New York Agricultural Experiment Station.

GENEVA, N. Y.

DIRECTOR'S REPORT FOR 1918.

W. H. JORDAN.

PUBLISHED BY THE DEPARTMENT OF AGRICULTURE.
BOARD OF CONTROL.
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STATION STAFF.

George W. Churchill,
Agriculturist and Superintendent of Labor.

Reginald C. Collison, M.S.,
Agronomist.

James E. Mensching, M.S.,
Associate Chemist (Agronomy).
†William W. Baer, B.S.,
Assistant Chemist (Soils).

Everett P. Reed, B.S.A.,
Assistant Agronomist.

James D. Harlan, B.S.,
Assistant Agronomist.

William P. Wheeler,
First Assistant (Animal Industry).

Robert S. Breed, Ph.D., Bacteriologist.

Harold J. Conn, Ph.D.,
Associate Bacteriologist.

Godfrey L. A. Ruehle,
Assistant Bacteriologist.

John Bright, M.S.,
Assistant Bacteriologist.

Fred C. Stewart, M.S.,
Botanist.

Walter O. Gloyer, M.A.,
Associate Botanist.

Mancel T. Munn, M.S.,
Assistant Botanist.

Lucius L. Van Slyke, Ph.D., Chemist.
†Rudolph J. Anderson, B.S.,
Arthur W. Clark, B.S.,
John C. Baker, Ph.D.,
Associate Chemists.

Morgan P. Sweeney, M.A.,
Otto McCreary, B.S.,
Richard F. Keeler, A.B.,
William F. Walsh, B.S.,
Walter L. Kulp, M.S.,
Assistant Chemists.

George A. Smith,
Dairy Expert.

Frank H. Hall, B.S.,
Vice-Director; Editor and Librarian.

Percival J. Parrott, M.A.,
Entomologist.

Hugh Glasgow, Ph.D.,
*Fred Z. Hartzell, M.A. (Fredonia),
Associate Entomologists.

Harold E. Hodgkiss, B.S.,
Bentley B. Fulton, M.S.,
Assistant Entomologists.

Ulysses P. Hedges, Sc.D.,
Horticulturist.

Roy D. Anthony, M.S.A.,
*Fred E. Gladwin, B.S. (Fredonia),
Orrin M. Taylor,
Associate Horticulturists.

†George H. Howe, B.S.A.,
Joseph W. Wellington, B.S.,
William C. Stone, M.S.,
Edward H. Francis, M.A.,
Assistant Horticulturists.

F. Atwood Sirrine, M.S. (Riverhead),
Special Agent.

Jessie A. Sperry, Director's Secretary.

Frank E. Newton,
Willard F. Patchin,
Lena G. Curtis,
Mae M. Melvin,
Maude L. Hogan,
K. Loraine Horton,
Clerks and Stenographers.

Elizabeth Jones,
Computer and Mailing Clerk.

Address all correspondence, not to individual members of the staff, but to the New York Agricultural Experiment Station, Geneva, N. Y.

The Bulletins published by the Station will be sent free to any farmer applying for them.

*Connected with Grape Culture Investigations. †In military service.
1 Resigned February 28, 1918.
2 Appointed April 15, 1918.
3 Resigned June 30, 1918.
4 Appointed May 1, 1918.
To the Honorable Board of Control of the New York Agricultural Experiment Station:

Gentlemen.—In accordance with the usual custom, I am presenting herewith a report of the operations of this institution for the calendar year 1918. I am also calling to your attention certain conditions and needs pertaining to the institution which should receive your serious consideration.

The report is the smallest in volume of any that has been presented during recent years. The explanation of this fact is that members of the Station Staff have entered war service or have been called to other positions without it being possible to fill the vacancies in a satisfactory way, and, in general, the thought and energy of members of the Staff have been diverted from a vigorous and continuous application to investigational problems by the stress and strain of the war. The great conflict has created an atmosphere of anxiety and uncertainty which has had its effect upon every phase of human activity in this country, and educational and research institutions have not been exempt from this influence.

ADMINISTRATION.

STATION STAFF.

There have been changes in the Station Staff of the usual character, due to the attractions offered by other institutions and commercial opportunities, in addition to which several of the Staff have entered into war service. Men of scientific attainments have had a peculiar and important relation to the winning of the war thru various openings of activity that have related to food, engineering and munitions.

In the spring of 1918, Rudolph J. Anderson, Associate Chemist, offered his services to the government. His offer was accepted and
he was commissioned captain and attached to the surgeon-general's office. His work at first was the inspection of the food supplies at several cantonments. Later he was assigned to a school of nutrition at Camp Greenleaf, Chickamauga, Ga., for instruction to prospective inspectors of food.

George H. Howe, Assistant Horticulturist, enlisted for war service in the early part of the year, and was assigned to the medical corps. Subsequently, however, he was attached to the Walter Reed Hospital, Tacoma Park, D. C., for the purpose of aiding in preparing disabled soldiers for agricultural work, particularly along horticultural lines.

Members of the labor force of the institution have at various times been called to war service.

The Director of the Station served as Chairman of the Federal Milk Commission for the Middle States, with headquarters in New York City, from November, 1917, until July, 1918. This commission had brought before it very complicated problems relative to the cost of production and distribution of milk—some of them almost impossible of solution within the time and facilities available to the commission. Nevertheless, the commission established prices to the producer and to the consumer which prevailed during the first six months of 1918, and which in the main were said to be fairly satisfactory to the parties in question.

Certain changes in the Staff have occurred, due to absences for war service and to the attractions of other institutions. Further changes are threatened for the same reasons.

Godfrey L. A. Ruehle, Assistant Bacteriologist, accepted a position in the Michigan Agricultural College at a salary considerably in advance of that which he was receiving at this institution. This call was undoubtedly due to the good work which Mr. Ruehle had accomplished in dairy investigations. It was unfortunate that he could not have been retained, but the present budget system of the State rendered this impossible.

Everett P. Reed, Assistant Agronomist, has accepted the position of farm bureau agent in one of the counties of Ohio, at a salary greatly in advance of that which was assigned to him at this institution. It should be remarked in this connection that the demand for farm bureau agents and the salaries which are being offered in these positions are causing a serious problem in retaining men on the
teaching and investigating staffs of our institutions. It was not possible to retain Mr. Reed in competition with the inducements offered in Ohio.

James D. Harlan, B.S., a graduate of Pennsylvania State College, was appointed as Assistant Agronomist to fill the position vacated by Mr. Reed. Mr. Harlan has the advantage of a good knowledge of practical agriculture, which together with his scientific training should render his services useful to the institution.

Edward H. Francis, M. A., a graduate of Cambridge University, England, was selected to fill the place vacated by George H. Howe. Mr. Francis is a member of the London Zoological Society, and brings to the service of the State a training that has specially fitted him for observational work along horticultural lines.

John C. Baker, while still a member of the Staff, is soon to enter upon a commercial position in New York City. The salary which Doctor Baker will receive is two and one-half times that which he was receiving at this institution. He would have remained at a considerably less salary than that which he will receive in his new position, but, as stated in a former case, the present budget system of the State renders it out of the question generally to retain men at a moderate increase of salary, even tho this may be the wisest policy.

MAINTENANCE FUND.

During the fiscal year beginning July 1, 1917, the expenditures of the Station were as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal service</td>
<td>$102,598.30</td>
</tr>
<tr>
<td>Maintenance and operation</td>
<td>30,575.45</td>
</tr>
<tr>
<td>Repairs</td>
<td>1,500.00</td>
</tr>
<tr>
<td>Drainage</td>
<td>427.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$135,101.25</td>
</tr>
</tbody>
</table>

The following are the appropriations available for the use of the Station during the fiscal year beginning July 1, 1918. This amount is $6,270 less than the request presented by the Board of Control:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>Personal service</td>
<td>$111,530.00</td>
</tr>
<tr>
<td>Salaries and wages</td>
<td>6,000.00</td>
</tr>
<tr>
<td>Maintenance and operation</td>
<td>15,400.00</td>
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<tr>
<td>Fuel, light, power and water</td>
<td>5,275.00</td>
</tr>
<tr>
<td>Printing</td>
<td>9,000.00</td>
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<tr>
<td>Equipment</td>
<td>2,500.00</td>
</tr>
<tr>
<td>Supplies</td>
<td></td>
</tr>
<tr>
<td>Hired horses and vehicles</td>
<td></td>
</tr>
</tbody>
</table>
Maintenance and operation (continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traveling expenses</td>
<td>$4,000 00</td>
</tr>
<tr>
<td>Communication</td>
<td>2,000 00</td>
</tr>
<tr>
<td>General plant service</td>
<td>2,200 00</td>
</tr>
<tr>
<td>Rent</td>
<td>1,000 00</td>
</tr>
<tr>
<td>Repairs</td>
<td>2,500 00</td>
</tr>
<tr>
<td>Construction and permanent betterments</td>
<td>70,000 00</td>
</tr>
<tr>
<td>Printing (special)</td>
<td>10,000 00</td>
</tr>
<tr>
<td>Rent (special)</td>
<td>1,900 00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$243,305 00</strong></td>
</tr>
</tbody>
</table>

In accordance with the action of your Board, the following budget for the fiscal year beginning July 1, 1919, as amended by subsequent action, has been presented:

Personal service

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries and wages</td>
<td>$115,160 00</td>
</tr>
</tbody>
</table>

Maintenance and operation

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel, light, power and water</td>
<td>6,000 00</td>
</tr>
<tr>
<td>Printing</td>
<td>15,400 00</td>
</tr>
<tr>
<td>Equipment</td>
<td>5,275 00</td>
</tr>
<tr>
<td>Supplies</td>
<td>8,500 00</td>
</tr>
<tr>
<td>Hired horses and vehicles</td>
<td>3,000 00</td>
</tr>
<tr>
<td>Traveling expenses</td>
<td>4,000 00</td>
</tr>
<tr>
<td>Communication</td>
<td>2,500 00</td>
</tr>
<tr>
<td>General plant service</td>
<td>750 00</td>
</tr>
<tr>
<td>Rent</td>
<td>1,000 00</td>
</tr>
<tr>
<td>Repairs</td>
<td>3,000 00</td>
</tr>
<tr>
<td>Construction and permanent betterments</td>
<td>2,900 00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$167,485 00</strong></td>
</tr>
</tbody>
</table>

**THE EXISTING BUDGET SYSTEM.**

When the New York Agricultural Experiment Station was established by legislative action in 1881, an agency was created thru which the purposes of the institution should be accomplished, namely, a Board of Control. It has been the duty of this Board of Control to appoint a Director and a scientific staff in whose hands have been placed the immediate administration of the affairs of the institution. For thirty-two years this Board and this appointed staff were given complete autonomy in the expenditure of the funds provided for the use of the Station, limited only by the general regulations pertaining to the expenditure of State funds. In 1914 there was established a closely segregated budget system in which the salaries of all the positions in the Station were specified, and various sums of money were individually designated to pay particular classes of expenses. It has been the duty of the administration of the Station nearly a year in advance to anticipate the
status of its scientific staff and the necessary expenditures along
from ten to fourteen lines. Such an anticipation of expenditures in
an institution the work of which varies from year to year, requiring
an unlike distribution of expense, cannot be intelligently made.

After more than four years’ experience, it can be safely said that
this budget has proved an administrative burden, and has not
accomplished, for the Station at least, any fiscal economies, but
rather the reverse. It has placed serious limitations upon the
autonomy of the administration. However worthy the motives
which lie behind such fiscal regulations, it may be safely asserted
that, so far as education and research are concerned, experience
indicates that the system in vogue not only is not helpful but is a
decided drag on efficiency.

Certain statements by the draft administrator of the State of
Wisconsin and director of the Society for the Promotion of Training
for Public Service are illuminating in this direction. Doctor Fitz-
patrick, in a very able treatise entitled “Budget-Making in a
Democracy,” writes as follows: “The segregated, that is, the
minutely itemized, budget was an expression of mechanical efficiency.
The recent changes proposed, permitting larger administrative
discretion, are in the direction of a genuine efficiency.”

Doctor Fitzpatrick recognizes that the legislature and the execu-
tive should be adequately informed in regard to the needs of a
particular institution, and that a budget proposal should express
in much detail the directions in which funds are needed. He makes
this comment, however: “While the budget proposals are pre-
sented in great detail, the legislative bill proposes action only upon
certain totals. It is not proposed that the Legislature shackle
the administration by making (into) law all the supporting detail
of the budget. The formation of the budget proposals is therefore
in certain lump sums and not in the minute detail of the ‘segreg-
gated budget’. If there is no accounting control and no super-
visory control, or officials are dishonest, or public funds are dissis-
pated, there may be excuse for detailed legislative appropriation,
but if administrators are to be given an opportunity to serve the
public they must not be mere automatons, registering legislative
edicts in all their minute detail.”

It does not appear that this institution has been accused of wasting
or misdirecting public funds, and it does appear that for thirty
years the institution made progress and accomplished results which were regarded as satisfactory by the agricultural people of the State with a budget either a single lump sum or segregated into not more than three or four divisions.

**SALARY AND WAGE CONDITIONS.**

The increased cost of living constitutes a hardship to persons holding salaried positions. The value of a dollar has been nearly cut in half during the past few years. Little or no increase in the salaries of State employees has been allowed. It is true that by chapter 556, Laws of 1918, a ten per ct. advance was granted on all positions where the compensation is less than $1,500 per year, with the provision that the addition of this ten per ct. shall not cause the salary to exceed $1,500. This small increase falls far short of measuring up to the increased cost of living, and either State employees were greatly overpaid five years ago or they are greatly underpaid now. Organized labor seems to have little difficulty in securing a reasonable advance in wages, but teachers, investigators and certain other State employees appear to have received very inadequate attention in this particular.

During the past summer artisans employed in the erection of a new building on the Station grounds were receiving considerably larger pay than certain members of the Station scientific staff, and greatly larger than useful employees acting as assistants to the scientific staff. This state of affairs will have but one result, namely, it will be impossible to hold valuable services against the attractions of commercial positions and of institutions in other States. If the State of New York expects that its College of Agriculture, its Experiment Stations, indeed all its facilities for agricultural education, are to maintain high standards, it must give practical recognition to the fact that the success of all these efforts depends upon the intellectual and professional quality of those engaged in these lines of work, and that the State must maintain the standard of the work it has established in the face of vigorous competition.

**NEW POSITIONS.**

The salary recommendations in the budget adopted by your Board look to the establishment of the position of Bio-chemist on a basis independent of other departments. There is scarcely any
field of investigation in which chemistry does not play an important part. This is especially true with reference to biological problems, whether pertaining to botany, bacteriology, dairying or animal nutrition. No institution similar to this one should be without a strong department of biological chemistry.

It is highly important, indeed necessary, that in the immediate future we begin the preparation of museum material for illustrating the work which the Station has accomplished in the past. In order that this may be accomplished to a satisfactory extent it will be necessary to employ expert assistance. In view of the fact that two salaries have been or will be dropped from our payroll, I am urging that provision be made for the employment of such an expert at a salary of $2,000.

**THE NEW BUILDING.**

It is gratifying to report that the new administration, library and demonstration building, provided by the Legislature of 1916, has been completed, and is now occupied. It is proper that the public should now be informed as to the facilities which the building offers.

In the first place, it contains the administrative offices of the institution. A brief occupancy indicates that this will be found very satisfactory. Certainly the members of the administrative staff will find greater convenience, pleasure and encouragement in the facilities now placed at their disposal than was the case in the old mansion house which has for many years been occupied, and which was no longer adequate to the needs of the administrative work.

It is particularly true that the mailing department, upon which such a burden of effort is ordinarily thrown, and which needs so much space for the handling and storage of bulletins, is now in a position for far greater efficiency than has been the case.

The library has been moved to its new quarters, and under arrangements which it is hoped to make in the future it will be possible to bring together the now scattered portions which it has been necessary to distribute among the various departments.

The auditorium, which has a seating capacity of practically 600 persons, may now be placed at the disposal of the people of the State along any line that will promote agricultural progress. It is hoped that the various organizations of the State will find it con-
venient to meet with us in order to become more fully acquainted with the facilities of the institution and with the results of past investigations along various lines.

It is expected that the museum, for which we have adequate space, but which is not yet equipped with cases, will become a place of instruction where there may be visualized the various practical results which have been worked out through over thirty years of investigation. Such a museum will be unique in the character of its exhibits.

PUBLICATIONS.

The Horticultural Division of the institution has in process of preparation an additional volume, to be known as "The Pears of New York". This will be the sixth in the series of fruit books, and will probably be ready for distribution sometime during 1920.

The first Director of this Station, a distinguished scholar and botanist, Dr. E. Louis Sturtevant, left at the institution a very valuable collection of notes on edible food plants. As this collection involved an immense amount of labor and is most valuable, it was felt that it should be put in form for publication, with such additions and editing as would be found necessary. The Horticultural Division undertook this work, and the manuscript is now ready for the printer. In view of the important food problems which now face the world and which are likely to become more and more serious, it is certainly desirable that we have the fullest possible information as to the sources of human food. It is for this reason that the State is asked to publish this volume.

BUILDING NEEDS.

Attention has been called several times to our need for new plant houses and a new cold-storage house. Because of the demands of the war upon the finances of the State, your Board has not been insistent that immediate appropriations should be made for these purposes. This is a matter, however, which cannot be long delayed because the present buildings, thru age and decay, have reached a condition that will not permit our using them very much longer. The Legislature of 1920 should be asked at least to make adequate appropriations for these two buildings.
The distribution of Station publications for the year has been in accordance with the following figures:

**Popular Bulletins.**

- Residents of New York: 37,548
- Residents of other States: 2,486
- Newspapers: 767
- Experiment Stations and their staffs: 2,395
- Miscellaneous: 100

**Total:** 43,406

**Complete Bulletins.**

- Experiment Stations and their staffs: 2,395
- Libraries, scientists, etc: 400
- Foreign list: 396
- Individuals: 4,175
- Miscellaneous: 100

**Total:** 7,466

**RESULTS OF STATION WORK IN 1918.**

The following is a general summary of the activities of the scientific staff, with certain proposals as to future work. It is clearly evident that the work of the Station has not been as fruitful in all particulars as has been the case in former years. This is probably the experience of all other institutions of the same class, and the reasons for this lie entirely with the diversion of thought and the entering of war service by members of the staff.

**DIVISION OF AGRONOMY.**

*Statement of work in progress and projects proposed.*—During the season of 1918 the following lines of investigation have been under way:

**Field Work.**

(1) Seven coöperative experiments at various locations in the State on the fertilization of fruit, including pears, apples, grapes and cherries. These require supervision of annual care of orchards and vineyards, including application of fertilizers, harvesting of fruit, recording yields and growth records, also selection of proper cover crops in the fall.

(2) Six series of fertilizer plats on Station farm, work including direct supervision of soil preparation and application of fertilizer mixtures, seeding and planting, cultural care, harvesting, etc. This
field work takes the whole time of one field man from early spring to freezing up in fall.

(3) **Lysimeter work.**—This consists of the work connected with a set of 20 lysimeters, including planting annual crops in a regular rotation, analysis of all seed and fertilizer added, crops harvested and drainage waters collected from all tanks. This work takes up practically the whole time of one analyst.

(4) **Outdoor cylinder work.**—Work connected with a set of 48 tile cylinders. These are used in an experiment to determine the relation of calcium and magnesium carbonates to the growth of high alkali requiring crops. The soil is a Volusia loam of high lime requirements, and is compared with our Station soil.

(5) **Laboratory work.**—Besides the analytical work connected with our field, lysimeter and cylinder work, a considerable number of miscellaneous samples of material, especially lime and limestone, are analyzed annually. Such work is strictly confined to samples having a direct relation to a group of farmers, such as, for instance, the samples sent in by Farm Bureau workers. Anything with commercial bearing is rejected.

**Projects Proposed for Coming Year.**

(1) Sulphur compost work in cooperation with New Jersey Station. This consists of six large composts made up in such manner as to attempt to show the effect of bacterial action in rendering the phosphorus of floats available. The work consists of composting, mixing every ten days, and monthly analytical work on the same. At the end of incubation period of six to seven months, vegetation experiments are made on said composts. This work has now been running about twenty days.

(2) Proposed co-operative experiment with Department of Bacteriology, consisting of chemical and bacteriological studies of ammonification and ammonia fixation in manure and phosphate composts on a laboratory scale. Such work will be started immediately.

(3) Plant physiological work on the optimum mineral requirement of definite plants in water culture.

This work is an outgrowth of the work of Dr. B. E. Livingston, Doctor Shive and others, and is under partial direction of the former. This work has not yet been started at this date.
(4) Plant physiological studies of crops of high mineral content. This problem is under consideration.

(5) Some small plat work on varietal studies and selection of certain field crops, especially dent corn, spring wheat, and alfalfa varieties.

Cooperative Work Carried on by Department of Agronomy, Outside the Station Farm.

Orchard Fertilizer Experiments.

Pears ................................ Lawrence Howard ...................... Kinderhook.
Grapes ................................ George Hammond ...................... Fredonia.
Apples ................................ Vick & Dildine ...................... Elm Grove.
Apples ................................ E. L. Chapman ...................... Albion.
Cherries ................................ P. O'Neil ...................... Geneva.

Tobacco Rotation Experiment.

George Harris (government agent) ........................................ Baldwinsville.

Bacteriological and Dairy Divisions.

The members of these divisions have given their chief attention to the study of milking machines, stable and milk sanitation, and to a study of soil micro-organisms.

Milking machine investigations.—The need for labor-saving farm machinery during the present national crisis has caused the Station to give special attention to studies of milking machines. A recent census shows that there are about 5,000 milking machines in use in the State; but there would be many times this number if they were a complete success. Observation has shown that there are still many dairymen who discard the machines after two or more years of use, and one of the most frequent reasons given is that the machines are difficult to keep in a clean and sanitary condition.

Because proper testing of the sanitary efficiency of machines requires facilities for bacteriological analyses and dairy equipment not ordinarily possessed by manufacturers, the Station has felt justified in making extensive tests of the sanitary efficiency of the B–L–K machines which have been operated in our stables since 1908, and in making similar observations upon this type and other types of machines in use on farms in the immediate neighborhood. The results of these observations have been published during the year as Bulletin No. 450. In general, very few dairymen were found to be getting as satisfactory sanitary results as the Station is getting.
By using extreme care and facilities not found even on the best of our dairy farms, it was found possible not only to identify all of the sources of bacteria in and about B-L-K machines, but also to bring them under perfect control for short periods of time. When methods were used which were entirely practical for farms producing high-grade milk, the control, while less perfect, was sufficient to prevent the addition of significant numbers of bacteria to the milk drawn thru the machines.

In view of the fact that milk drawn thru machines thus cared for is more perfectly protected from unsanitary influences than is hand-drawn milk, the Station plans to continue these studies not only with the machines now in use, but also (where necessary because of fundamental differences in construction) with other types of machines. The object of the work will be to devise more convenient and usable methods of cleaning machines under ordinary farm conditions. Those methods which we now regard as the most successful have been described in a revised edition of Circular No. 54.

The control of market milk supplies.— During the year the coöperative studies upon methods of securing good milk, which were started in 1915, have been continued with good results. The control exercised has been based upon a laboratory analysis of milk samples secured from individual 40-quart cans of milk as they were delivered at the two pasteurizing plants which supply the larger part of the milk sold in the city of Geneva. During the first 30 months the only influence brought to bear upon the dairymen to induce them to bring good quality milk was a premium, varying from 8 to 24 cents per hundred pounds, which was offered for milk of a specified grade. Where the milk delivered continually failed to meet this standard, visits were made to the farms and analyses made to find the exact cause of the trouble. These results were reported to the dairyman with an explanation of the cheapest and simplest way of correcting the trouble.

At the end of 30 months it was found that payment based on the quality of milk, while effective in many cases, did not secure the elimination of unsatisfactory milk quickly, and beginning with July, 1918, more vigorous means of securing improvement have been used. Since that date the city health authorities have, after reasonable notice, excluded unsatisfactory milk wherever the dairyman
failed to care for his milk as directed. The effectiveness of this procedure is now being observed.

In the course of this work from five to six thousand samples have been examined yearly, a much larger number than has been examined in any other milk control laboratory in the State outside of New York City. Due to the simplicity of the microscopic method of examining milk developed at this Station, all of the work has been done by a single analyst. It is gratifying to note that this method of milk examination is coming into general use, having been accepted as a standard method of analysis both by the Committee on Standard Methods of Milk Analysis and by the surgeon-general of the United States army.

The studies made on individual farms in connection with this work have continued to uphold the conclusions previously reached (see Bulletin No. 443), that the sources of the excessively high numbers of bacteria found in the milk delivered at the pasteurizing plants were relatively few in number. The most important of these were cans which were improperly steamed and left moist with the covers on, improperly cleaned milking machines, and streptococccic infections of udders (garget or mammitis). Cooling of milk delivered within four hours after milking has been found to be unnecessary in the production of a milk of a grade equivalent to Grade A pasteurized. Even where the milk was from 12 to 16 hours old, excessively high bacterial counts were few in number wherever the above-mentioned sources of bacteria were under control, even tho the milk was as warm as 60° F.

The microscopic study of bacteria and fungi in soil.—The results of the work on the microscopic examination of soil mentioned in the Director's Report for 1917 has been published as Technical Bulletin No. 64. This bulletin gives the details of the technic which reveals the bacteria in the soil. It shows that the number of bacteria in soil is probably five, ten or even twenty times as great as indicated by the culture plate method (the only method available in the past for counting bacteria in soil). It furnishes additional evidence in confirmation of one point brought out in Technical Bulletin No. 51, namely, that the large spore-forming bacteria which are abundant in culture plates made from soil, actually occur in normal soil only as spores. The microscopic method does not reveal the presence of fungus mycelium in any soil except
where there is an unusual amount of organic matter, such as the leaf mold of woodland soil. In general, the microscopic examination of the soil has brought out that, when an organism is concerned which produces spores or any other resting stage, the plate count may not be an index of activity, but only of ability to produce spores, and its significance cannot be determined unless the microscope is used to distinguish between spores and active vegetative cells.

The ammonification of manure in soil.—The soil flora studies carried on by this division in previous years have shown what kinds of bacteria are to be expected in soil, but have given little indication as to the practical significance of the various kinds present. It is planned to follow up this work by learning which kinds predominate in soil under conditions of practical importance to agriculture and to study the activities of such kinds of organisms. The first condition of this sort selected is the decomposition of manure in soil.

When manure is mixed with soil, the organisms that increase in number to the greatest extent belong to the group of non-spore-forming bacteria described in 1917 in Technical Bulletin No. 59. The majority of these forms are difficult to recognize, but two types were found which could be identified with previously described species, and these two types were selected for study. They both proved to be vigorous ammonifiers of manure in soil.

The proof of the agency of any particular organism in some chemical transformation in the soil (such as the ammonification of manure) is not as simple as has often been supposed. To show that the organism causes the transformation in pure culture under laboratory conditions does not prove that it is the agent in this transformation in soil under natural conditions. In regard to the two ammonifiers selected for this work, however, more complete proof has been obtained than has been offered in the past to demonstrate the agency of any other soil bacteria in this process. This thorough test has been made because the general impression in the past has been that spore-forming bacteria, instead of non-spore-formers, were the most important ammonifiers in soil. The steps taken to obtain this proof, together with detailed descriptions of the two organisms in question is shortly to be published as a technical bulletin.

Ammonification in the manure pile.—Work is now in progress to determine which microorganisms cause the ammonification that
takes place in the manure pile, and to find an organism causing especially vigorous ammonia production. This work is expected to lead up to a study of practical methods of fixing this ammonia in the manure, thus preventing the loss of considerable nitrogen.

*Potato scab investigations.*—Little progress has been made upon this investigation during the year, chiefly because war conditions have temporarily stopped the coöperative work. Work on the classification of the group of organisms concerned (Actinomycetes) is still being continued.

**Coöperative Studies.**

Methods of controlling the sanitary quality of milk ........................................... White Springs Farm Dairy Company.
Geneva Milk Company.
Geneva Board of Health, and about 50 dairymen in the vicinity of Geneva.

Stable and milk sanitation ................................................................. Illinois Agricultural Experiment Station.

Potato scab investigations ......................................................... Department of Botany, University of Illinois.

**Statement of Amount of Babcock Glassware Tested from December 1, 1917, to December 1, 1918.**

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>10 per ct. bottles</td>
<td>16,734</td>
</tr>
<tr>
<td>8 per ct. bottles</td>
<td>18,032</td>
</tr>
<tr>
<td>30 per ct. 9-gram</td>
<td>84</td>
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<td>30 per ct. 18-gram</td>
<td>586</td>
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<tr>
<td>40 per ct. 9-gram</td>
<td>12</td>
</tr>
<tr>
<td>40 per ct. 18-gram</td>
<td>304</td>
</tr>
<tr>
<td>50 per ct. 9-gram</td>
<td>1,863</td>
</tr>
<tr>
<td>50 per ct. 18-gram</td>
<td>1,162</td>
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<td>50 per ct. 9-inch, 18-gram</td>
<td>242</td>
</tr>
<tr>
<td>50 per ct. 9-inch, 9-gram</td>
<td>349</td>
</tr>
<tr>
<td>17.6 c.c. pipettes</td>
<td>3,987</td>
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<tr>
<td>18 c.c. pipettes</td>
<td>122</td>
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<td>9 c.c. pipettes</td>
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<td>6 c.c. pipettes</td>
<td>66</td>
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<tr>
<td>8.8 c.c. pipettes</td>
<td>24</td>
</tr>
<tr>
<td>Skim-milk bottles</td>
<td>236</td>
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<tr>
<td>Acid measures</td>
<td>589</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>44,736</strong></td>
</tr>
<tr>
<td><strong>Total rejections</strong></td>
<td><strong>297</strong></td>
</tr>
<tr>
<td><strong>Number packages sent out</strong></td>
<td><strong>1,004</strong></td>
</tr>
</tbody>
</table>

**BOTANICAL DIVISION.**

*Seed testing.*—Bulletin No. 446, published in January, 1918, reports the results of seed tests made by the Station during 1916 and 1917. It gives the percentage of pure seed, foreign seed and
inert matter in each of 906 official samples of seed collected by agents of the Commissioner of Agriculture; also a summary showing the condition, as regards purity, of 1251 unofficial samples sent in by farmers and seed dealers.

Among the 906 samples analyzed, there were 51 which were violations of the New York seed law. Altho containing more than 3 per ct. of foreign seed, they were not so labeled when offered for sale.

The analyses of the unofficial samples indicate that there is much poor and impure seed on the market. Plainly, there is need of a stricter law governing the sale of agricultural seeds. All lots of seed containing 10 pounds or more, and sold for seeding purposes within the State, should be labeled in such manner as to show the purity and viability of the seed.

_The velvet-stemmed collybia—a wild winter mushroom._—This is the title of Bulletin No. 448, which contains an account of an edible fungus remarkable for its ability to withstand cold weather.

The velvet-stemmed collybia, *Collybia velutipes*, is a common wild mushroom which should be better known and more generally used for food. It has a reddish yellow cap, white gills and velvety brown stem. It grows in dense clusters on stumps, logs and partially buried wood of many kinds. Its principal season is October, November and May, but it may be found also in spells of mild weather during winter. The caps may freeze and thaw several times without injury.

In flavor and consistency it is excellent. Its most objectionable feature is the viscosity of the caps, which makes them disagreeable to handle and difficult to clean. The caps possess a remarkable capacity for the absorption of water. In the presence of moisture shriveled caps revive. Owing to its season of growth there is little danger of confusing the velvet-stemmed collybia with poisonous species and it is not often seriously infested with worms.

Preparation for cooking consists in the removal of the stems, picking off adhering leaves and blades of grass and washing. Peeling of the caps is unnecessary. A good way to cook the fungus is to boil it for thirty minutes, then fry for fifteen minutes in butter, oleomargarin or bacon fat, and season with salt and pepper.

Any surplus which it is desired to preserve for future use may be dried.
FIELD EXPERIMENTAL WORK OF BOTANICAL DIVISION, 1918.

Potato experiment ....................... L. L. Foote, Malone.
                                   W. S. White, Cadyville.
                                   F. A. Sirrine, Riverhead.

DIVISION OF CHEMISTRY.

BULLETINS PREPARED IN 1918 BY CHEMICAL DEPARTMENT.

1. Analyses of 550 Samples of Commercial Fertilizers.
2. Analyses of 971 Samples of Feeding-Stuffs.
3. Analyses of 120 Samples of Insecticides.
4. Studies of Milk.
   I. The Preparation of Pure Casein.
   II. Method for Making Electrometric Titrations of Milk and Other Solutions Containing Proteins.
   III. Free Lactic Acid in Sour Milk.

The methods which have been used for the preparation of casein from cow's milk produce an impure product, containing calcium caseinate, calcium phosphate, and often products formed from the hydrolysis of casein. Casein is a basic substance in the cheese industry and it is important to know its properties, which can be learned satisfactorily only from a study of the pure substance. The New method of preparing pure casein depends upon careful control of the introduction of acid into the body of the milk used, and simultaneous stirring of the milk by a mechanical stirrer revolving at a high speed. By this method not only can a pure product be made, but the time required is much shorter than by other methods and the yield of casein is larger.

In studying the chemical properties of casein it is desirable to add known amounts of acid to the milk or casein under study, and after each addition to determine the hydrogen ion concentration, instead of confining the work to titration with some indicator. The method devised accomplishes the desired results satisfactorily.

It has been the universal custom to speak of the acid constituents in sour milk as free lactic acid. Lactic acid in sour milk is present largely in combination as calcium lactate, but there is also some free lactic acid. Under ordinary conditions free lactic acid does not appear in appreciable amounts in souring milk for about 20 hours after inoculation with lactic acid organisms; the amount then increases more rapidly and in 48 hours is about 20 c.c. of tenth normal acid in 100 c.c. of milk. The rapidity of action and amount of free lactic acid present depend upon different conditions and especially the kind of organism present. The casein of milk begins to coagulate when the PH value reaches 4.64 to 4.78.
CHEMISTRY.

Status of Work.

Work has been practically completed during the past year in the following investigations:

1. A method for determining the condition of milk in relation of (a) abnormal water content; (b) pasteurization or heat; (c) presence of garget; (d) keeping quality. Practical applications in milk inspection.

2. Amount of carbon dioxide and carbonates in milk, and relation to abnormal milk.

3. Some properties of casein.

DIVISION OF ENTOMOLOGY.

Leaf-hoppers injurious to apple trees.—The investigation of the leaf-hoppers attacking apple trees was undertaken because early observations showed that more than one species was involved in serious outbreaks during recent years in apple orchards. It was believed that failure to recognize the different forms had probably led to errors in observations of the habits and life histories, and perhaps in recommendations relative to control measures. Detailed knowledge of the different forms was therefore of prime importance before conclusions could be drawn as to satisfactory repressive measures aiming either at the individual or collective control of the leaf-hoppers. The results of this study, as presented in Bulletin 451, show that apple trees are subject to attack by three species: Empoasca mali Le Baron, Empoasca unicolor Gillette, and Empoas rosae Linnaeus. These display great similarities in certain activities and in the resemblance of nymphal and adult stages. As pointed out, differences exist in their habits, life histories and structures by which the various species may be accurately and readily identified. Contrary to certain recorded observations, E. mali hibernated largely, if not exclusively, in the adult stage. Two generations were observed. The species E. unicolor spent the winter in the egg stage and was single brooded, while E. rosae overwintered in the egg stage, largely on roses, altho a few eggs were placed on apples. This latter species had two generations.

The leaf-hoppers differ considerably in feeding habits. The species E. mali obtains its food almost exclusively on tender terminal growth, causing a characteristic curling of the foliage. Both E. rosae
and *E. unicolor* feed largely on older leaves, and they may be found on young and old apples trees. The former is more abundant on older trees, while the latter is more numerous on younger trees. Leaves attacked by the two species display white stippling of the upper surfaces.

In experiments with the leaf-hoppers as carriers of fire blight (*Bacillus amylovorus* Burrill) positive results were obtained with *E. mali*. No infections were noted in similar efforts with associated species, and the role of these as potential carriers of the disease was not clearly indicated.

The leaf-hoppers have a number of natural enemies, as various small spiders and hymenopterous parasites. A common and destructive enemy of *E. rosæ* is the egg parasite *Anagrus armatus* Ashmead. For protection from leaf-hoppers, chief reliance should be placed on spraying with soap and nicotine mixtures to combat the younger nymphs. A supplementary measure is destruction of weeds which harbor the insects. Attention is also called to the fact that *E. rosæ* breeds abundantly on currants and gooseberries, which should be considered in any plans that provide for the interplanting of apples with these bush fruits.

The grape root-worm.—The serious losses caused by the excessive numbers of the grape root-worm (*Fidia viticida*) in vineyards of western New York, and the many unsuccessful efforts of grape growers to control this pest led to a series of field tests during six seasons (1910 to 1915 inclusive) to learn the causes of these failures, and to evolve more practical methods of control. The results of these efforts are presented in Bulletin No. 453.

Having found during the first season's experiments that the beetles are susceptible to poison baits, the investigation developed along two lines: (1) To determine the effect of bordeaux mixture and poison upon the beetles; and (2) to learn the best method of using molasses and arsenate of lead in the spraying scheme. Two applications of bordeaux mixture and arsenate of lead applied at an interval of about 10 days were found to control efficiently the grape root-worm, and it was also noted that the effects of applications during successive seasons are cumulative. In seasons when the beetles were numerous the reduction in the number of beetles was generally not as marked with this system of treatment as with an application of molasses and arsenate of lead followed with a supple-
mentary spraying within a week with bordeaux mixture and arsenate of lead. The important sources of failure with both systems are lack of thoroness and improperly timed applications, either the first spray being applied too late or the interval between sprayings being too long. An additional cause of failure when the sweetened poison is applied is the lack of adhesiveness which results when molasses is added to arsenate of lead. If rains occur shortly after the spraying, there is danger that much of the material may be washed from the leaves. Laboratory tests indicate that this loss of adhesive properties is due to the cane sugar in the molasses. While studies are now under way to overcome this defect, field tests have proved that, if the vineyardist studies the weather and applies the sweetened poison at a time when rain does not occur in less than three days after the spraying, a large number of beetles will be killed. An application of bordeaux mixture and arsenate of lead within a week, or at most 10 days, after the molasses spray is advised in order to protect the vines from invading beetles, as well as to prevent losses from powdery mildew. Two gallons of molasses in each 100 gallons of spray material was found to give somewhat better results than one gallon, and a cheap stock molasses proved more effective than the refined grades.

Altho nicotine sulphate can be used in bordeaux mixture and arsenate of lead with safety on foliage of Concord grapes, a combined spray for the grape root-worm and the grape leaf-hopper (*Typhlocyba comes*) was not found to be feasible, at least during the seasons when the tests were made, since the periods when control measures are effective for the two insects do not coincide.

Incidentally it is to be noted that the number of grape root-worms fluctuated considerably during the several seasons that the investigation was in progress, and this was found to be related to the prevalence of certain ground beetles which are predaceous enemies of this pest.

*Insect injuries of apple fruit.*—The enforcement of the New York State Apple Grading Law had clearly shown the necessity on the part of orchardists of a more careful discrimination of fruits with respect to their imperfections. Attempts to grade fruits more closely have led to an unusual demand upon the Station for information as regards the nature of the agents that are responsible for the disfigurement of apples. The purpose of Circular No. 57 is to help
the fruit-grower to distinguish the different kinds of insect injuries that appear on the fruits at picking time. In many cases the work of the insect is quite characteristic and often more conspicuous than the pest itself. When the grower has once learned to recognize these defects, he can easily tell which insects are least under control in his orchard, and can modify his spraying practices accordingly. Only those insects are considered which attack the fruits, and the extent of this injury is not always a measure of the damage caused by a particular species. Many serious pests do not work on the fruits at all. There are some insects which destroy more fruits than are apparent from the results at picking time. For example, bud-moth larvae and leaf-rollers cause many of the young fruits to drop, so that evidence of the injury is not present later in the season. The circular contains illustrations of the injurious work of fourteen of the more important insects that attack apples, and a chart which shows clearly the periods in the development of the fruits when damages occur. There is also included a spraying schedule which outlines the principal treatments for the protection of apple trees.

<table>
<thead>
<tr>
<th>Coöperative Experiments, Division of Entomology.</th>
<th>Coöperator.</th>
<th>Location.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control of pear thrips.</td>
<td>A. W. Hover.</td>
<td>Germantown.</td>
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<tr>
<td>Control of pear thrips.</td>
<td>Wessel Ten Broeck.</td>
<td>Hudson.</td>
</tr>
<tr>
<td>Control of pear thrips.</td>
<td>F. B. Harrington.</td>
<td>Hudson.</td>
</tr>
<tr>
<td>Control of pear thrips.</td>
<td>Fred and William Hallenbeck.</td>
<td>Hudson.</td>
</tr>
<tr>
<td>Control of pear psylla.</td>
<td>Oswego County Farm Bureau, E. Victor Underwood, Manager.</td>
<td>Oswego.</td>
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<td>Control of pear psylla.</td>
<td>E. J. Lonis.</td>
<td>Hannibal.</td>
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<td>Control of pear psylla.</td>
<td>Middlewood Farms.</td>
<td>Varick.</td>
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<td>Control of pear psylla.</td>
<td>Fred Hammond.</td>
<td>Geneva.</td>
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<td>Control of rosy aphis.</td>
<td>E. S. Gifford.</td>
<td>Gasport.</td>
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<tr>
<td>Control of rosy aphis.</td>
<td>S. F. Burton.</td>
<td>Ransomville.</td>
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<td>F. D. Weaver.</td>
<td>Lockport.</td>
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<tr>
<td>Control of rosy aphis.</td>
<td>Lynn Burrows.</td>
<td>Albion.</td>
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<tr>
<td>Control of rosy aphis.</td>
<td>C. M. Harding.</td>
<td>Knowlesville.</td>
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<tr>
<td>Control of rosy aphis.</td>
<td>Mrs. Ida Lafer.</td>
<td>Albion.</td>
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<tr>
<td>Control of rosy aphis.</td>
<td>H. E. Wellman.</td>
<td>Kendall.</td>
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<tr>
<td>Control of green apple aphis.</td>
<td>Orleans County Farm Bureau, L. C. Steele, Manager.</td>
<td>Albion.</td>
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Nature of activity. | Coöperator. | Location.
---|---|---
Control of green apple aphis | Donahue, McCrelish, Mack Company | Holley.
Control of green apple aphis | Thomas Mack | Holley.
Control of green apple aphis | B. G. Wilson | Waterport.
Control of green apple aphis | Mrs. George Rollie | Lyndonville.
Control of green apple aphis | Dayton True | Holley.
Control of green apple aphis | D. A. Salisbury | Holley.
Control of green apple aphis | John Beckwith | Lyndonville.
Control of green apple aphis | E. M. Mower | Carlton.
Control of green apple aphis | Ora Lee | Albion.
Control of green apple aphis | Clarence T. Powley | Lyndonville.
Control of green apple aphis | Ralph Wilson | Holley.
Control of green apple aphis | J. T. Peck | Albion.
Control of green apple aphis | C. M. Harding | Knowlesville.
Control of green apple aphis | E. C. Paine | Albion.
Control of green apple aphis | Leslie Tanner | Medina.
Control of green apple aphis | William Thiel | Lyndonville.
Control of green apple aphis | A. A. Comstock | Kent.
Control of green apple aphis | Clark Allis | Medina.
Control of green apple aphis | H. H. Freeman | Kent.
Control of cherry aphis | McKay Brothers | Geneva.

HORTICULTURAL DIVISION.

The Horticultural Division has published but one bulletin in 1918. This is No. 447, entitled "Newer Varieties of Strawberries." It contains full descriptions of 61 varieties, including discussions of such horticultural matters as yield, vigor of variety, health, sex of plants, season of bloom, ability to make plants, size of fruit, season of ripening, flavor and quality. A list of the most desirable of the 61 varieties is given.

The Department is preparing for publication data on fertilizers for apples in the orchard of Rome Beauties on the Station grounds. Eight years have elapsed since the first report on this experiment, and sufficient additional data have now accumulated to make a second report desirable.

A report is also being prepared on the work being done in the greenhouse with violets, to throw light on inheritance in asexual reproduction. This is the fifth season that this experiment has been under way, and data are now at hand sufficient to make a more or less valuable contribution to the subject under consideration.

The status of other work in the Department is given in a very general way in a few words. Experiments in breeding apples, pears, grapes, raspberries and other small fruits continue with indications of valuable results with all of these plants, both as a study of inheritance in the plants and as a means of producing new varieties, a number of which are now under test at the Station and elsewhere.
The Station has produced valuable new varieties of fruits in the past, and has been confronted with the problem of distributing these to the people of the State in an effective way. Recently a corporation has been formed for the purpose of accomplishing such distribution of our new varieties that are worthy of attention by growers. This is not to be a money-making organization, but through it it is hoped to place within reach of the fruit-growers of the State such new varieties as secure commendation on the Station grounds and elsewhere.

FIELD EXPERIMENTAL WORK OF HORTICULTURAL DIVISION, 1918.
Vineyard experiments, Fredonia and Urbana.

POULTRY DIVISION.

So far as possible, chief attention has recently been given to working up and tabulating data collected in experiments to study the importance of certain mineral nutrients in the food for poultry. Some of the manuscript for report of this work is now being prepared.

Because of the greatly increased cost of standard foods, special attention has been given to a continuation of feeding experiments with poultry, that have been carried on before as opportunity permitted, relative to the importance of coarser vegetable food and to the utilization of waste foods.

Work on selective breeding experiments with poultry has been continued, involving during the year the testing of individual birds and the rearing of young from numerous matings.

In a study of soil requirements as to certain constituents, chiefly calcium and sulphur, experiments have been continued with soil plats which have been modified by annual applications of chemicals and growing crops to secure a gradual change without sudden disturbance of natural conditions. Buckwheat was the crop grown on these plats this year.