .....	.....	.....	.....	.....	.....	.....	.....	.....
Total	6	3	96	\$592	\$187.75	\$40.45	\$40.45	\$106.75
State Total	401	162	35,497	\$244,942	\$9,262.25	\$3,444.48	\$3,444.50	\$2,602.34

* This total is greater than the actual number (554) because in 9 cases one fire burned in two or more townships.

† The sum of these columns often differs from the "Cost to Extinguish" item because a fine was larger than the bill, or a bill was withdrawn, etc.

‡ See page 71.



Figs. 29 to 34. New Jersey has a great diversity of playgrounds. Lakes, mountains and rivers are as alluring as our famous seacoast.

Land Registry and Publicity

LAWRENCE G. GILLAM, Chief, Land Registry.

EDWARD C. STOVER, JR., Publicity Agent.

The close of the fiscal year completes the second year of the Land Registry, created to advertise the State's farming, industrial, residential and recreational advantages, and to obtain the data necessary to give inquirers definite and trustworthy information and assistance in locating within its borders. It works in closest co-operation with the publicity office.

The first undertaking was to attract farmers to our soil; that well established, special attention was directed toward promoting the State's industrial advantages, and incidentally toward our residential and recreational attractions. A good start has been made, and the effort promises to be worth while, though it is too soon to measure positive results.

GENERAL PUBLICITY

Methods.—Various publicity methods have been employed to secure for New Jersey her rightful place of distinction in the eyes of the people within and without her borders, and to acquaint her citizens with certain important departmental activities, the aim of which is to promote the general welfare. The booklets, "Industrial Opportunities in New Jersey," now on the press, and "New Jersey for Progressive Farmers," published during the preceding year, have a definite value in this work, aside from their utility in the particular field covered by their subject matter. Other booklets and circulars have been published, special articles written, advertisements placed in newspapers and magazines, circular letters distributed, frequent press bulletins issued, posters and signs sent out, an exhibit held, lectures and addresses given, and co-operation entered into with outside agencies along various lines.

In the publication of booklets and folders that are of a popular nature, an endeavor has been made to set a standard of quality and attractiveness in keeping with the principles of modern advertising. This has brought forth much favorable editorial comment from magazines and newspapers, and because of the attitude created toward the Department, manuscripts have become more acceptable and are sought with increasing frequency. A number of special articles have been written for such publications by members of the Department, and many photographs and cuts have been loaned and data supplied.

Efforts have been continued to secure new and valuable material for future publications, especially a high-class collection of photographs which properly illustrate the attractions of the State and every feature connected with its development.

Need for a general publication.—There has been a constant demand for information regarding New Jersey and the activities of the Department respecting the conservation and development of her natural resources. The stimulation of interest in the State as a part of the school program has so added to the number of requests for various publications that it has been necessary to make many refusals in order that limited editions may be reserved for other needs. An issue of "New Jersey," published by the State Chamber of Commerce, and containing comprehensive text and photographs furnished by this Department served to satisfy a large proportion of such inquirers, but the supply of 500 copies was exhausted early in the year. A fairly large edition of an inexpensive booklet similar to this is greatly needed in order that interest in the State, when aroused, may always be encouraged with appropriate information. It is recommended that an appropriation of \$5,000 be made for this and for other desirable printing.

FARMING AND UNDEVELOPED LANDS

Farm settlement.—As the farm registry work was well organized within the preceding twelve months, less attention has been given this year to that phase of the bureau's activity. In order that more definite information might be given to inquirers the farms listed are classified in various ways allowing for a greater selection of farms for each particular case without the waste of a large amount of unnecessary descriptive matter. The plan of furnishing typewritten descriptions

of available land, rather than a printed book containing a great number of farms for sale, a large part of which is soon out of date and useless, has been maintained and seems justified. A constant effort to increase the farm registry through various means has resulted in several hundred farms and tracts of lands being listed.

While agricultural conditions, coupled with the general business depression, have resulted in a falling off in the number of persons seeking land for farming purposes, there have been a large number of inquirers who have applied for definite information. In preparation for the renewed activity in farm real estate which is expected shortly, and to meet the very positive movement from the West to choice locations in the East, an effort is being made to provide efficient service to every prospective settler.

Advertising.—Our paid advertising during the year cost about \$300 and consisted only in the insertion of a small classified advertisement about 100 times in 40 farm and local newspapers in various parts of the country, but especially in the Middle West. Between 300 and 400 replies were received as a direct result. It is to be regretted that more funds are not available to extend this effort.

The following articles prepared in this office have appeared in farm papers and similar publications. Such advertising is worth much more than any that is paid for; on whatever basis an estimate is made it could not have been bought for several thousand dollars:

Poultry Raising in New Jersey.

Agricultural Opportunities in New Jersey.

Successful Farming in North Jersey.

Diversified Farming in Central Jersey.

Peach Growing in South Jersey.

Various Methods of Stump Pulling.

New Jersey Municipalities Profit by Farmers' Market.

Industrial Opportunities in New Jersey.

Of the booklet, "New Jersey for Progressive Farmers," 7,000 copies have been distributed, and it is expected that the remaining 3,000 copies will be exhausted within a few months. The greater part of these booklets have gone to interested parties outside the State, whose names have been obtained through the small amount of paid advertising, through reading notices and articles in various papers, or through farm agencies. One of the largest farm papers in the country in printing a picture from this booklet commented as follows:

"The picture of this corn was printed in a booklet sent out by the New Jersey Department of Conservation and Development to show what their State can grow besides mosquitoes. Pretty good sample, don't you think?"

Comments of this type have stimulated the demand for the booklet from persons seeking new locations. Numerous letters have been received from its readers indicative of the assistance which it has given them.

Direct and indirect results.—It is difficult to estimate the results of work of this type as the benefit through such efforts can hardly be figured in numbers of settlers located. The returns must be cumulative and extend over a long period. It is possible to record, however, that this office has been in touch by correspondence with upwards of 2,800 farmers in every state in the Union, and in six foreign countries, who are considering New Jersey as a future home. Several hundred others have been supplied with our publications through outside agencies, from whom no information is available regarding their intentions. Upon the other hand County Agricultural Agents say that our efforts have been instrumental in locating outside parties in their territory. For example, one county agricultural agent wrote as follows: "There are several people who have settled in this county through the influence of your office. I am receiving inquiries all the time, and I wish to thank you for your help in advancing the interests of this county." Farm agencies likewise report that they are selling increasing numbers of New Jersey farms, and tracts of land, to parties from other states and foreign countries. And the Jewish Agricultural Aid Society, which was supplied with booklets for distribution to their applicants, has reported locating 30 or more persons in New Jersey within 15 months. As a criterion of the farm movement to the State, a survey of deeds recorded in the County Clerk's offices in two South Jersey counties show that 43 parties from other states have bought farms in those two counties during a four months' period.

UNCLEARED LANDS

Immigrant settlement.—It has been estimated that there are 600,000 acres in the State still wooded but possessing soil of a quality to justify the removal of the forest whenever the land shall be needed



Fig. 35. A new industry — cultivated blueberries. The insert shows actual size of largest berries.

Photo. from
Joseph J. White,
Inc.



Fig. 36. Fine roads are found in many parts of "The Pines" section.

for development. It has been our aim to offer such land to pioneers—people with abundant working power but little money. In this connection a study of immigration was made with a view to having new immigrants take up our undeveloped land. Conferences were held with the Director of the Division of Immigrant Distribution, at Ellis Island, and it was determined that the most effective way to turn immigrants to this State is through the various foreign aid societies. Connections have been made with several of these organizations for that purpose.

As a further step in placing the advantages of undeveloped land, especially that in South Jersey, before immigrants and aliens in the cities several days were spent in the vicinity of Vineland, Richland and Landisville in company with a representative from the Department of Labor at Washington. At the same time a study was made of the success of the Italian colonies in that section, and an important paper was published in the U. S. Monthly Labor Review which received wide circulation throughout the country. Copies of this issue were sent to the leading Italian newspapers, Italian Consuls and others interested in the subject and a summary of the article appeared in the Literary Digest. As a result of bringing this situation to the attention of the Italian Consul at Newark, that official, in company with the "Counsellor for the Emigration" at the Italian Embassy, Washington, spent several days in South Jersey inspecting tracts of land suitable for settlement and holding conferences with prominent Italian leaders. Plans are now under way for the establishment of such colonies.

Blueberry culture.—Data on and photographs of the culture of blueberries on light soils were obtained during the season. As this industry promises to bring into use thousands of acres of light soils in central and southern Jersey which now are lying idle some publicity has been given to the subject.

Stump removal investigations.—A study has been made of various methods of removing stumps and data obtained as to the cost of each method. Further study along this line is necessary before definite recommendations can be made as to the most effective method under different conditions. However, a general knowledge of this subject has been obtained which will be of value in answering the numerous requests for information.

INDUSTRIES

Need for distribution.—A continuous and extended industrial growth is assured to New Jersey if an effort is made to advertise our natural advantages. With only a restricted area under full development the State now ranks sixth in total value of manufactures, second on a per capita basis, and third on a basis of area. With the return of prosperity that now is expected there is ground for a belief that manufacturers in increasing numbers will seek locations in rural sections, away from the congested life of cities yet within easy reach of the commercial centers. Nowhere better than in our State can such conditions be found.

The Land Registry has undertaken the fostering of this decentralization as well as the promotion of the State's industrial development as a whole. Early in the year a comprehensive survey was made of existing conditions in this and other states, and of the agencies and influences which control and affect the location of industry. Working arrangements have been made for co-operation with these agencies wherever it has seemed to be of advantage. It was decided that it would be inadvisable to attempt to carry a list of available factory sites and buildings, similar to the method employed in the case of farmlands, but every provision has been made for satisfying the varying needs of each separate inquirer.

Industrial Opportunities in New Jersey.—In order to bring the facts gathered during the survey before the industrial world, and to stimulate the growth of the smaller communities, attention was directed largely to putting them in a form that should make a strong appeal. A 32-page booklet entitled "Industrial Opportunities in New Jersey" has accordingly been prepared and is now on the press. Within an attractive cover is set forth in direct and condensed form the State's message of opportunity, amply illustrated with photographs, drawings, graphs and maps, and with an alphabetical reference list of cities and towns with their locations and populations. The edition of 5,000 copies will be distributed in such a way as to place a maximum number in the hands of those outside the State who are interested in finding suitable locations for industries. Upon receipt of the booklet from the printer the bureau is prepared to open an active campaign and through trade journals, the press and other mediums to make itself known as a reliable source of information and assistance.

RESORTS

Recognition.—Though more people patronize New Jersey resorts than those of any other state, the popularity of a few places has overshadowed the facilities offered elsewhere. Bringing about the development of these by calling them to the attention of the nearby millions who look eagerly for convenient playgrounds, represents an effort which offers a rich return in increased ratables. Nine-tenths of our 125 miles of seashore remains undeveloped, though that is just as suitable for development as sections which have attained world-wide fame. Our woodland, lake and mountain sections in North or South Jersey, wait only to be known to become rivals of the popular resorts in other states. The automobile, invited into every section by our fine highways, is revealing these attractions to a growing number of tourists. The Land Registry is making a strong effort to stimulate interest in these resources and plans to issue a booklet that will be an authoritative guide.

EXHIBITS

Reaching the public by means of exhibits is a field of publicity which offers a promising return for the money and effort spent, but has been barely touched because of limited funds. Several exhibits which could be set up at conventions, fairs, in public buildings and wherever opportunity might offer would do much to bring New Jersey's advantages along various lines before certain people whom it is desirable to reach, and to present the activities of the Department along the lines of forestry, forest fire prevention, geology, water supply, museum extension work, land registry, mosquito control and other projects.

Inter-State Fair exhibit.—Much interest was manifested in the annual exhibit of the Department at the Inter-State Fair at Trenton during the last week in September, several thousand people visiting the log cabin. It also called forth favorable comment from the press.

The feature of the exhibit was a miniature reproduction of a section of country, laid out on the scale of one inch to the foot, including a group of farm buildings along an improved highway surrounded by fields and orchards, a lake, mountain, and burned and unburned

woodland. Upon this as a setting the various activities of the Department, especially forestry, forest fire prevention and land registry, were emphasized by suitable groups and settings, accompanied by explanatory signs.

PUBLICATIONS

In addition to the annual administrative report for 1920, the staff has prepared and the Department has published:

Fighting Forest Fires.—A 40-page booklet of instruction, illustrated, directed to those who may have occasion to assist in protecting the forests against fire and in fighting those which have started. A first edition of 3,000 copies was quickly exhausted and a second edition of 3,000 copies published.

Fires for Fun.—A 24-page booklet, illustrated, in the interest of forest fire prevention, directed to those who use the woods for pleasure. Second edition, revised, in 3,000 copies.

List of Firewardens.—A 24-page directory, in 1,200 copies. Revised for 1921.

Souvenir Post Cards of Lookouts.—A series of seven forest fire lookouts, 500 each, distributed from the respective lookouts.

Safeguarding the Home Against Fire.—A 96-page booklet on Fire Prevention provided by the National Board of Fire Underwriters, with a supplement on forest fires added through cooperation with the State Department of Public Instruction. Fifty thousand copies were distributed to the schools and are used as manuals for teaching fire prevention.

School Lending Collections.—A 12-page catalogue in 6,000 copies, of educational material available from the State Museum. Revised for 1921.

Industrial Opportunities in New Jersey.—A 32-page booklet, illustrated with photographs, drawings, graphs and maps. (See figs. 4 to 9.) It sets forth the exceptional opportunities offered to industries, particularly in the less developed sections, being supplemented with an alphabetical reference list of cities and towns, with their locations and populations.

Laws and Rules Relating to Public Water Supplies and the Erection of Dams.—A 52-page booklet, in 1,000 copies, for the use of officials, water companies, engineers and others engaged in water supply work.

List of Bench Marks in New Jersey.—(Bulletin 21, Geologic Series.) A 116-page bulletin in 1,000 copies for the use of engineers, surveyors, etc.

Soil Survey of the Belvidere Area.—(Bulletin 20, Geologic Series.) A 72-page bulletin, illustrated, and containing a large colored map, published in cooperation with the Soil Survey, U. S. Department of Agriculture, of which 1,000 copies were obtained.

Soil Survey of the Millville Area.—(Bulletin 22, Geologic Series.) A 46-page bulletin, illustrated, and containing a large colored map, published in cooperation with the Soil Survey, U. S. Department of Agriculture, of which 1,000 copies were obtained.

Road Map of New Jersey.—(On a scale of four miles to an inch.) Revised edition, 1921. Seven hundred and fifty copies on sale at 25 cents each.

Atlas Sheet 24.—On a scale of one inch to a mile, covering parts of Warren, Hunterdon and Morris Counties. Revised edition. One thousand copies on sale at 40 cents each.

APPENDIX

Our Mineral Industry in 1919 and 1920

M. W. TWITCHELL, Assistant State Geologist.

Co-operative collection of statistics.—The figures for 1919 as given in the following statistical statement were collected jointly by the United States Bureau of the Census and the United States Geological Survey and are published by this Department in accordance with its co-operative arrangement with the Federal Survey. Because of the magnitude of the task of the Bureau of the Census, great delay occurred in the collection and tabulation of the figures and in consequence they were not received in time for insertion in the last Annual Report. The figures for 1920, as given herewith, were collected jointly by the Department of Conservation and Development and the United States Geological Survey, a co-operative method which is mutually advantageous and has proven quite satisfactory for a number of years.

General summary.—The mineral industry of New Jersey is steadily increasing in importance. The *total value of our mineral products in 1920* was \$82,134,233. This is a record-breaking figure, \$25,345,266 greater than in 1919, \$33,614,757 greater than in 1918, \$36,617,755 more than in 1917 and practically double what it was in 1916. The remarkably high total for 1920 is due both to increase in quantity of production (except in a few cases) and to the higher prices prevailing in the mineral industry as in other industries of the country. The following summary table will give at a glance the progress in the chief products involved. Full details for 1920 and 1919 will be found farther on.

RECENT PROGRESS IN MINERAL PRODUCTION IN NEW JERSEY

Chief Products	Value, 1916	Value, 1917	Value, 1918	Value, 1919	Value, 1920
Clay and clay products.	\$21,605,198	\$23,564,935	\$21,837,396	\$27,624,441	\$41,789,619
Mineral pigments	(1)	(1)	5,026,109	5,670,714	8,264,167
Sand and gravel	1,517,473	2,025,324	2,462,864	2,576,272	4,330,844
Stone	1,666,299	1,872,755	2,212,477	2,521,860	2,777,018
Iron ore	1,877,056	2,341,160	1,945,651	1,712,255	2,595,949
Coke					
Fuel briquets					
Portland cement	13,733,000	15,712,304	15,034,979	16,683,425	22,376,636
Zinc ore					
Minor products					
Grand totals	\$40,399,540	\$45,516,478	\$48,519,476	\$56,788,967	\$82,134,233

1. Cannot be separately published.

Zinc ore.—The chief metal-mining industry of New Jersey is the mining of *zinc ore*. Only two mines are in operation, one at Franklin and the other near Ogdensburg, both being owned and operated by the New Jersey Zinc Company. The combined production of crude zinc ore by the two mines was 639,714 short tons in 1919 and 550,770 short tons in 1920. This makes the total quantity of zinc ore which has been taken from the mines of New Jersey since 1880, 10,053,314 short tons. Comparative figures are not yet available for 1920, but in 1919 New Jersey stood *second* in the mining of zinc ore, Oklahoma being first and Montana third. When the small size of New Jersey is taken into consideration, and the fact that Oklahoma and Montana are among the great mining States of the west, this is a really remarkable showing. The United States produces about two-thirds of the world's total output of zinc, and New Jersey, in 1919, produced about 17 per cent of the output of the United States, the output of Oklahoma being about 32 per cent of the total.

The New Jersey zinc ore is crushed at Franklin and separated into several types by powerful electro-magnets, and the gangue removed by jigs and tables. The ore is then shipped to the company's smelters at Palmerton, Pennsylvania, where metallic zinc and zinc oxide are made from it. A residue remaining from the smelting of part of the ore is rich in manganese and iron and is converted into spiegelcisen and disposed of for use in the making of steel. The quantity of this *manganiferous zinc residuum* produced in 1919 was 80,418 long tons and in 1920, 133,602 long tons. As this Department credits the value of the crude zinc ore, it does not include the value of this residuum in its totals for New Jersey.

Iron ore.—In 1919 there were decreases in the quantity of iron ore mined in New Jersey, and in the quantity and value of the ore marketed, as compared with 1918; the amount of the decreases being 19,097 long tons in ore mined, 38,609 long tons in ore marketed and

\$233,396 in value of ore marketed. In 1920 the iron mining industry of New Jersey recovered the ground lost in the preceding year and in *value* of the marketed products—\$2,595,949—attained the highest point in its history. The quantity of ore mined—431,567 long tons—and also that marketed, 417,100 long tons, was, however, less than in the great war years 1916 and 1917. The average value per ton in 1920 was \$6.223, the highest of record. During the half century since 1870 a grand total of 23,132,873 long tons of iron ore has been mined in New Jersey. There were five periods of high production, namely, 1872-1874, 1880-1883, 1885-1891, 1904-1911 and 1916-1917. The greatest output of record is that of 1882, when the reported amount mined was 932,762 tons. There were also five times of low production, namely, 1876-1877, 1884-1885, 1894-1899, 1903 and 1912-1914. The least output was in 1897 when the reported amount mined was 257,235 tons.

The most important development in connection with the iron industry of New Jersey in many years was the formation of the Wharton Steel Company and later the Replogle Steel Company in the fall of 1919, which acquired the iron properties formerly owned by Joseph Wharton—ore beds, iron furnaces and railroads. The new concern made extensive borings which indicated that the properties contain large reserves of iron ore, and then went ahead during the year 1920, developing especially the Scrub Oak Mine, renaming it the Replogle Mine, and making it an important producer. The other operators were: the Empire Steel and Iron Company, which worked the Mt. Hope and Washington mines; the Thomas Iron Company, which operated the Richard, Allen and Teabo mines; the Ringwood Company, which worked the Peters and Cannon mines, and the Basic Iron Ore Company, which made shipments of iron ore from the stock pile at the Ahles Mine. The North Jersey Steel Company was organized in the latter part of 1920, and did considerable development work on the old Beach Glen mine, in Morris County.

In addition to the mining of iron ore, New Jersey continues to smelt some of its ores and produce *pig iron*. Its production of pig iron in 1919 was 118,418 long tons, and its shipments 111,362 long tons, valued at \$3,505,635. As there were less than three producers in 1920, the corresponding figures for that year cannot be published. This Department does not include the value of pig iron in its totals as to do so would involve a partial duplication of the value already credited for the iron ore.

Stone.—The production of stone is steadily increasing in importance in New Jersey. It will probably surprise many of our citizens to learn that the value of our total stone output exceeds that of New Hampshire, the so-called “Granite State!” In 1920 our output of stone was greater than ever before. The total quantity was 1,679,720 short tons and the value \$2,777,018. This was 53,850 tons greater in quantity and \$255,158 greater in value than in 1919. Comparative data are not available for 1920; but our rank among the States in 1919 was tenth in the value, and twelfth in the quantity, of stone produced. New Hampshire stood twenty-second in the value and still lower in the quantity of her output. Indiana, famous for its limestone for building purposes, while fifth in the value of its output, was practically just equal in rank to New Jersey in the *quantity* of stone produced.

Of the various kinds of stone produced by New Jersey at the present time, trap rock (basalt and related dark-colored igneous rocks) stands first, in fact far outclasses the other kinds. Following this in the order of their importance are limestone, granite and sandstone. The *trap rock* output in 1920 was 1,216,810 short tons, valued at \$2,140,845, an increase in quantity of 22,020 tons and in value of \$224,151 over the output for 1919. The *limestone* production in 1920 amounted to 361,370 short tons, whose value was \$493,665, a decrease in quantity of 12,710 tons and in value of \$12,528 over the output for 1919. The granite production cannot be separately published. The same is true of sandstone. In 1919, for the first time in many years, there was no production of *slate* in New Jersey. The slate quarries were also idle in 1920.

Mineral pigments.—The production of mineral pigments in New Jersey from lead and zinc ores mined in other States has developed into a great industry. So far as this Department has been able to ascertain, the New Jersey zinc ores are not drawn upon either directly or indirectly as the source of raw materials for these pigments. There is therefore no duplication of values due to including these figures in the total. The chief pigments made are lithopone and white lead. There are six producers and their combined output of *zinc and lead pigments* in 1919 was 42,250 short tons, valued at \$5,670,714 and in 1920, 50,887 short tons whose value was \$8,264,167.

Clay and clay products.—Nineteen hundred and twenty was a record-breaking year in this great New Jersey industry, the *total value for clay and clay products* being \$41,789,619. This was \$14,165,178 more

than in 1919 and \$19,952,323 more than in 1918. Owing to the fact that the clay products figures or statistics as collected by the census for 1919, and as given in the table farther on, are for products manufactured during the year 1919 (whether sold or not), whereas this Department usually collects and publishes the figures for sales only, the figures for 1919 are not strictly comparable with those for 1920. However, the clay products figures for 1920 are comparable with those for 1918 as published in the Annual Report of this Department for the year ending June 30, 1919, and mentioned at times in the present report. The total value of the *pottery* in 1920 was \$24,597,376, which was \$8,279,847 more than in 1919 and \$12,026,534 greater than in 1918. There were substantial increases in all the important pottery items, the greatest being that in sanitary ware, which was \$12,763,442 in 1920, an increase of \$4,832,071 over 1919, and \$6,611,690 over 1918. The total value of the *brick and tile* in 1920 was \$15,535,376, which was \$5,306,946 more than in 1919, and \$7,337,394 greater than in 1918. This year we publish for the first time a number of interesting separate figures regarding this group of clay products, among them being the hollow building tile (including partition, load-bearing, back-up, floor arch, blocks, silo tile and fire-proofing), wall tile, ceramic mosaic, floor tile and faience tile (including art tile, enameled tile and hand-decorated tile). There was increases in 1920 over 1919 in nearly all items, both in quantity and value. The most striking exception was common brick, in which case there was a pronounced *decrease* in quantity though a substantial *increase* in value. In the case of fire brick both quantity and value figures were practically the same in 1919 and 1920, while it is notable that both the quantity (40,202M) and value (\$2,880,413) in 1918 were much greater than in either 1919 or 1920. The total output of *raw clay* mined and sold as raw clay in 1920 was 354,613 short tons, valued at \$1,656,867, which involved an increase in quantity of 76,423 tons and in value of \$578,385 over 1919.

Sand and gravel.—A striking advance in the *sand and gravel* output for New Jersey took place in 1920 when the *total production* was 4,616,444 short tons whose value was \$4,330,844. This was 906,218 tons more in quantity and \$1,754,572 more in value than in 1919. Of the different kinds of sand the *molding sand* and *building sand* are the most important and present interesting variations. The quantity figures for molding sand for the past five years were as follows: 1916, 644,611 short tons; 1917, 611,916 tons; 1918, 442,007 tons; 1919,

501,583 tons, and 1920, 735,930 tons. The corresponding values were: 1916, \$479,426; 1917, \$651,279; 1918, \$626,637; 1919, \$583,656, and 1920, \$1,191,523. These figures show strikingly the great increase in prices in a single mineral product, also the high production of this particular material in war times, the drop off in 1918 and the somewhat surprising recovery in 1920. In the case of *building sand* the quantity figures for the years from 1916 to 1920 inclusive were as follows: 1,950,858 short tons; 1,818,275 tons; 1,748,576 tons; 1,640,704 tons, and 1,794,424 tons. The corresponding values were: \$417,954; \$545,437; \$690,209; \$763,896, and \$1,065,999. This shows the drop off in output in war time and slow recovery as building operations were resumed, and also the steady mounting in prices.

Other mineral products.—In addition to the minerals separately discussed above, New Jersey produced in 1920 the following: Of *peat*, 26,623 tons, valued at \$281,527, which was more than the 1919 output, which was itself the greatest amount produced up to that time. Of *mineral waters*, 702,867 gallons, valued at \$68,036, which was a decided decrease in both amount and value as compared with the previous year. Of *lime*, both ordinary and hydrated, 3,301 short tons, valued at \$27,407, a slight decrease compared to 1919. There was also considerable quantities of *fuel briquets*, *coke* and *Portland cement* and minor amounts of *greensand marl*, *gems*, *ground quartz* and *ground talcose rock*, but as there were less than three producers in these cases the values cannot be separately published. They are therefore combined under the term "Miscellaneous" and their combined value is also added to the total for all products.

Statistical table.—Details of the mineral production are given in the following table. This year this Department has included the figures for 1920, the latest yet available and those for 1919, which are here published for the first time, as they were not available at the time the previous Annual Report went to press.

MINERAL PRODUCTION IN NEW JERSEY IN 1919 AND 1920

Products	Producers	1920		1919	
		Quantity	Value	Quantity	Value
Zinc ore (a).....	1	550,770 s. t.	(a)	639,714 s. t.	(a)
Iron ore (b).....	4	417,100 l. t.	\$2,595,949	336,629 l. t.	\$1,712,255
Mineral pigments (c)...	6	50,887 s. t.	8,264,167	42,250 s. t.	5,670,714
Peat (d).....	3	26,623 s. t.	281,527	27,743 s. t.	267,567
Mineral waters (e).....	8	792,867 gal.	68,036	1,244,983 gal.	143,303
Lime (f).....	7	3,301 s. t.	27,407	4,828 s. t.	29,098
Sand and gravel—					
Molding sand.....	27	735,930 s. t.	1,191,523	501,583 s. t.	583,656
Building sand.....	27	1,794,424 s. t.	1,065,999	1,640,704 s. t.	763,896
Glass sand.....	5	141,079 s. t.	300,489	121,799 s. t.	225,036
Grinding and polishing sand.....	7	76,803 s. t.	200,941	43,097 s. t.	79,048
Paving sand.....	6	563,855 s. t.	328,210	281,124 s. t.	149,842
Fire and furnace sand,	8	69,761 s. t.	132,657	63,232 s. t.	93,447
Engine sand.....	8	124,519 s. t.	93,175	90,789 s. t.	63,837
Other sands (g).....	7	50,418 s. t.	85,903	52,299 s. t.	54,460
Total sand.....	51	3,556,789 s. t.	\$3,398,897	2,794,627 s. t.	\$2,013,222
Gravel.....	22	1,059,655 s. t.	931,947	915,599 s. t.	563,050
Total sand and gravel.....	55	4,616,444 s. t.	\$4,330,844	3,710,226 s. t.	\$2,576,272

a. Crude ore mined. Value included in "Miscellaneous," the value so included being that of the crude ore only, as furnished by the producer. This ore was smelted in Pennsylvania, yielding metallic zinc, zinc oxide and manganiferous zinc residuum. The quantity of residuum was 80,418 long tons in 1919 and 133,602 tons in 1920. Its value cannot be published and we do not include it, as to do so would involve a duplication of a part of the value already credited to the crude zinc ore.

b. Practically all magnetic iron ore. The quantity of ore mined in 1919 was 404,428 long tons, and in 1920, 431,567 tons. In 1919, 118,418 long tons of pig iron was produced in the State, of which 111,362 tons, having a value of \$3,505,635 was marketed. As there were less than three producers in 1920, the corresponding figures for that year cannot be published. The value of pig iron is not included in our totals as part of it is smelted from New Jersey ore, the value of which has already been credited.

c. Zinc and lead pigments, made wholly or chiefly from ores not mined in nor credited to New Jersey. Chiefly lithopone and white lead. This value is included in our grand total.

d. Chiefly for use as a fertilizer, or ingredient of fertilizers.

e. Fourteen active springs in 1919; eight in 1920. In addition to the figures of sales as given above, 88,176 gallons in 1919 and 45,000 gallons in 1920 were taken from the active springs and used in the manufacture of soft drinks.

f. Chiefly for use as a fertilizer.

g. Includes filter sand, and sand for several purposes not specified.

MINERAL PRODUCTION IN NEW JERSEY IN 1919 AND 1920—Continued

Products	Producers	1920		1919	
		Quantity	Value	Quantity	Value
Stone—					
Trap (basalt, etc.)	39	1,216,810 s. t.	\$2,140,845	1,194,790 s. t.	\$1,916,694
Limestone	12	361,370 s. t.	493,665	374,080 s. t.	506,193
Other stone (h) . . . . .	..	101,540 s. t.	142,508	57,000 s. t.	98,973
Total stone	58	1,679,720 s. t.	\$2,777,018	1,625,870 s. t.	\$2,521,860
Clay—					
Fire clay . . . . .	..	285,842 s. t.	\$1,423,159	271,952 s. t.	\$1,048,313
Stoneware clay . . . . .	..	20,627 s. t.	91,067	(i) s. t.	(i)
Ball clay . . . . .	..	4,980 s. t.	43,157	(i) s. t.	(i)
Miscellaneous (j) . . . . .	..	43,164 s. t.	99,484	6,238 s. t.	30,169
Total raw clay	43	354,613 s. t.	\$1,656,867	278,190 s. t.	\$1,078,482
Pottery—(k)					
Sanitary ware . . . . .	..	.....	\$12,763,442	.....	\$7,931,371
Porcelain electrical supplies . . . . .	..	.....	5,058,518	.....	3,447,830
China, belleek, etc. (l) . . . . .	..	.....	2,829,379	.....	1,870,542
White ware, etc. (m) . . . . .	..	.....	2,087,008	.....	1,542,947
Miscellaneous (n) . . . . .	..	.....	1,859,029	.....	1,524,839
Total pottery	57	.....	\$24,597,376	.....	\$16,317,529

h. Includes granite, sandstone and argillite.

i. As there were less than three producers in 1919 the figures for that year cannot be separately published.

j. Includes slip clay, foundry clay, crucible clay, clay for abrasive wheels, etc. In 1919 also includes stoneware clay and ball clay.

k. The clay products figures or statistics for 1919 as here given are for products manufactured during the year 1919 (whether sold or not). This was the method of the U. S. Bureau of the Census.

l. Includes china, bone china, delft and belleek.

m. Includes whiteware, C. C. ware, white granite, semi-porcelain ware and semi-vitreous porcelain ware.

n. Includes red earthenware (flower pots, etc.), red and brown white-lined cooking ware, stoneware, yellow and Rockingham ware, chemical stoneware; also minor articles such as tobacco pipes, hardware trimmings, art pottery, souvenirs, sappers, etc.

MINERAL PRODUCTION IN NEW JERSEY IN 1919 AND 1920—*Concluded*

Products	Pro- ducers	1920		1919	
		Quantity	Value	Quantity	Value
Brick and tile (k)—					
Common brick .....	..	160,549 M	\$3,075,388	213,250 M	\$2,489,876
Fire brick .....	..	27,807 M	2,001,988	28,716 M	2,018,624
Face brick	}	19,736 M	896,831	33,241 M	1,042,027
Enameled brick					
Hollow building tile					
(o) .....	..	234,598 s. t.	3,665,668	173,933 s. t.	1,623,628
Terra cotta (p).....	..	17,434 s. t.	2,735,042	.....	1,104,715
Wall tile (q).....	..	2,922,495 sq. ft.	1,352,071	1,988,266 sq. ft.	652,205
Ceramic mosaic (r)....	..	3,178,930 sq. ft.	918,615	2,224,840 sq. ft.	542,538
Floor tile (s).....	..	1,692,214 sq. ft.	510,945	1,469,765 sq. ft.	310,370
Faience tile (t).....	..	165,823 sq. ft.	137,186	321,102 sq. ft.	174,338
Miscellaneous (u) .....	..	.....	241,642	.....	270,109
Total brick and tile.	69	.....	\$15,535,376	.....	\$10,228,430
Total clay products..	126	.....	40,132,752	.....	26,545,959
Total clay and clay products	195	.....	41,789,619	.....	27,624,441
Miscellaneous—					
Briquets, fuel (v)...	}	13	21,999,666	.....	16,243,457
Cement, Portland (w).					
Coke (x)					
Gems					
Greensand marl					
Quartz, ground					
Talcose rock, ground (y)					
Zinc ore (a).....					
Total, all products (z)	349	.....	\$82,134,233	.....	\$56,788,967

- o. Includes partition, load-bearing, backup, floor arch, blocks, silo tile, and fireproofing.
p. Architectural terra cotta.
q. Thin, white glazed, etc. Partition tile is included under hollow building tile.
r. Vitreous and semi-vitreous.
s. Including plain, vitreous, encaustic, quarry, etc.
t. Including art tile, enameled tile and hand-decorated tile.
u. Includes drain tile, sewer pipe, stove lining, gas logs, wall coping, conduits, flue lining, glass house pots, etc.
v. Made from anthracite coal mined outside of the State.
w. Two producers only, therefore cannot be separately published.
x. By-product coke made from coal mined outside of the State.
y. In former years has been included under stone.
z. For these two years, this includes all of the items listed in the above table. Does not include pig iron nor manganiferous zinc residuum (which this year are mentioned in footnotes only) as this would involve a partial duplication of values already credited for iron and zinc ores. Owing chiefly to the fact that the U. S. Geological Survey, with whom this Department co-operates in the collection of these statistics, has to avoid duplications arising from crediting products to two or more States, whereas we have New Jersey alone to consider, their total for the State cannot readily be brought to agree exactly with ours. For example, for the year 1918 our total was \$48,519,476 and the Federal Survey's total was \$49,510,290. The Federal totals for New Jersey for the years 1919 and 1920 are not yet available, but, judging from other recent years, are likely to exceed the totals as here given by this Department.

