U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 79.

Experiment Station Work—VI.

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ANTHRAX.

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CONTENTS OF THE SERIES OF FARMERS' BULLETINS ON EXPERIMENT STATION WORK.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., June 15, 1898.

SIR: The sixth number of Experiment Station Work, prepared under my direction, is transmitted herewith with the recommendation that it be published as a Farmers' Bulletin.

Respectfully,

A. C. TRUE,
Director.

Hon. JAMES WILSON,
Secretary of Agriculture.

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EXPERIMENT STATION WORK—VI.[1]

FRAUD IN FERTILIZERS.

The value of commercial fertilizers annually used in the United States is estimated at from $35,000,000 to $40,000,000. The fertilizer industry in this country has grown to these proportions within fifty years. It was but natural that a business growing so rapidly and offering such opportunities and temptations for fraud and imposition should have early become a field for extensive operations of unscrupulous and dishonest men. Fraud became so prevalent as the industry developed in one State after another that there was an urgent demand both from the consumers of fertilizers and from honest manufacturers and dealers in fertilizers for laws providing for the inspection of fertilizers with a view to the prevention or the detection and punishment of fraud. Every State in which commercial fertilizers are used to any great extent has now provided for such inspection (see p. 7). The work in the majority of cases has been assigned to the agricultural experiment stations of the different States and forms one of their most important and exacting duties. In some cases the stations cooperate with the State boards of agriculture, while in a few instances the inspection is entirely in the hands of the latter or of the State chemist. Thousands of analyses of fertilizers are made and reported by the inspection officials each year, accompanied in most cases by general information relating to fertilizers. These reports may usually be had on application to the proper officials (see p. 7).

This system of inspection has been very effective in repressing fraud, but it has by no means eliminated it from the fertilizer business. The

[1]This is the sixth number of a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint our farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended on to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. TRUE, Director, Office of Experiment Stations.

man who peddles a worthless "formula" at an exorbitant price or exploits under a high-sounding name a mixture which has little or no value as a fertilizer is still abroad in the land.

As a bulletin of the Maine Station states—

There are two claims which generally characterize the representations of the companies and agents selling these questionable goods:

(1) The process of manufacture is a secret one, having been "discovered" by some one who is generally unknown either to science or practice.

(2) The "fertilizer," or "food," either contains ingredients of which the whole world, outside of a favored few, is ignorant, or else certain ingredients are so wonderfully compounded as to produce marvelous results.

The inspectors of fertilizers report examples of this from all parts of the country. The mere existence of such "business" proves that in spite of the work of inspection officials there are still persons who allow themselves to be imposed upon by extraordinary claims or plausible representations. There is abundant evidence that through credulity, lack of accurate knowledge, and hasty judgment the farmers of the country suffer to a considerable extent each year at the hands of "agents" of such business.

As the Maine Station bulletin already quoted states, "in too many instances the goods are first bought for cash or on credit, invariably at an unusually large price, and then after the act is past recalling information is sought as to the character and value of the 'fertilizer' or 'food' purchased. If accurate information were first obtained in these cases, there would be less of these transactions where value is not received for the money paid." Such information can always be had for the asking from the agricultural experiment stations or from the officials charged with the inspection of fertilizers in the different States. (See list on p. 7.)

In a recent bulletin relating to a fraudulent fertilizer "formula," the North Carolina Station says:

The farmers of the State are urgently advised not to pay any money for fertilizing formulas, as the station is ready and willing to suggest any mixture for any crop, using any materials at hand or most convenient to be had. It has in the past distributed many hundreds of these formulas, and is distributing them every day. These formulas are sent entirely free, and are made up in proportions that are known to be correct, not only from a scientific but a practical standpoint. Of what earthly use is it to buy from a man, at a high price, a set of figures which nine times out of ten is incorrect and, even if correct, could be had by application to the station without cost?

There is a large class of fertilizers on the market which are not strictly fraudulent, although extravagant claims are made for them. They are often sold at low prices but are nevertheless very expensive. They are sold at low prices because they contain very small amounts of fertilizing constituents in the form of low-grade materials, the greater part of the mixture being worthless makeweight. It may be laid down as a general rule that such low-grade fertilizers are actually more expensive than high-grade goods. It costs just as much to mix, bag,

and ship a ton of material furnishing 50 pounds of actual fertilizing constituents (phosphoric acid, potash, and nitrogen) as it does the same amount of a fertilizer furnishing 500 pounds of valuable constituents. The farmer therefore must be guided not by the price per ton, but by the actual amounts of fertilizing constituents which the fertilizer contains and the requirements of his own crops and soils.

The purchaser of fertilizers is generally, but not always, justified in regarding with suspicion a fertilizer for which extraordinary claims are made. While the best fertilizing materials—superphosphates, potash salts, nitrates and ammonia salts, industrial by products such as tankage, dried blood, cotton-seed meal, etc.—have become standard articles of commerce and there is no good reason why fertilizers compounded from them should not stand on their merits and be sold under easily understood names, absurd names and extravagant claims have in many cases cast suspicion upon mixtures of these standard articles which are really high-grade fertilizers. This practice partakes of the nature of quackery, and, as Dr. C. W. Dabney has stated, "the nostrum excites the suspicion of the sensible man; the staple article inspires his confidence." For this reason, as Dr. Dabney further states—

Farmers who take their life work seriously and study earnestly the experimental work of the State stations, for the purpose of informing themselves with regard to the useful ingredients of fertilizers, the proper method of applying them, and such matters, * * * are getting more and more into the habit of buying the raw materials for fertilizers and mixing them themselves, or else they have a compound mixed at a factory according to their own formula and from materials of their own selection.

For the convenience of those desiring information and advice regarding fertilizers the following list of official inspectors of fertilizers is given:

Official inspectors of fertilizers.

Alabama.—Commissioner of Agriculture, Montgomery.
Arkansas.—State Chemist, Arkansas Industrial University, Fayetteville.
Connecticut.—Director, Agricultural Experiment Station, New Haven.
Delaware.—State Chemist, Delaware College Agricultural Experiment Station, Newark.
Florida.—Commissioner of Agriculture, Tallahassee.
Georgia.—Commissioner of Agriculture, Atlanta.
Illinois.—Secretary of the Board of Agriculture, Springfield.
Indiana.—State Chemist, Purdue University, Lafayette.
Kentucky.—Director, Agricultural Experiment Station, Lexington.
Louisiana.—Commissioner of Agriculture and Immigration, Baton Rouge.
Maine.—Director, Agricultural Experiment Station, Orono.
Maryland.—State Chemist, Maryland Agricultural Experiment Station, College Park.
Massachusetts.—State Chemist, Hatch Agricultural Experiment Station, Amherst.
Michigan.—State Chemist, Michigan Agricultural College, Agricultural College.
Mississippi.—State Chemist, Mississippi Agricultural and Mechanical College, Agricultural College.
Missouri.—Director, Agricultural Experiment Station, Columbia.
New Hampshire.—Secretary of the State Board of Agriculture, Concord.

New Jersey.—Director, New Jersey Agricultural Experiment Station, New Brunswick.
New York.—Director, New York Agricultural Experiment Station, Geneva.
North Carolina.—Commissioner of Agriculture, Raleigh.
Ohio.—Secretary of the Board of Agriculture, Columbus.
Pennsylvania.—Secretary of Agriculture, Harrisburg.
Rhode Island.—Secretary of the Board of Agriculture, Providence.
South Carolina.—Secretary, Fertilizer Department, Clemson College.
Tennessee.—Commissioner of Agriculture, Nashville.
Vermont.—Director and Chemist of the Agricultural Experiment Station, Burlington.
Virginia.—Commissioner of Agriculture, Richmond.
West Virginia.—Director, West Virginia Agricultural Experiment Station, Morgantown.
Wisconsin.—Chief Chemist, Agricultural Experiment Station, Madison.

THE SUGAR-BEET INDUSTRY IN THE UNITED STATES.

Sugar is a prime necessity in every household. In 1896 the United States consumed about 1,960,000 tons of sugar, or about 62 pounds per head annually. Of this amount over 1,670,000 tons came from abroad. The desire to meet, at least in part, this enormous demand for sugar by home production has led to efforts by the Department of Agriculture, the experiment stations, and similar institutions to demonstrate the feasibility of supplementing the sugar industry of Louisiana by a sugar-beet industry. As a result of these efforts the culture of sugar beets for sugar-making purposes is receiving widespread attention in the United States at the present time. Many of the experiment stations have carried on experiments in the culture of sugar beets for several years past with very encouraging results, and at present a large majority of the stations in the country are studying the subject. The experiment stations of Arizona, Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Missouri, New York, Ohio, Oregon, Pennsylvania, South Dakota, Utah, Washington, Wisconsin, and Wyoming have recently issued bulletins on the subject of sugar beets. The United States Department of Agriculture has cooperated with the stations in this work and has just reported the results of experiments during 1897 in almost every State and Territory.

These experiments have shown that there are wide areas in the United States adapted by soil and climate to the growth of sugar beets. While the beet has generally attained its greatest perfection in what are called north temperate latitudes, the tests which have been made in different parts of the United States show that the lines must not be drawn too closely in this respect. Beets of excellent quality have been grown in regions having very dissimilar climates. For a large part of the United States the amount and distribution of rainfall or other supplies of water seem more important considerations than the temperature. An average of 2 to 4 inches of water per month during the summer is considered necessary for the normal growth of beets, but it is especially important that the weather should remain dry during the ripening and

harvesting of the beets, otherwise new growth will start and the sugar rapidly disappear. Where irrigation is practiced the water supply is, of course, under control, and experiments in the irrigated region of the United States have shown that beets of fine quality can be produced with an artificial water supply. The Colorado Station has found that in order to secure good beets the last irrigation should be made about six weeks before maturity.

"In general it may be said that any soil which will produce a good crop of Indian corn, wheat, or potatoes will, under proper cultivation, produce a good crop of sugar beets. The soil on which sugar beets are grown, however, should be reasonably level, and this being the case it should be well drained." The draft of the sugar beet upon the soil is not great provided the tops and factory by-products are returned to the farm.

The varieties of beets which have been most widely tested and have given the most satisfactory results are White Improved Vilmorin and Kleinwanzlebener. Seeds are now imported almost exclusively, but farmers and seedsmen might profitably turn their attention to the raising of seed.

It is not the purpose of this article to enter in detail into methods of culture. These are explained in full in a bulletin of this Department.[1] It suffices to state here that the object kept constantly in mind should be the production of a beet of a high sugar content and paying yield. It must always be borne in mind that the largest beets are not the sweetest. Any undue increase in the size is almost sure to be accompanied by a decrease in sugar content. Beets weighing from 1 to 2 pounds are considered the best for sugar making. When beets are paid for by the ton it is of course to the farmer's advantage to secure as large a yield as possible, but the manufacturer at the same time has a right to demand that quality shall not be sacrificed to size, and that the beets which he buys shall contain a sufficiently high percentage of sugar to make manufacture profitable.

In order to secure such beets it is absolutely essential to deeply and thoroughly prepare the soil. No fact has been more clearly brought out by experiment than this. "It is of the highest importance that the land intended for beet raising should be plowed deeply enough to permit the beet to develop its normal shape and still not protrude above the ground. The soil should be loosened to a depth of not less than 15 inches."[2] It is probable that neglect to observe this precaution has been responsible for a large part of the failures to produce beets of good quality which have been reported from different localities. Some of the effects of an improperly prepared soil are shown in the accompanying illustration on page 10 (fig. 1).

From what has been said it is evident that there must be mutual

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[1] U. S. Dept. Agr., Farmers' Bul. 52.

[2] Indiana Sta. Bul. 68.

understanding and cooperation between the farmer and the manufacturer. As soon as farmers in a given locality can demonstrate their ability to grow a beet of high sugar content and will bind themselves to supply such beets in the necessary quantities, manufacturers will not be slow to establish factories wherever the other conditions (of location, transportation, etc.) are favorable. "The manufacture of beet sugar is an industry entirely distinct from agriculture, and can only be successfully accomplished by the investment of large capital under the

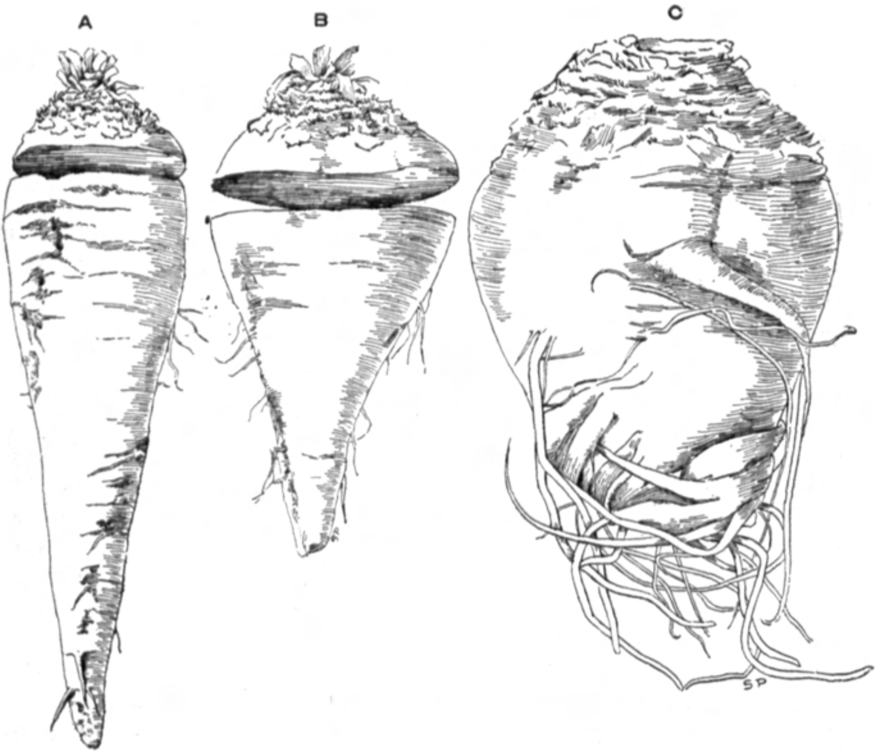

FIG. 1.—Different-shaped beets: *A*, a well-shaped beet grown in good soil with a porous subsoil, 15 per cent waste in trimming; *B*, a poorer-shaped beet, the result of a hard subsoil or other unfavorable conditions which caused the root to grow mostly near or above the surface of the ground, 33 per cent waste in trimming; *C*, a very large beet grown in rich soil and well tilled, but subsoil too hard and beets allowed too much room. (Adopted from New York Cornell Station Bul. 143.)

direction of skilled artisans. From the nature of the process it is quite improbable that any simple method of home manufacture of beet sugar will ever prove commercially successful. * * * The farmers of this country, as is the case with those of Europe, in respect of the beet-sugar industry, must be satisfied with acquiring the requisite degree of agricultural skill to produce a crop of beets with a paying tonnage and a high content of sugar."[1]

[1] U. S. Dept. Agr. Farmers' Bul. 52

In order that the sugar-beet industry may be successfully established in the United States it will be necessary to determine definitely the regions especially adapted to the beet and to confine its culture to those areas. It will also be necessary for the farmer to learn and practice methods of culture which will produce a beet of high sugar content and fair yield per acre. As a bulletin of the New York State Station states, "Farmers may not expect to realize unusual profits for any long period of time from the growing of sugar beets. The crop promises to become one which will give satisfactory returns to those who learn to grow it successfully."

As a recent bulletin of the Pennsylvania Station shows, the estimates which have been made of the cost of raising sugar beets are very variable, ranging from $20 to $70 per acre. A conservative estimate is probably $30 to $40 per acre, although the cost of production will naturally depend upon local conditions, and especially upon the experience and intelligence of the grower. The general experience has been that the second year's crop is more cheaply produced than that of the first year. If $4 be assumed as an average price per ton for the beets, and the yield from 10 to 15 tons, the total value of the crop at the factory would range from $40 to $60 per acre. To this should be added the value of the diffusion residue or pulp from the factory which forms a palatable and nutritious food for stock.

Farmers can well afford to undertake experiments with sugar beets on a limited scale for the purpose of familiarizing themselves with methods of culture and of determining the adaptability of their soils to the production of beets. Even if factories are not established to work up this product it can be utilized to advantage on the farm, since the beets form a valuable food for stock.

SEEDING GRASS LAND WITHOUT A NURSE CROP.

The practice of sowing grass and clover seed with crops of grain is a very common one and undoubtedly has many advantages on rich soils and in a favorable season, the most marked of which is the choking out of weeds by the vigorous growth of the grain. In many cases, however, this method fails. Especially is this true in dry seasons when the supply of moisture is frequently insufficient for both the grain crop and the grass. In this case the grain instead of acting as a nurse crop actually robs the young grass plants of moisture, and thus becomes injurious instead of advantageous.

The claim that grass and clover plants need protection from the sun is entirely without foundation. As the Wisconsin Station has shown, "there is absolutely no necessity, under ordinary conditions, for sowing oats, barley, or any other grain with grasses for the purpose of yielding shade and protection. Young grass and clover plants are not injured by direct sunlight and sun heat any more than other plants of our fields."

Experiments by the Wisconsin Station during a number of years have shown that "grasses and clover sown by themselves on properly prepared soil spring up at once and make rapid growth, bearing seed heads the same year. If all conditions as to fertility of soil, moisture, etc., are favorable, a very excellent crop of hay can be secured the same season." One objection to this method of seeding grasses is the presence of weeds, but these can usually be checked by running a mower over the fields when the weeds are 6 or more inches high, setting the cutter bar so that the tops of the weeds are removed while the grass plants are not touched.

In order that this method of culture may be successful the soil must be quite free from weed seeds and of fair fertility. It should be carefully prepared before seeding and from two to three times the usual amount of grass seed should be sown. It is probably best, although not fully demonstrated, to sow seed very early in the spring. Finally, it is of the greatest importance to check the growth of weeds, which may be done by the method noted above.

"The system here under consideration is not put forth as suited to every farm and all farmers, but eminently adapted to meeting the wants of those who desire to secure with the least possibility of failure a fine stand of grass and clover. To such we can recommend the system as having been sufficiently tried to prove satisfactory when properly followed out."

The results obtained by the Wisconsin Station have in general been borne out by those of similar experiments at the New Jersey Station. The experiments by this station, however, differed from those conducted by the Wisconsin Station in the fact that at the former the seed was sown in the fall instead of in the spring.

GRAFTING APPLE TREES.

Probably no topic connected with apple growing has received more discussion than the methods of grafting, the most diverse opinions being held by nurserymen and apple growers. The Kansas Station has recently reported experiments in which some important points in regard to root grafting apples were brought out. The object of the work was to determine the relative merits of various lengths of stock and scion, and of various positions of the graft on the stock. The tests were carried through a number of years and in all several thousand grafts were made. The stocks used were all No. 1 seedlings, most of which were regraded to get a uniform lot. The scions were also as uniform as possible.

In the first experiment 6-inch Ben Davis scions were grafted on different parts of roots. The tops of seedlings were cut off below the crown and the roots cut into three pieces. One hundred grafts were made with the upper parts of the roots, 100 with the middle parts, and

100 with the lower parts or tips of the roots. About 80 per cent of the grafts made with the upper and middle parts of the roots grew and at one and two years old there was little difference between the trees grown from them. Of the grafts made with the root tips only 60 per cent grew. The first season the trees of this lot averaged one-third less in height than the other lots and were more slender and weak. The second year the difference was less marked. The same year that the above experiment was begun 100 Ben Davis scions 2 feet long were grafted on the upper parts of roots cut below the crown. At two years old these trees were about one-half larger and stronger than the trees from 6-inch scions on similar stocks. Many of the tops were so heavy as to necessitate summer pruning.

In 1893 more extensive experiments were made. Wine Sap, Missouri Pippin, Ben Davis, and Maiden Blush apples were used in each series of grafts made. Three lengths of scions, 6, 12, and 24 inches, were used. With each kind of scion four lengths of stocks were used, namely, piece roots, 1¼, 2½, and 5 inches long, and whole roots. For all piece-root grafts the upper parts of roots were used. In all cases except where 1¼-inch stocks were used one-half of the grafts were made 1 inch above the crown and the other half below the crown. Besides the above, a number of grafts were made on 2½-inch piece roots of small size. In all, 9,200 grafts were made. The grafts were set in nursery rows, with the place of union of stock and scion in all cases about 3 inches below the surface of the soil. The percentage of loss was great, owing to the very unfavorable spring and to the grafts having been stored in a cellar which was too warm. The loss with the whole root grafts was least and increased as the length of the root diminished. About 82 per cent of the whole-root grafts were living at the end of the first year, as against only about 49 per cent of the 5-inch, 17 per cent of the 2½-inch, 11 per cent of the small 2½-inch, and 6 per cent of the 1¼-inch piece-root grafts. From measurements made at the end of the third season it was shown that the greatest growth was made in trees grafted on the longest stocks and that the growth declined gradually, though slightly, with the shorter stocks, being about 11 per cent greater with the whole root than with the 1¼-inch piece-root grafts. The trees also showed a tendency to make the best growth from the longest scions, the growth being 11 per cent greater with the 24-inch scions than with the 6-inch ones. There was no constant difference in growth between the trees grafted above the crown and those grafted below it.

In 1894 the above experiment was repeated in part with Wine Sap, Ben Davis, and Missouri Pippin apples, using 6, 12, and 24 inch scions on whole roots and 5-inch piece-root stocks grafted above and below the crown. After two years' growth there was no constant difference between the trees grafted above the crown and those grafted below, either as regards height or diameter. The length of the stocks and scions had a marked influence on the growth, the difference in favor of

the long stocks and long scions being practically constant in all cases. The height of 2-year-old trees grafted on whole roots averaged 21 per cent greater than on 5-inch stocks and the diameter over 3 per cent greater. Trees from 24-inch scions averaged 10 per cent higher than from 12-inch scions and 20 per cent higher than those from 6-inch scions. Their diameters were 27 per cent greater than the trees from 12-inch scions and 34 per cent greater than those from 6-inch scions. These differences were not nearly so marked after the trees had made three years' growth, the diameter of the trees from 24-inch scions at that time averaging only 6 per cent greater than those from the 12-inch scions and only 7 per cent greater than those from the 6-inch scions, as against 27 per cent and 34 per cent, respectively, after two years' growth.

In 1895 grafts were made with 12 and 6 inch scions on whole roots, 5-inch roots, and 2½-inch roots, grafted above and below the crown. In addition, a stock grafted above the crown, with roots cut 8 inches long, was tested. After two years' growth no constant differences were shown in favor of either length or style of stock or of grafting either above or below the crown. The trees from 12-inch scions were invariably greater in height and diameter than those from 6-inch scions.

An experiment in root grafting was made by F. Wellhouse, president of the Kansas Horticultural Society. About 400 trees each of Wine Sap, Ben Davis, and Missouri Pippin apples, grafted on whole-root stocks, were set in the orchard together with trees grafted on 2-inch piece-root stocks. During nineteen years no difference in growth, vigor, or fruitfulness was observed between them, except that for the first six or eight years the whole-root trees threw up from their roots more water sprouts than the piece-root trees.

These tests show that there are fairly uniform differences in the first few years' growth of trees in favor of the longer scions and stocks, but that by the end of the third year's growth the differences largely disappear, and that there is no constant difference between trees grafted above and those grafted below the crown.

Besides the observations on the height and diameter of trees, the Kansas Station has also reported a study of the root development of grafted trees. It was found that the main root growth of the first year from all lengths of stock was made at or just below the union of the stock and scion, and that the growth at this point became more pronounced in the second and third years. The growth from the lower portion of the stock was very slight during the first year, and became of even less importance during the second and third years; the growth from the lower part of the stock was greatest in case of the shorter piece roots and least in case of the whole roots. With grafts that were buried deeply, a new system of side roots formed at about the usual depth below the surface of the soil, to the more or less complete dwarfing of the lower and earlier root system. This is shown in fig. 2, which represents the root development from a whole-root graft, which was

buried about 5 inches below the surface of the soil. The whitened portion of the root is the original stock. The other roots formed from the scion.

All these experiments go to show that the use of long scions and stocks may be of some little advantage to nurserymen in inducing a better growth of trees during the first two or three years. The long scions and stocks are, however, considerably more expensive than the shorter ones. Planting whole-root grafts is much more laborious than planting short piece-root grafts. In reporting these experiments the authors say that the difference in growth in favor of the longer scions and stocks is probably not sufficient to repay the extra expense made necessary by their use.

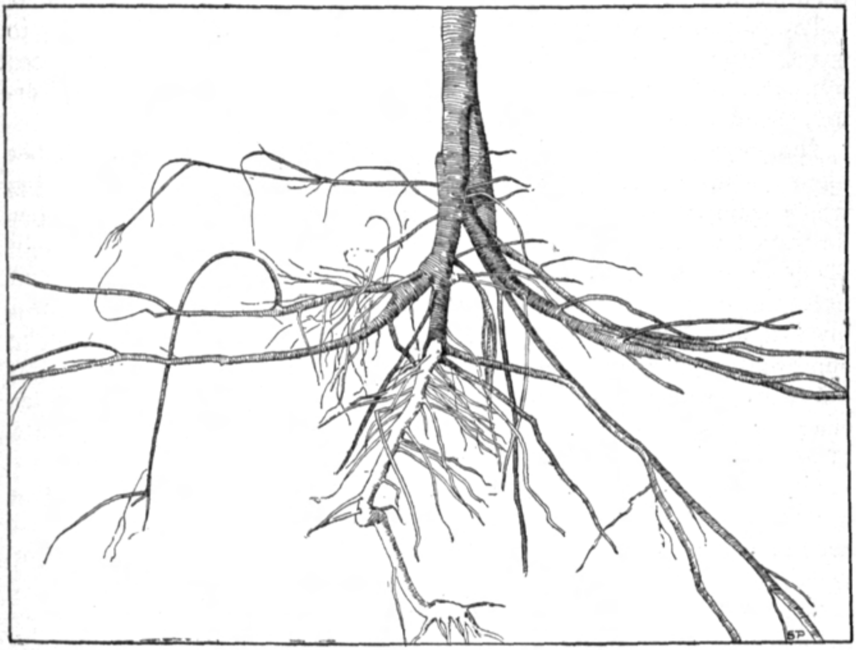

FIG. 2.—Root graft of apples.

For the fruit grower, at least in the locality of the Kansas Station, the longer stocks appear to have no advantage over the shorter ones, since trees produced from them make no greater growth than trees from the shorter stocks except in the first few years. The fact that the greater part of the root growth is made from the upper part of the stocks is evidence that the long stocks serve very little purpose. The production of roots from the scion, as occurred when short piece roots were used, is in many cases a direct advantage, since seedling stocks are very variable in hardiness and vigor of growth. Under the conditions at the Kansas Station piece roots from 2 to 5 inches long are thought to give the best results, all things considered.

FOREST FIRES.

Anyone who has had occasion to travel through the great forest regions of the country is struck with the tremendous losses due to fires. In the northern pineries and the coniferous forests of the far West vast areas have been almost denuded of trees, blackened, charred stumps marking the place where valuable timber once stood. Nor is the loss confined to the destruction of merchantable timber alone. Trees of unmerchantable size and seedlings which, if protected, would have served to replace the timber cut under rational management, are destroyed and the ground is often left bare, to be covered with weeds, grass, and less valuable trees. If upon a mountain side, watershed, or similar exposure, the soil is frequently swept away by the rains which, their natural barriers being removed, sweep down with torrential force.

The causes of forest fires are usually attributed to accident due to sparks from engines, carelessness regarding camp fires, clearing, etc., but not a few, especially in the West, have been due to intentional firing, the object usually being to secure better stock ranges.

The losses occasioned by the destruction of merchantable timber alone amount to millions of dollars each year. Definite figures for the whole country are not obtainable, but the estimated loss due to timber destroyed by forest fires in the State of Pennsylvania is more than $500,000 annually. To this must be added the value of fences and buildings destroyed and other incidental expenses. This is probably a low estimate, but if applied to all the States in the same proportion the sum would appear tremendously large.

We are warned that the consumption of timber in this country under the present system is vastly in excess of the production. Such a state of affairs necessitates some system of forest management. Under any system the question of fires must first receive attention. In 47 States and Territories forestry fire laws have been enacted, but many of them are insufficient, on account of lack of sentiment for their enforcement or from their inadequacy.

One of the greatest sources of danger in lumbering regions is the presence of tops, slashings, and débris. If these are looked after, properly piled and burned, much danger will be avoided. Such a plan is said to have been tried in Canada with success. In the Province of Ontario during 1895 it is said that the feasibility of destroying such waste was clearly established. The protective service was carried on at an expense of about 3¼ cents per 1,000 feet of lumber cut. The expense of burning waste by lumber companies was estimated at $5 per square mile. If these figures are applied to the three great lumber States of Michigan, Wisconsin, and Minnesota, it is claimed that a great part of the annual loss could be prevented at an expense of about $100,000 for each State.

The stations in cooperation with this Department are doing much to disseminate correct ideas about the need and importance of conserving

the forest resources of the country. The far-reaching effects upon agriculture, as well as upon other industries, of the destruction of forests make this a question which demands the most serious consideration of every farmer.

AMERICAN CLOVER SEED.

The misrepresentation to which American clover seed has been subjected abroad is well known to all who have investigated the subject. American clover has been reported as greatly inferior in chemical composition to that grown from European seed; it is claimed to be less hardy, and that stock dislike it on account of its great hairiness. By reason of this last characteristic, also, the plants are said to be especially subject to fungus diseases.

In 1897 the exports of clover seed were valued at more than $1,000,000. The introduction of such a large amount of seed into foreign countries tended to lower prices there somewhat, and almost universal condemnation of the American seed followed in the agricultural press of the Continent. This antagonism recently culminated in Austria-Hungary, when a consignment of clover seed, valued at more than $1,600, was excluded and sent back to New York, the explanation being that it contained seed of clover dodder (*Cuscuta epithymum*).

The dodders are well represented in this country. They live parasitically on large numbers of plants, but those known as clover dodders in Europe are not abundant with us. Dodder may be recognized by the yellowish, thread-like, leafless stems which run over and bind together the plants on which it lives. Often it forms such a compact growth that the mass of color is apparent at a considerable distance. The dodder plant is furnished with suckers, which penetrate the plant to which it is attached, robbing the host of its nourishment and causing its death after a time.

The contention that American red clover seed is inferior to European-grown seed and contains dodder seed needs considerable qualification, if it is not wholly erroneous. This can be readily shown from the published reports of the seed control stations of Europe, as well as by the testimony of some of the most prominent agricultural writers of the Continent. At Hamburg specimens of clover seed from Baltimore, Philadelphia, New York, Chicago, Milwaukee, Toledo, and Toronto were examined by an agent whom there is no reason to suppose is favorably disposed toward American seed, and but three samples were found to contain any dodder seed, and that was of a species quite different from the one concerning which complaint is made. Professor Nobbe, of the Tharand Seed Control Station, states that, while American clover seed is not always absolutely dodder-free, yet such is usually the case. He further states that the species of dodder, seed of which are sometimes found in American clover seed, must not be confounded with the clover dodder of Europe, the two being very different.

At the Hohenheim Seed Control Station, in 1895, it was found that out of 480 lots of red clover seed inspected, only 26 of which were of American origin, most of the others having been grown in central Europe, 29.6 per cent contained on an average 200 dodder seeds per pound. Of the alfalfa seed examined 20 per cent contained dodder, and more than 25 per cent of samples of white clover seed were similarly infested.

In the report of the Vienna Seed Control Station for 1890 it is stated that one-fourth of the red clover, one-half of the French, Italian, and Hungarian alfalfa, one-half of the alsike clover, and one-half of the timothy seed contained clover dodder seed. In the report of the same station for 1892 the percentage of samples of seed containing clover dodder were as follows: Red clover 13.3, alfalfa 13.5, alsike 36.2, white clover 14.3, and timothy 12.5. While the origin of all these different lots of seed is not fully stated, it seems probable that American seed supplied but a small proportion of the totals. The existence of the clover dodder in seeds from different parts of Europe is shown by this report, yet it is upon the recommendation of this station that the American seed was excluded.

In reports from the seed control station at Gratz two lots of Austrian seed are specifically reported upon. One of red clover seed from Pettau contained 1.3 per cent clover dodder seed and one of yellow clover seed from Budapest contained 5.2 per cent of the same. These amounts are greatly in excess of any ever reported in American seed, our seed-cleaning machinery eliminating most of the weed seed.

A recent report of one of the Scandinavian seed control stations gives comparative tables showing the relative value of American and European grown seed. From this report it appears that the purity, germinative ability, and viability of the seed in the hands of retail dealers and consumers averaged higher for the American seed. The average percentage of weed seed mixed with the European seed was more than double that found in the American seed.

Investigations carried on at the seed laboratory of this Department show that fully one-fourth of the European seed examined contained varying quantities of dodder seed, while American seed are almost invariably free from these seed.

Comparing the published records of European seed control stations with those of this Department and of the different experiment stations, the evidence shows that American clover seed is, as a rule, of better quality than European seed, and contains very little and often no dodder seed, while about one-fourth of that of European origin does contain it. This comparison shows that there is no just basis for discrimination against American seeds in foreign markets.

MUSHROOMS AS FOOD.

There is a widespread idea that mushrooms and other edible fungi are very nutritious foods. They are commonly said to contain very

large quantities of protein (nitrogenous material) and to rank close to meat as sources of this important nutrient. The term "vegetable beefsteak" has been applied to them, and other equally extravagant statements are frequently met with. Numbers of analyses of edible fungi have been reported by the experiment stations. German investigators have also determined their composition and studied their digestibility by human subjects and by methods of artificial digestion.

An extended study of the food value of edible fungi, including their digestibility, has recently been published from the physiological laboratory of the Sheffield Scientific School of Yale University.

Analysis does not show that edible fungi (mushrooms) possess a high food value, as will be seen by the following table, in which their composition is compared with that of several common articles of food:

Comparison of the composition of mushrooms and other foods.

	Water.	Total nitrogen.	Albuminoid nitrogen.	Nonalbuminoid nitrogen.	Protein.	Fat.	Carbohydrates.	Fiber.	Ash.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Common mushroom (*Agaricus campestris*)	91.30	0.60	0.36	0.24	3.75	0.20	3.50	0.80	0.50
Shaggy coprinus (*Coprinus comatus*)	92.19	.45	.15	.30	2.81	.26	[1] 1.40	.57	.98
Inky coprinus (*C. atramentarius*)[2]	92.31	.36	....	....	2.25	.24	....	.72	1.29
Common morel (*Morchella esculenta*)	89.54	.49	.37	.12	3.06	.50	[1] 1.60	.91	1.08
Sulphury polyporus (*Polyporus sulphureus*)	70.80	.96	.65	.31	6.00	.93	[1] 3.56	.88	2.13
Oyster mushroom (*Pleurotus ostreatus*)	73.70	.63	.30	.33	3.94	.42	[1] 4.84	1.97	1.60
Potatoes	75.50	.40	.20	.20	2.50	.10	20.90	.30	1.00
Cabbage	92.50	.18	.11	.07	1.13	.50	.70	....	.70
Carrots	87.50	.18	.08	.10	1.13	10.60		[3] 1.50	.80
Wheat bread	35.40	1.52	[3] 1.47	[3] .06	9.50	1.20	52.80	....	1.10
Beefsteak (round)	63.00	3.00	....	....	18.75	8.80	....	....	1.00

[1] Dextrose. [2] Young small specimens. [3] Approximation.

It will be seen that the mushrooms contain a very high percentage of water. In ordinary food materials protein is the most important nutrient. As regards protein content, the mushrooms rank about the same as potatoes, though they are decidedly inferior in food value, since they contain much less carbohydrates. Nonalbuminoid nitrogen is thought to have little food value. As will be seen, the mushrooms do not contain a high percentage of nitrogen, and a considerable portion of the nitrogen present is in the form of nonalbuminoids.

The value of a food is not determined alone by its composition. The digestibility—that is, the material which the body can retain and utilize—is of even more importance. The experiments at the Sheffield Scientific School showed that from 26 to 59 per cent of the total dry matter of the edible fungi tested was indigestible. The total amount of digestible protein is about the same as in the potato. These results were obtained by the methods of artificial digestion. They agree in all essential points with those obtained by the German investigators. From them the following conclusions were drawn:

When it is remembered that mushrooms contain 75 to 92 per cent of water, and that the total amount of protein present is comparatively small, it will be seen that they correspond with fresh vegetables. Indeed, they are decidedly inferior to many vegetables. The expression "vegetable beefsteak" seems peculiarly inappropriate when applied in a strictly chemical sense. A person depending upon mushrooms to furnish the amount of protein necessary in a day's diet would be compelled to consume about 8 pounds, if the morel, a fair average species, were selected. The carbohydrate content of mushrooms is relatively high, but there is no lack of carbohydrate foods in the ordinary diet, and, consequently, no great need for this constituent of the mushrooms.

Although mushrooms and other edible fungi can not be considered as highly nutritious foods, they are undoubtedly useful condiments or food accessories. They add to the palatability of many food materials when cooked with them, and may be served in many appetizing ways. Their use can undoubtedly be extended by skillful growing and careful marketing. The principal edible fungus raised by market gardeners is the common field agaric (*Agaricus campestris*), and the term mushroom is generally understood to mean this variety.

Although the number of wild edible fungi is comparatively large, there are many poisonous varieties, and too great care can not be exercised in gathering fungi for food. The poisonous and the more important edible fungi have been described in a recent circular of the Division of Botany,[1] and in an earlier publication[2] of this Department a number of native mushrooms were described. The growing and marketing of mushrooms has also been described in a recent bulletin of this Department[3] and a bibliography of mushrooms has been issued by the Department library.[4]

PASTURING PIGS ON STUBBLE FIELDS.

When grain is harvested some necessarily escapes the reaper and is usually lost. While the amount may hardly be sufficient to make it profitable to follow the reaper with a rake, the scattered grain may be profitably utilized by turning pigs or other stock into the stubble fields, and as a matter of fact the custom of pasturing stock on such fields is quite common in many regions.

Some interesting experiments have recently been made at the Montana Station to learn the value of this as compared with other methods of feeding. Forty-one pigs from 6 to 9 months old were allowed the run of barley, wheat, and pea stubble fields of 18, 10.44, and 10.73 acres, respectively. For some time before the test they had been pastured on alfalfa and fed 1 pound of cracked barley per head daily.

[1] U. S. Dept. Agr., Division of Botany Circular 13.
[2] U. S. Dept. Agr., Division of Microscopy, Food Products, I.
[3] U. S. Dept. Agr., Farmers' Bul. 53.
[4] U. S. Dept. Agr., Library Bul. 20.

For 10 weeks immediately preceding the test they made a daily average gain of 0.42 pound per head. While pastured on the stubble fields they were given no grain in addition to what they could find except on stormy days. The grain thus fed amounted to 24.1 pounds in the 5 weeks of the test.

During this time the pigs made a gain of 22.8 pounds per head, or 17.5 pounds, deducting the amount which it was calculated they gained from the grain fed during stormy weather. On the supposition that 4.5 pounds of grain are required to produce a pound of pork, the 41 pigs gathered 3,228.75 pounds of grain, which otherwise would have been lost. The harvesting had been done in the usual manner, and in the investigator's opinion the amount of peas and grain remaining in the field did not exceed that left in the stubble fields on the average farm. The scattered grain could not have been saved in any other way, and represents a clear profit.

The grain saved from the stubble fields by these pigs was not all that could have been gathered if they had remained in the fields a longer time. Seven brood sows were afterwards pastured during the winter on the station stubble fields, which included a 24-acre oat field in addition to those mentioned above. They were given no food in addition to what they could gather except kitchen slops and a small grain ration on stormy days. The sows frequently rooted down through 6 inches ot snow and found sufficient grain to keep them in good condition throughout the entire winter.

It is stated in a recent communication from the Montana Station that several brood sows have been pastured during the past season on stubble fields without receiving any grain in addition, and that they are in fair condition. They had, in addition to the grain stubble fields, the range of clover, alfalfa, and timothy meadows, and the gleanings of fields where root crops had been raised. The manure from grain-fed stock, which was spread upon the fields, also furnished some grain.

ENSILING POTATOES.

A number of French agriculturists have recently studied the desirability of ensiling potatoes. A considerable amount of heat is generated by the fermentation of the green material in silos, and it was thought this could be utilized and the potatoes could be cooked as well as preserved.

In one test the potatoes were buried in a silo filled with crimson clover. They acquired the characteristic color of the plant and the odor developed in fermentation. The tubers were flattened by the heavy pressure to which they had been subjected. When removed from the silo they were comparatively soft. They were examined microscopically and chemically, and it was found that they had been cooked by the heat of fermentation, and that they were rendered more digesti-

ble by the process; that is, the percentage of soluble material was increased.

Another silo was filled by surrounding about a ton of potatoes with corn (whole plant). Upon opening, the corn and potatoes were both found in good condition. The tubers were somewhat flattened, as in the previous experiment, but were more cohesive. The potatoes were not as thoroughly cooked, since the temperature and pressure were less than in the previous case.

As shown by analysis, the potatoes ensiled with crimson clover had lost less water than those ensiled with corn. The most striking difference, however, was the high percentage of cooked starch; or, in other words, the increased assimilability of the potatoes ensiled with clover. The crushed potatoes when removed from the silo lost weight very rapidly on exposure to the air, and formed a hard mass containing only 15 to 20 per cent of water. In this condition they could be kept for a long time. When required for feeding purposes they were soaked in water, which they readily absorbed, and thus regained their softness and digestibility.

Another investigator ensiled chopped raw potatoes with 2 pounds of salt per 1,000 pounds of potatoes under pressure of 2,500 pounds per square yard. The total cost of washing, chopping, putting in the silo, and weighting 50 tons of potatoes was about $15. The potatoes were put in the silo in the latter part of November. When the silo was filled the material was 5½ feet deep. Sixty-two days later the silo was opened, and the mass had sunk to a little over 3 feet. The temperature of the silo when filled was 39° F., and when opened it was 50°. The ensiled potato pulp was white, but became blackened on exposure to the air. Cattle ate this pulp greedily, alone or mixed with cotton-seed cake.

Experiments made at the Minnesota Station have shown that while the digestibility of cooked and raw potatoes by pigs was about the same, pigs could be induced to eat larger quantities of cooked potatoes. It was calculated that a ration of 15 pounds of potatoes and 4 pounds of shorts would furnish an amount of protein sufficient for maintenance, leaving a margin for growth.

On the basis of cost comparisons were made of the value of potatoes and other feeding stuffs. In the investigator's opinion, with foods at the present prices, it is doubtful whether it would be profitable to feed large amounts of potatoes to dairy stock, because cows require more protein than would be supplied by a fattening ration similar in character to that mentioned above.

Potatoes can not be fed to young animals as safely as to more mature ones, since if fed in too large quantities they have a tendency to prematurely fatten the animal. With mature animals, when the object is principally the addition of fat to the body, potatoes may be fed to good advantage.

When the crop of potatoes is large and prices low, a method of storing and feeding potatoes to advantage is desirable.

A method of preserving potatoes which at the same time cooks them would seem worthy of trial, but it would doubtless be wise to experiment on a small scale at first.

ANTHRAX.

On account of the rapidity with which it develops and runs its course, the variety of animals subject to it, including man, and its fatality, anthrax, or charbon, is one of the most dreaded diseases to which animals are subject. It is a world-wide disease, and, though few of the experiment stations have been called upon to deal with it, it has been reported during the past decade from Vermont, Massachusetts, Michigan, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Mississippi, Louisiana, Texas, Illinois, and South Dakota. The greatest damage seems to have been done in New Jersey and Delaware. In the latter State it has existed since 1892, and of late has infested a territory some 3 miles wide by 40 long along the Delaware River and carried off on an average two animals per farm per year, or from 70 to 82 per cent of the animals in the herds attacked.

Nearly all domestic animals are attacked, including sheep, goats, cattle, horses, mules, swine, and sometimes dogs and cats. Rabbits, guinea pigs, rats, and mice are susceptible to it, and the last two species of domestic pests must be taken into account as transmitters of the disease. In degree of susceptibility sheep stand first and carnivorous animals last. Swine, once thought immune, are very susceptible and readily succumb to it. As a rule domestic animals become infected by the bacilli and spores obtaining entrance to the alimentary tract, and in some cases man becomes infected in the same way by eating improperly cooked meat; but generally human cases of anthrax have been traced to breathing spore-laden air, as in working over wool or hides, and to the infection of cuts, scratches, and other abrasions of the skin.

The spores are very tenacious of life and will remain dormant for years. Cases are recorded where soil has remained infectious for twelve and thirteen years. A moist clay soil seems especially favorable for preserving the germs. As the bacilli are excreted in the urine and feces and in nose and mouth discharges from live animals, and occur in great numbers in the bloody discharges from dead animals, and soon develop spores upon exposure to the air, it may be readily inferred how easily the disease may be spread from place to place. The fact that the disease in Delaware does not seem to have been spread from farm to farm by the infected animal, but to have arisen in all but one case from river drift, and in that one case from sewage from a morocco factory, must be due to lack of opportunity. Anything that can carry the spores may act as a transmitter, and a case has been recorded in which the disease was carried some distance on the clothing and boots of a person who had been aiding at a post-mortem examination. Another case is on record in which

a diseased carcass had been buried and the ground above it sown to several crops during as many years, the last crop being clover. The rank growth of the clover excited the cupidity of a neighbor of the person on whose land the clover grew. The clover disappeared, but a day or so after it was missed the neighbor's wife came with the report that her animals were dying. An investigation showed that they had anthrax and also brought to light some of the stolen clover that had not yet been fed. Hay and roots carry the disease as well as grass, but by far the most important factors in the spread of the disease over the world are hides and wool. In the less civilized countries the disease is much more serious than in the United States. In Siberia it has been given the name of the Siberian plague. It is a common disease in South America, whence large numbers of hides are imported. As the hides are simply dried or cured with salt, dung, or clay—processes that in no way affect the vitality of the spores—and as the skinning of an animal must expose large numbers of the bacilli in the blood and in the skin and connected adipose tissues to the air, under the influence of which they quickly transform into the easily scattered spores, the process of handling and packing must infect many more hides than there were animals diseased. When the skins are handled at the tanneries the chances of spreading the disease are thus multiplied many times. Infection has been traced to animals licking the salt from the ground over which salted skins have been carried. The air also is an important medium whenever wool or skins are handled, and anthrax in the lungs and air passages of wool sorters is of such common occurrence as to have given rise to what is termed "wool-sorters' disease." In Delaware, the most important medium for scattering the germs has been the tidal currents of the Delaware River. The progress of various outbreaks of the disease has been studied by the Delaware Experiment Station and found in a number of instances to advance up the river. As no other possible means for spreading the disease could be discovered, and as a study of the currents and tides of the river showed it to be possible for carcasses or germ-laden drift to be carried up the stream, the conclusion was arrived at that the disease must have come from the New Jersey shore. It is explained that when a carcass enters the mouth of a stream, it is carried upward by flood tides. The first ebb tide leaves it stranded on some bar or flat, from which point it will be started by the next flood tide, and with each successive tide the process is repeated until the carcass has become disintegrated and fragments and spores spread over the meadows of the adjacent shores.

Aside from this danger in Delaware from the opposite New Jersey shore there is also danger from sources up the river. Nearly four-fifths of the output of morocco in the United States is produced in the cities of Philadelphia and Wilmington. The daily product exceeds $80,000 in value. The skins are received from India, Russia, Africa,

China, Australia, and South America. In all of these countries anthrax outbreaks are common and rage without control. It follows that the washing from the twenty-five Philadelphia shops and the fourteen shops in Wilmington carry myriads of spores to the river.

To be added to this list of disease bearers are fleas, mosquitoes, and flies. From a specimen of the first of these insects taken from animals infected with anthrax the bacilli have been isolated, and the report of the Delaware Station records cases where the only possible explanation for the existence of the disease is that it was carried by flies from anthrax carrion.

EXPLANATION OF TERMS.

TERMS USED IN DISCUSSING FERTILIZERS.

Complete fertilizer is one which contains the three essential fertilizing constituents, i. e., nitrogen, phosphoric acid, and potash.

Nitrogen exists in fertilizers in three distinct forms, viz, as organic matter, as ammonia, and as nitrates. It is the most expensive fertilizing ingredient.

Nitrates furnish the most readily available forms of nitrogen. The most common are nitrate of soda and nitrate of potash (saltpeter).

Phosphoric acid, one of the essential fertilizing ingredients, is derived from materials called phosphates. It does not exist alone, but in combination, most commonly as phosphate of lime in the form of bones, rock phosphate, and phosphatic slag. Phosphoric acid occurs in fertilizers in three forms—soluble, reverted, and insoluble phosphoric acid.

Soluble phosphoric acid is that form which is soluble in water and readily taken up by plants.

Reverted phosphoric acid is that form which is insoluble in water but still readily used by plants.

Available phosphoric acid is the soluble and reverted taken together.

Superphosphate.—In natural or untreated phosphates the phosphoric acid is insoluble in water and not readily available to plants. Superphosphate is prepared from these by grinding and treating with sulphuric acid, which makes the phosphoric acid more available to plants. Superphosphates are sometimes called acid phosphates.

Potash, as a constituent of fertilizers, exists in a number of forms, but chiefly as chlorid or muriate and as sulphate. All forms are freely soluble in water and are believed to be nearly, if not quite, equally available, but it has been found that the chlorids may injuriously affect the quality of tobacco, potatoes, and certain other crops. The chief sources of potash are the potash salts from Stassfurt, Germany—kainit, sylvinit, muriate of potash, sulphate of potash, and sulphate of potash and magnesia. Wood ashes and cotton-hull ashes are also sources of potash.

TERMS USED IN DISCUSSING FOODS AND FEEDING STUFFS.

Water is contained in all foods and feeding stuffs. The amount varies from 8 to 15 pounds per 100 pounds of such dry materials as hay, straw, or grain to 80 pounds in silage and 90 pounds in some roots.

Dry matter is the portion remaining after removing or excluding the water.

Ash is what is left when the combustible part of a feeding stuff is burned away. It consists chiefly of lime, magnesia, potash, soda, iron, chlorin, and carbonic, sulphuric, and phosphoric acids, and is used largely in making bones. Part of the ash constituents of the food is stored up in the animal's body; the rest is voided in the urine and manure.

Protein (nitrogenous matter) is the name of a group of substances containing nitrogen. Protein furnishes the materials for the lean flesh, blood, skin, muscles, tendons, nerves, hair, horns, wool, casein of milk, albumen of eggs, etc., and is one of the most important constituents of feeding stuffs.

Albuminoid nitrogen is nitrogen in the form of **albuminoids**, which is the name given to one of the most important groups of substances classed together under the general term protein. The albumen of eggs is a type of albuminoids.

Amid nitrogen is nitrogen in the form of **amids**, one of the groups of substances classed together under the general term protein. Amids, unlike albuminoids, are usually soluble in water, but are generally considered of less value as food than albuminoids.

Carbohydrates.—The nitrogen-free extract and fiber are often classed together under the name of carbohydrates. The carbohydrates form the largest part of all vegetable foods. They are either stored up as fat or burned in the body to produce heat and energy. The most common and important carbohydrates are sugar and starch.

Fiber, sometimes called crude cellulose, is the framework of plants, and is, as a rule, the most indigestible constituent of feeding stuffs. The coarse fodders, such as hay and straw, contain a much larger proportion of fiber than the grains, oil cakes, etc.

Nitrogen-free extract includes starch, sugar, gums, and the like, and forms an important part of all feeding stuffs, but especially of most grains.

Fat, or the materials dissolved from a feeding stuff by ether, is a substance of mixed character, and may include, besides real fats, wax, the green coloring matter of plants, etc. The fat of food is either stored up in the body as fat or burned, to furnish heat and energy.

MISCELLANEOUS TERMS.

Fungus (plural **fungi**) is a low form of plant life destitute of green coloring matter; mold and mushrooms are familiar examples.

Spore is a minute body, borne by a fungus, which is capable of reproducing the fungus directly. It corresponds in function with the seed of higher plants.

Bacillus (plural **bacilli**) is a genus of **bacteria**, which is the name applied in common to a number of different or closely related microscopic organisms, all of which consist of single short cylindrical or elliptical cells or two such cells joined end to end and capable of spontaneous movement. Many kinds of bacteria are harmful and cause diseases and other injurious effects, but many are beneficial. Among the latter are those which give aroma to tobacco and flavor to butter and cheese, and those which enable leguminous plants to use the free nitrogen of the air.

Inoculation is the introduction of bacteria or other organisms into surroundings suited to their growth with a view to producing the effects which are the result of their activity.

FARMERS' BULLETINS.

These bulletins are sent free of charge to any address upon application to the Secretary of Agriculture, Washington, D. C. Only the following are available for distribution:

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No. 16. Leguminous Plants for Green Manuring and for Feeding. Pp. 24.
No. 18. Forage Plants for the South. Pp. 30.
No. 19. Important Insecticides: Directions for Their Preparation and Use. Pp. 20.
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No. 55. The Dairy Herd: Its Formation and Management. Pp. 24.
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No. 57. Butter Making on the Farm. Pp. 15.
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No. 79. Experiment Station Work—VI. Pp. 28.
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