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Experiment Station Work, XL.

Compiled from the Publications of the Agricultural Experiment Stations.

INSOLUBLE PHOSPHATES.
FORMS AND METHODS OF APPLYING LIME.
SEDIMENT IN IRRIGATION WATER.
HARDY BERMUDA GRASS.
WILLIAMSON METHOD OF CORN CULTURE.
KILLING SASSAFRAS SPROUTS.
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STORING PRESERVES AND CANNED GOODS.
INCUBATION OF CHICKENS.
PREVENTION OF NODULE DISEASE OF LAMBS.
SOME MILK TERMS.

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PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.

A. C. TRUE, Director.

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EXPERIMENT STATION WORK.

Edited by W. H. Beal and the Staff of the Experiment Station Record.

Experiment Station Work is 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 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 upon 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.

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EXPERIMENT STATION WORK.[a]

INSOLUBLE PHOSPHATES.[b]

The fertilizing value of fine-ground insoluble phosphates (floats) is attracting considerable attention at the present time. The work of C. E. Thorne, of the Ohio Station; C. G. Hopkins, of the Illinois Station, and H. J. Patterson, of the Maryland Station, especially, has encouraged the hope that under certain conditions the cheaper untreated phosphates may be used with profit, as explained in a previous bulletin of this series.[c] Experiments under other conditions, however, suggest caution in the general application of the results obtained in the above experiments.

For example, experiments made by W. P. Brooks at the Massachusetts Experiment Station have emphasized the fact established by the earlier experiments at the Maine Station that the kind of crop to be grown will often determine whether it is profitable to use the insoluble phosphates.

H. J. Wheeler and G. E. Adams, of the Rhode Island Station, have recently reported experiments extending over a series of years in which floats were compared with a number of other soluble and insoluble phosphates on corn, grass, and a great variety of other crops on limed and unlimed soil, showing a wide variation in the efficiency of the insoluble phosphate under varying conditions of soil, crop, etc.

The floats gave very poor results on corn the first year as compared with the other phosphates. In subsequent years, however, the phosphoric acid of the floats slowly became available and gave good results on both corn and grass. It is probable that in the case of the grass the accumulating organic matter materially aided in rendering the phosphoric acid of the floats assimilable.

In view of the low price of floats and the relatively large amount of phosphoric acid applied in consequence, these results demonstrate that if one begins

[a] A progress record of experimental inquiries, published without assumption of responsibility by the Department for the correctness of the facts and conclusions reported by the stations.

[b] Compiled from Rhode Island Sta. Bul. 114.

[c] U. S. Dept. Agr., Farmers' Bul. 262, p. 7.

upon land deficient in assimilable phosphoric acid, even with Indian corn, one should not place too much reliance upon the floats the first year, but should supplement them with some soluble phosphate. In later years they appear to be of marked value in connection with timothy, and especially with redtop and Indian corn.

In case of peas on limed soil floats gave very good results, confirming the general conclusion " that the legumes have, as a rule, a marked ability to acquire phosphoric acid from certain unacidulated mineral phosphates." With " oats, summer squash, crimson clover, Japanese millet (on the unlimed land), golden millet, white-podded Adzuki bean, soy bean, and potato (on the unlimed land) floats [also] gave very good results, but with the flat turnip, table beet, and cabbage they were relatively very inefficient, notwithstanding that much more phosphoric acid had been applied in the floats than in any other of the phosphates."

The results in general indicate that—

Floats can probably be used to best advantage on moist soil rich in decaying vegetable matter, and for such crops as certain legumes, Indian corn, millet, and possibly wheat and oats, which seem far better able to make use of them than certain vegetables. The vegetable growers in the East should not be influenced to use them on account of their reported value on the Illinois black soil of the corn belt, where wheat, grass, clover, and Indian corn are the chief crops, and where the soil conditions are exceptionally favorable to their ready assimilability. Perhaps it may be fouud that floats can be advantageously mixed with the stable manure which gardeners collect during the winter, but this is a point which needs to be more definitely determined. The fact that phosphoric acid in floats costs less than half what it does in bone makes it most desirable to utilize the former where it can be done to advantage, but the Rhode Island gardener and general farmer will do well to study the foregoing results carefully before employing the floats extensively or depending upon them at the outset, or his bank account may pay the penalty.

The conditions under which these experiments were made in Rhode Island are to a considerable extent representative of those of other parts of the eastern United States where diversified and intensive farming is largely practiced on thin, worn soils. It seems quite clear from the results of all the experiments which have been made under such conditions that (1) the insoluble phosphates are not equally effective on all crops, and hence are not generally well adapted to intensely diversified farming, such as market gardening; (2) they are slower in action than soluble phosphates, and hence not well suited to short-season, quick-growing crops; (3) they do not, as a rule, prove very efficient on thin, worn soils deficient in decaying organic matter, and hence if they are to give good results on such soils they must be used in connection with liberal applications of barnyard manure and green manures.

FORMS AND METHODS OF APPLYING LIME.[a]

H. J. Patterson, of the Maryland Experiment Station, has recently reported the results of fourteen years' experiments on the relative value of different kinds of caustic, quick, or burnt lime (fat or rich stone lime, poor magnesian stone lime, oyster-shell lime), slaked lime, gas-house or gas lime, gypsum or land plaster, ground limestone, marl, and phosphate of lime, as well as soft-coal ashes, when applied in different ways (slaked and unslaked, as top-dressing, or worked into the soil) and amounts in a common crop rotation (corn, wheat, and timothy and clover), in connection with green manures (cowpeas) and with stable manure.

It was found that in case of the rotation named, on a run-down sandy loam, naturally well drained, limed plats gave larger yields than unlimed plats, the average net return from liming being $4.50 per acre annually, valuing corn at 40 cents per bushel, corn fodder at 20 cents per hundredweight, wheat at 90 cents per bushel, straw at 20 cents per hundredweight, and hay at 50 cents per hundredweight. A net return of $4.50 per acre means a profit of $450 to $600 annually when applied to a 100-acre or a 150-acre farm, respectively.

A study of the most profitable rate of applying lime showed that an application of 20 bushels per acre gave only about 25 per cent more net profit than an application of 10 bushels, and of 60 bushels only about 50 per cent more than 10 bushels, but that the relative profits at the end of four years were in favor of 20 bushels per acre. On unproductive, stiff, rather wet clay soil it was found to be decidedly advantageous to use lime at the rate of 40 bushels per acre in combination with a green manuring of cowpeas. It was also found to be advantageous on the same kind of soil to use lime in combination with stable manure. "The net profits per year from the use of 12 tons of manure and 20 bushels of lime per acre are greater than have been obtained in any of the other lime tests and are in a measure an explanation for the better crops which are obtained in those sections of the State that have used lime and manure extensively for generations."

In these experiments the results slightly favored the incorporation of unslaked lime with the soil immediately upon application rather than applying it as a top-dressing.

Oyster-shell lime was apparently somewhat more effective than stone lime, though the difference was not marked. Magnesian lime produced decidedly better yields of grain than pure lime, though not quite so much forage. Calcium carbonate (2,600 pounds per acre)

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[a] Compiled from Maryland Sta. Bul. 110. See also U. S. Dept. Agr., Farmers' Buls. 65, 77, 122, 124, 133, 237, 259.

gave decidedly better results than caustic lime, and the application of shell marl (13,000 pounds per acre) produced more grain and forage than either stone lime or oyster-shell lime. Caustic lime and fine-ground oyster shells (calcium carbonate) were cheaper and much more effective than gypsum or land plaster (4,125 pounds per acre). Caustic lime was also much more effective than gas lime (2,925 pounds per acre) of oyster-shell origin. Calcium phosphate in the form of finely ground South Carolina rock (2,925 pounds per acre) gave better results than gypsum, but not so good as either calcium carbonate or caustic lime. Soft-coal ashes (13,000 pounds per acre) produced little if any effect.

FERTILIZING VALUE OF THE SEDIMENT IN IRRIGATION WATER.[a]

The rivers of arid regions generally carry large amounts of sediments, particularly in times of flood. The Nile, which by its annual overflows has maintained the marvelous fertility of Egypt through untold ages, is a well-known but typical illustration of the importance of water sediments in relation to the maintenance of soil fertility. Similar illustrations may be cited in case of other streams, either in connection with natural floods or with the use of their waters in irrigation.

The Office of Experiment Stations of this Department, through its Irrigation and Drainage Investigations, has determined the amount of silt or sediment carried by various streams used for irrigation. These determinations show, for example, that the principal Texas streams—the Rio Grande and the Brazos and Colorado rivers—carry from about 0.65 to nearly 3 per cent of sediment, it being calculated from the measurements which have been made that the Brazos, for example, carries enough sediment during the year to cover 40,000 acres 1 foot deep.

R. H. Forbes, of the Arizona Station, has made a very careful study of the sediments carried by the Gila, Salt, and Colorado rivers in Arizona. He estimates that the Gila River at Florence carries on an average 19.23 tons of sediment per acre-foot of water, the Salt River at McDowell 1.2 tons, the Colorado River at Yuma 9.62 tons. The amounts, however, vary very widely at different times. The average amounts stated would furnish on the average 214 pounds of potash per acre annually, 37 pounds of phosphoric acid, and 28 pounds of nitrogen in case of the Gila River; 18 pounds of potash, 6.6 pounds of phosphoric acid, and 5.5 pounds of nitrogen in case of Salt River, and 113 pounds of potash, 10 pounds of phosphoric acid,

[a] Compiled from Arizona Sta. Buls. 44, 53; U. S. Dept. Agr., Office of Experiment Stas. Buls. 133, p. 200; 158, p. 85.

and 4.8 pounds of nitrogen in case of the Colorado River. Analyses by G. E. Colby, of the California Station, of samples of creek waters used for irrigation in the Santa Clara Valley, California, as reported by S. Fortier, of the Irrigation and Drainage Investigations of the Office of Experiment Stations, showed, however, that a 12-inch irrigation with these waters added only 4.55 pounds of available potash and 1.3 pounds of phosphoric acid to each acre of land.

These facts merely serve to give definite form to the knowledge, as old as human history, that river irrigating sediments increase the productiveness of land. The varying values, shown in our southwestern river sediments, call to mind the parallel fact, known in Egypt since ancient times, that the Red Nile floods from Abyssinia are more valuable than those from other watersheds tributary to that river.

The calculations, however, are based upon the assumption that all of the sediment reaches the irrigated fields, but—

By no means all of the sediments are carried upon irrigated fields. With gentler gradients and slackening motion of the water, the heavier portions are soon dropped in canals and laterals, necessitating the never-ending work of ditch cleaning. The remaining lighter portions are carried upon irrigated ground where, with still further decrease in the movement of the water, the residual solids are deposited in large part near the point of diversion from the supply ditch.

In considering the effects of sediments upon lands, therefore, it is necessary to allow for the manner in which they are distributed, this distribution being affected by the kind of crop, the method of irrigation, and the slope, as well as by the fineness of the sediments themselves.

While we calculate, therefore, that 4 average acre-feet of Colorado River water at Yuma carry sediment enough to make a layer of soil about one-fourth of an inch thick each year, the larger portion of this amount is actually concentrated upon probably much less than half of the ground irrigated.

Rising ditch banks and increasing gradients in irrigated fields under muddy streams attest the activity of this factor and suggest that in this region in time to come the disposal of ditch cleanings and field deposits may become a serious problem.

While the fertilizing value of these sediments is undoubted, the results of their accumulation on irrigated soils are often decidedly injurious.

Irrigating sediments may be beneficial or harmful to crops according to their composition and physical character and their disposition in or upon the soil. Whether beneficial or harmful in composition, if they accumulate upon the surface of the soil in the form of silt blankets more or less impervious to water and air, their influence, by limiting the supply of these essential substances to plant roots, is notably harmful. In certain localities where these irrigating sediments are very plastic in character and excessive in amount the damage, particularly to alfalfa and other crops which can not receive constant and thorough cultivation, is of an increasingly serious character.

Cultivation, where practicable, as deep and thorough as possible is the best available means of handling these accumulations. Beneficial sediments are thus incorporated with the soil and their fertilizing properties made available to plant roots, while sediments of barren character are dispersed to the depth of cultivation through the soil. When, however, sediments of undesirable character predominate cultivation can only modify and not remedy resulting conditions.

In such cases it is desirable to lessen the sediments in irrigation waters by means of settling basins and similar devices.

HARDY BERMUDA GRASS.[a]

In recently settled prairie regions the problem of grass culture does not usually present itself until the wild lands are largely brought under cultivation and the individual farms are becoming well stocked with farm animals. Up to this time the wild grasses have furnished sufficient hay and pasturage and, as a rule, little thought has been given to providing forage from another source. Under these conditions the problem is rather difficult of solution, for the settler finds himself in a new environment, soil and climate probably differ largely from these same factors in the region from which he came, and no advice founded on actual experience is available by which he might be guided in laying down cultivated land to grass. In Oklahoma where these conditions obtain, the experiment station realized that sooner or later this question would have to be met, and therefore has come to the assistance of the farmer through data gathered in grass culture tests begun in 1892. This work, which is still in progress, has now been followed for fourteen years, and the recommendations based on the results secured, which the institution at the present time is able to make, are of special value to the region concerned.

The results of these tests, as well as of cooperative work with farmers over the Territory, indicate that of all the grasses coming under observation Bermuda grass alone has shown the necessary qualities of a pasture grass for Oklahoma. One of the first experiences with this grass grown from seed was that although it made a good growth during the season, it killed back during the winter and made a late start in the spring. With these disadvantages the species failed to fulfill two very essential conditions of a successful pasture and lawn grass, but through the efforts of the station these objections have been largely overcome. On several test plats plants were observed which showed a superior resistance to cold weather, combined with an early spring growth, beginning to grow as early as April 1 even after a severe winter. This observation suggested a line of work for the improvement of Bermuda grass and its culture. A large planting of roots was made in July of 1904. Part of these roots were taken from a plat recently grown from seed and part from plats that had been

[a] Compiled from Oklahoma Sta. Bul. 70.

established at least ten years and had passed through a cold period with a minimum temperature of 17° below zero and with no snow on the ground. This planting made an almost uniform heavy growth before frost. The following spring, after a winter with temperature records of 18° below zero, the plants grown from the acclimated roots produced on the long-established plats were found growing vigorously on March 29, and these soon covered the ground and kept out the crab grass, while the plats planted with roots recently grown from seed had all of their previous season's growth killed back. Some of the plants were entirely killed out and all that survived did not begin to grow again until May and were almost overwhelmed by crab grass.

A further test was made of the hardy strain by sending the roots for trial to every county in the Territory. The reports from these cooperative trials indicate in general that this hardy grass was much more vigorous than that grown from seed, that the stems remained green throughout the winter, and that it began its new growth in March. One of the experimenters, who had tried growing Bermuda grass from seed many times only to have it frozen out every winter, reported that with him this hardy strain began its growth about March 5, and that he regarded it as an entirely satisfactory pasture grass if not pastured until the second year, and then not too closely, in order to allow the runners to become firmly rooted.

A number of tests of this hardy Bermuda grass for lawn purposes were also made with satisfactory results. The principal objection to this species, even if a hardy strain has been secured, is that it does not remain green during winter. The station has also found a means of mitigating this disadvantage to a large extent. "A covering of Bermuda grass on the lawn will not hinder the germination of white clover or Kentucky blue grass seed sown into it in September. Some of the white clover will persist and show up early in the spring. There are areas on the college campus here where white clover and Bermuda grass have been growing together for five years. From February to May the white clover makes excellent growth and the Bermuda is scarcely noticeable. From June to October the Bermuda grass covers the ground with a mat of green and the clover almost disappears. This combination of white clover and Bermuda grass promises well, and may ultimately be useful for pastures as well as lawns. But the foundation should be a perfect sod of hardy Bermuda grass."

To effect a rapid distribution of Bermuda grass the station advises the planting of sod from grass which has successfully survived several winters and starts its new growth by April 1 of each year. Seed of hardy Bermuda grass for Oklahoma is not obtainable, but the expense of starting the grass from a home-grown supply of sod is not so great as starting it from seed.

As a soil preparation for planting the sod, winter plowing and frequent harrowings are recommended. The planting may be done from April 15 to July 15, the sod being placed in furrows made with a single shovel plow about 6 inches deep and 3 feet apart. The pieces of sod from 1 to 2 inches square are dropped 18 inches apart in the newly made furrows and covered with either the foot hoe or double-shovel plow, a thicker covering being given when the soil is dry than when it is wet in order to assure the necessary moisture conditions. Harrowing does not sufficiently cover the sod. When roots free from dirt are planted the soil is prepared in the same way, but the roots are set out more carefully than the sod, the soil being firmed about them and a little of the root left exposed to the air, while the sod is completely covered. The new plantings of Bermuda grass are cultivated the same as corn or potatoes to kill out the crab grass and other weeds and to promote the rooting of the grass by providing loose soil, but as soon as the runners begin to extend from one row to another and there is danger of tearing them away cultivation is discontinued. Worn-out pastures, loose sandy soils, and waste land with a scanty growth of timber and poor grass may all be transformed into useful pastures by planting sod as described and allowing the grass to establish itself during the first season. At the station thin, well-cultivated upland soil was set out to Bermuda grass by planting small pieces of sod 18 inches apart in rows 3 feet apart on June 29 and 30, 1905, and the grass cut from this planting September 25, 1905, was entirely free from weeds and crab grass and yielded 2,584 pounds of cured hay per acre. The rainfall during the three months in which this crop was grown was 14.18 inches, as compared with 9.62 for the same period in previous years. An analysis of the hay showed that it contained 9.20 per cent of protein and 1.24 per cent of fat, as compared with 5.9 per cent of protein and 2.5 per cent of fat for timothy hay, 7.8 per cent protein and 3.9 per cent fat for Kentucky blue grass hay, and 14.3 per cent of protein and 2.2 per cent of fat for alfalfa hay.

Although hardy Bermuda grass is not easily killed out, it is not believed that at this latitude it will spread and become a pest in fields and other places where it is not desired. "Its place is for permanent pasture, for hay on good land subject to overflow, and for a solid covering of the lawn and the usual muddy spots about house and feed lots." At the station it is giving a profitable yield of pasture on land so full of white alkali that no other crop will grow. It has also been found most effective in sodding ditches in cultivated fields, pond banks, and other bare places, to prevent washing.

THE WILLIAMSON METHOD OF CORN CULTURE.[a]

Considerable interest and discussion have been aroused during the past two years among corn growers in the South by the exploitation of the so-called Williamson method of corn culture. This is largely due to the fact that the method involves a new principle and one departing widely from generally accepted ideas on corn growing. If the method is successful in achieving the object sought, it is of the greatest importance to that section of the country for which it is intended. An undesirable feature in the growth of corn in the South is the tendency to produce a large stalk at the expense of the yield of grain, and the primary object of this new method of culture is to produce more grain and less stalk. In a recent bulletin the South Carolina Experiment Station presents a detailed description of the method as authorized by Mr. E. M. Williamson, the originator, and also reports the results of observations made on farms where corn is grown according to this plan.

It appears that of the fields inspected all were planted with corn secured from Mr. Williamson except two, one of which was planted with a variety similar to the Williamson corn and the other with Marlboro Prolific. The Williamson corn bore the ears about 3 feet and the Marlboro Prolific about 26 inches above the ground. The number of ears per stalk or the size of the ears of the Marlboro Prolific was apparently not influenced by the method of culture. "The Williamson corn habitually bears one ear to the stalk, and the ears, when grown by the Williamson plan, are from 6 to 8 inches long and from 7½ to 10 inches in circumference. The type is intermediate between southern gourd seed and the standard dent. The grains are (white) from eight to eleven sixteenths of an inch long, four to six sixteenths of an inch wide, and two or three sixteenths of an inch thick. The cob is usually red and from 4½ to 5½ inches in circumference, the circumference measurements being taken one-third the cob length from the butt. A hundred pounds of ears shell from 82 to 90 pounds of grain. Eighty-five to 100 ears will shell a bushel of corn."

Mr. Williamson advocates plowing the land during the winter about one-fourth deeper than it was plowed before if the soil has never been broken deep enough for corn, or one-third deeper if much vegetable matter is to be turned under. Subsoiling to a greater depth may be practiced in connection with plowing at any time, provided no more subsoil than is turned up by the plow is worked to the surface. The disk plow is very effective in turning under cotton or cornstalks without previous chopping, and it also works well in pea vines. The next step is bedding the land in 6-foot rows with the turn plow,

[a] Compiled from South Carolina Sta. Bul. 124; Alabama Sta. Bul. 138.

and in doing this a 5-inch balk is left, which is broken out with the scooter just before planting. The scooter furrow is deepened with the Dixie plow with the wing taken off, and a ridge is then thrown on this furrow with the same plow. As soon as the danger of frost is over the corn is planted on this ridge at the rate of one kernel every 5 or 6 inches. Early planting is especially necessary on very rich lands to prevent stalks from growing too large. The first working is given soon after planting with the harrow or any suitable implement that will not cover the plants. The crop is worked the second time when the plants are about 8 inches high, a 10 or 12 inch sweep being used on both sides of the row. After this the corn is thinned to about 16 inches in the drill. Up to this time the system of culture has been quite regular, but here the distinctive feature of retarding the stalk is introduced. The crop is not cultivated again until the stalks have been so retarded and hardened that they will not grow too large. The richer the land the greater the thoroughness required in the retarding process. Experience and judgment are necessary to decide when the corn has been sufficiently held back and the work of assisting the plant in developing the ear should begin. At this period the corn is from 12 to 18 inches high. The first fertilizer application is now made by putting half of the mixed fertilizer, consisting of 200 pounds of cotton-seed meal, 200 pounds of acid phosphate, and 400 pounds of kainit per acre, in the old sweep furrow on both sides of alternate middles and covering the same by breaking out this middle with the turn plow. About a week later the other middles are treated in the same way. After a few days the corn is sided in the first middles with a 16-inch sweep and nitrate of soda put in this furrow and covered with one furrow of the turn plow. Peas are then sown broadcast at the rate of at least 1 bushel per acre in this middle and the work finished by breaking out. Several days later the other middles are given exactly the same treatment. If the application of nitrate of soda exceeds 150 pounds per acre, one-half the quantity is applied in the first and the other half in the second middles, otherwise the entire application is made in the first middles. In Darlington County, S. C., where Mr. Williamson is practicing this method, this final application of nitrate of soda is made during an average season from June 10 to 20, and the last plowing is also done at this time.

The peculiar or essential features of the Williamson method are summarized as follows: Deep and thorough preparation of seed bed, deep planting, infrequent and partial cultivation in the early stages of growth, an increase of 200 per cent or more in the number of stalks per acre, postponing the application of fertilizers until the corn is given its second cultivation, intentional retardation of the early growth of the stalk until its size is reduced one-half or one-fourth of its normal development, and following this an augmented development of the yield by cultivation and heavy applications of fertilizers made at appropriate intervals. It is believed that since the corn is planted 4 to 6 inches below the level and is laid by 4 to 6 inches above the level, the brace roots, being below the surface, are probably better able to perform their nutritive functions than if a part of them were exposed to the air. The application of fertilizers given above is recommended for a 50-bushel crop, and it is suggested that for a crop of 100 bushels per acre the quantities should be doubled.

The Alabama Station made a comparison of the Williamson and the ordinary methods of corn culture in 1906, and the bulletin reporting the results enumerates the distinctive features of the Williamson method as follows: Dwarfing the corn plant by withholding fertilizers until the plant is several feet high and by omitting all cultivation from the time the plant is about 8 inches high until it is about 18 inches high, thick planting in the row, the use of the turn plow in the last cultivations, and planting on land enriched by plowing under the entire growth of cowpeas. The comparative test was made on two plats of poor gray sandy upland soil prepared and fertilized alike. On both plats a fair growth of velvet beans was plowed under in February. The rows were laid off 6 feet apart and bedded out, the water furrows thus formed being subsoiled with the Dixie turn plow with wing removed. A slight list was then formed in the water furrow with the same plow. This list was opened and the corn planted on April 19, not as early as recommended by Mr. Williamson. An application of 200 pounds of cotton-seed meal, 200 pounds of acid phosphate, and 400 pounds of kainit per acre was made June 23, and a further application of 200 pounds of nitrate of soda in side furrows was made July 7, when the crop was cultivated with scooter and scrape and cowpeas were sown and plowed in.

The details of cultivation on the two plats were identical except in the later hoeing, thicker planting, omission of two early cultivations, and the use of the turn plow in laying by on the Williamson plat. After planting the middles were cultivated shallow on both plats. Nothing further was done on the Williamson plat until June 21, when it was hoed and thinned to one plant every 16 inches. During this time the check plat was given two cultivator trips per row May 21, a hoeing and thinning to one plant every 33 inches June 1, and cultivation with scooter and scrape, five furrows per row, June 7. The cultivation of the middles was finished June 23 with the Dixie turn plow on the Williamson plat and with scooter and scrape on the check plat.

The thicker planting and the omission of cultivation between the early part of May and June 23 dwarfed the plants on the Williamson plat. The yield of shelled corn on the Williamson plat was 30.5 bushels per acre and on the check plat 29.5 bushels. On the Williamson plat each plant averaged 0.346 of a pound of shelled corn and on the check plat 0.667 of a pound. The average weight of shucked ear or nubbin on the check plat was 0.54 of a pound as compared with 0.45 of a pound on the Williamson plat. The average height from the ground to the joint from which the lower ear grew was 44½ inches on the check plat and 36¼ inches on the Williamson plat. The ordinary method of culture showed 14 per cent of broken-over plants and the Williamson method 29 per cent.

At no time during the growing season did either plat suffer for moisture. The cost of 1,000 pounds of commercial fertilizer was $12.80 and the value of the crop at 70 cents per bushel $21.35. These results were not profitable, and the results of other experiments made by the station in various localities of the State lead to the belief that the proportion of kainit in the Williamson fertilizer is too high. It is further considered an open question whether the large yields obtained by Mr. Williamson on upland in South Carolina are not due more to the frequent plowing under of a crop of cowpeas, to the liberal use of nitrogenous fertilizers, and to close planting than to the distinctive features of his method. "Our previous experiments lead us most heartily to recommend plowing under a crop of cowpeas or other legumes as a fertilizer for corn, or the liberal use of nitrogenous fertilizers, and in many cases somewhat thicker planting than is customary, but a single year's test does not permit us to recommend all the details of the Williamson method."

CARBON BISULPHID FOR KILLING SASSAFRAS SPROUTS.[a]

Grubbing is a laborious and expensive operation, as all know who have had experience with this means of ridding land of sprouts and small growths of various kinds. This is especially true of growths like sassafras, for example, having extensive root systems which it is almost impossible to entirely remove from the soil by grubbing, and which consequently send up new sprouts every year, making grubbing a perennial task. In experiments at the Arkansas Experiment Station on methods of managing and caring for apple orchards E. Walker found that a great deal of grubbing was necessary to keep the orchard free from sassafras sprouts, and therefore sought to find a substitute for the process. Experiments were made with various substances, including coal tar, salt, and carbon bisulphid.

The results were only partially successful with the first two substances, but entirely satisfactory with the carbon bisulphid. [The carbon bisulphid was]

[a] Compiled from Arkansas Sta. Bul. 91, p. 193.

applied to the lower parts of the stem July 20. On the sprouts 3 to 5 feet tall a teaspoonful to a tablespoonful was used. It was poured down the stem, beginning 6 inches above the ground. This portion of the stem turned brown in a few days. The top of the plant was brown and dead in a short time. At the end of the month several were dug up in order to examine the root. They were old roots in some instances which had been cut off several times before. The roots treated with the carbon bisulphid were dead to the end of the roots taken out, the heartwood being discolored.

This material costs 10 to 20 cents a pint. It would be more expensive to use it than the grubbing hoe, but it would be cheaper in the end for the scattering sprouts, which persist in pushing up in spite of the grubbing hoe.

While experiments were made only with sassafras sprouts, there is good reason to believe that the carbon bisulphid would prove effective in destroying other kinds of sprouts.

In using the carbon bisulphid it should be borne in mind that both the liquid and the fumes which it gives off freely are inflammable and explosive when brought in contact with fire.

SOLUBLE OILS FOR THE CONTROL OF SAN JOSÉ SCALE.[a]

Within the past two or three years several of the experiment stations have been giving some attention to the nature and value of soluble oils as insecticides for use against scale insects. Soluble oils is the term used to denote compounds of petroleum so treated as to mix readily with water. As suggested by Dr. J. B. Smith, of the New Jersey Experiment Station, they might, therefore, be more properly called miscible oils. The soluble oils thus far used are proprietary preparations and have been compared with mechanical mixtures of petroleum and water and also with lime sulphur and other insecticides.

The chief advantages claimed for soluble oils are ease of preparation, great spreading and penetrating power, and absence of corrosive effects upon machinery and operators. In Virginia one of these soluble oil preparations was tested in a 5 per cent solution. At this strength it seriously injured the foliage of apple trees and failed to destroy the San José scale in a satisfactory manner. The preparation ready for spraying cost from 13 to 15 cents a gallon, as compared with 1 cent a gallon for lime-sulphur wash. Similar results were obtained by Mr. H. A. Gossard at the Ohio Experiment Station. In the opinion of this entomologist, soluble oils will probably prove valuable for use in small orchards and on apple trees with rough bark. "When safety, cost, and efficiency are all considered, we believe lime sulphur is the best remedy for the orchardist to use."

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[a] Compiled from New Jersey Stas. Bul. 186; New York State Sta. Bul. 281; Ohio Sta. Circ. 60; Virginia Sta. Bul. 152.

Mr. Gossard feels unable to recommend the soluble oils as highly as lime sulphur until more experiments have been carried on with the proprietary compounds.

P. J. Parrott, H. E. Hodgkiss, and F. A. Sirrine, of the New York State Station, report the results of experiments which showed that miscible, or soluble, oils in the proportion of not less than 1 part of oil to 10 or 15 parts of water destroyed a large percentage of scale, but were not quite so efficient as boiled lime-sulphur wash.

They call attention to the fact that "the miscible oils are commercial insecticides and therefore the orchardist should understand that the reliability of the stock material rests with the compounder."

These sprays are simple to prepare for use, and are convenient preparations for the treatment of odd trees and small orchards. The cost of the miscible oils in the proportions of 1 part to 10 or 15 parts of water makes their use almost prohibitive for commercial orchardists who desire a safe and comparatively cheap oil spray.

INDIAN CORN AS A FOOD FOR MAN.[a]

Indian corn and the products made from it constitute a very important part of the available food supply of American families, though the use of corn is by no means limited to the Western Hemisphere. It is also extensively used in Italy, the Balkan regions, China, India, South Africa, and other countries.

Corn meal is undoubtedly the principal food product derived from corn, but large amounts of hominy, hulled corn, corn grits, flaked corn, and various parched and specially prepared breakfast foods are also eaten. Corn starch is a staple food product and corn flour is used to some extent. Unripe ears are extensively used as a vegetable and canned green corn is an important food product. In earlier times corn was dried or evaporated for winter use and such products are still used in a limited way. Pop corn is grown in large quantities and though sometimes used as a breakfast food, in the preparation of puddings, etc., is most commonly eaten out of hand. Corn oil, expressed from the germ, has possibilities as a food product and corn sirup or glucose, made by inverting the cornstarch, is much used as a table sirup, in the manufacture of confectionery, and in other ways. An infusion of parched corn makes a fairly palatable "cereal coffee," or coffee substitute.

At the Maine Agricultural Experiment Station the value of Indian corn as a food has been studied for some time. As Prof. L. H. Merrill points out in a recent publication on the subject, the excellence of Indian corn as a food seems to have quickly impressed itself upon the

[a] Compiled from Maine Sta. Bul. 131.

early settlers and from the first this grain has been closely identified with the history of the American colonists.

Corn is a native of the Americas and has been cultivated by the aboriginal inhabitants of the New World for many centuries. It was the principal food plant raised by the Indians, though beans, pumpkins, and some other crops were also grown. So extensively was corn used in early times by the American colonists that the word corn, which formerly signified any cereal food grain, soon lost its original significance and was applied exclusively to Indian corn, although the wider use of the term is still retained in Great Britain. In South Africa corn is called " mealies."

It was a long time before this grain ceased to be the most important of our food cereals; indeed, it is scarcely a century since wheat has assumed the leading place to which its superior bread-making qualities entitle it.

Although Indian corn now occupies the second place in importance among the cereals which in this country serve as food for man, it far exceeds wheat in the size and value of the crop produced. * * *

In 1905 there were in the United States 94,000,000 acres in corn, and the crop attained the almost incredible size of 2,707,993,540 bushels, with a value of $1,116,696,738. In the same year 47,854,079 acres were given up to wheat, and the crop was 692,979,489 bushels, worth $518,372,727. * * *

Of course, but a small fraction of this amount is utilized as human food. There are no reliable statistics to show how much is thus consumed, but it is doubtful if it exceeds 1 bushel in 50 of the total crop. Its use to-day is much more general in the South than in New England, where for the most part it is eaten only at irregular intervals as brown bread, johnnycake, or occasionally as hominy. The colonists, following the example of the Indians, ate parched corn, either entire or in the form of a coarse meal. * * *

Other dishes which found favor with the colonists, composed wholly or in part of corn, were hominy, hasty pudding, johnnycake, brown bread, pone, samp, and succotash, the last consisting of green corn cooked with beans. Although wheat has so largely replaced corn, it may be questioned whether we can not profitably make a fuller use of the cereal which seemed to conduce to both the physical and intellectual vigor of our forefathers.

In connection with the investigations at the Maine Experiment Station, corn and various corn products were analyzed in comparison with wheat flour, average results being shown in the table which follows:

Average composition of corn, corn products, and wheat flour.

	Water.	Protein.	Fat.	Carbohydrates.		Ash.	Heat of combustion, per pound.
				Crude fiber.	Nitrogen extract.		
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Calories.*
Corn	10.75	10.00	4.25	1.75	71.75	1.50	1,796
Hominy	10.96	9.44	.67	.37	78.24	.32	1,808
Corn meal, unbolted	10.30	7.50	4.20	65.90		1.20	1,544
Corn meal, bolted	11.60	8.40	4.70	74.00		1.30	1,728
Granulated meal	11.79	8.50	.98	.46	77.79	.48	1,734
Do	7.77	8.69	1.92	.40	80.72	.50	1,825
Wheat flour	11.09	11.37	1.33	.13	75.44	.64	1,771

The corn meal formerly found upon the market consisted merely of unbolted gronnd corn, the composition of which was practically identical with that of the grain from which it was prepared. Such meal was commonly sifted before it was used, the bran and other coarse particles being thus removed. While such meal may still be found upon the market, being extensively used as food for stock, that used as a food for man is generally bolted before the meal leaves the mill, the offals or bran being sold as cattle food. Since the fat or oil, so abundant in corn, is confined largely to the germ, and since the oil is peculiarly subject to changes resulting in rancidity, the presence of the germ is prejudicial to the keeping qualities of the meal. This has led to the production of the so-called "grannlated corn meal," obtained by the use of roller mills. Instead of reducing the kernel to the desired fineness by a single operation, it is first crushed by a machine known as a "degerminator," which so loosens the germ and hull that they may be removed before the final grinding. It is evident that the composition of the product thus obtained will differ in several very important respects from that previously described, being poorer in fat, through loss of the germ, and also poor in crude fiber or woody matter, which is found for the most part in the rejected outer coating, or the bran. These differences are well shown in the above table. In the manufacture of hominy the germ is also removed, with marked effect upon the proportion of fat in the product. It will be noted that in the manufacture of both hominy and granulated corn meal two-thirds or more of the ash constituents are removed. While small amounts of these salts play a very important part in the animal economy, there is reason for believing that the most of our foods carry them in such large excess that the removal of a part of them in this case is no cause for uneasiness.

Using the corn products whose composition is shown in the above table, the digestibility of hominy, hasty pudding, and corn bread of different sorts was studied with healthy young men as subjects.

The hasty pudding was prepared by stirring the meal into salted water and cooking in a double boiler. In both johnnycake and brown bread equal weights of meal and flour were used. * * *

The brown bread was steamed in tin cans made for the purpose, somewhat conical in form, and provided with covers. Four loaves were cooked at once, the cans being immersed to half their depth in boiling water in a large pan having a perforated false bottom and a cover with a small opening. * * *

Neither flour nor baking powder was used in the preparation of the hoecake. The hot meal was stirred with boiling water until a thick pudding was formed, which was then spread in thin sheets upon the hot, well-greased iron plates and baked at once. In all the work care was taken to insure thorough cooking.

For purposes of comparison, digestion experiments were also made with wheat-flour bread. The special foods studied were eaten with milk and sugar, this ration being termed a simple diet, and as a part of a more elaborate "mixed ration," which also included canned peaches and meat. The following table shows the average coefficients of digestibility obtained for the entire rations and the calculated digestibility for the special food products alone.

Coefficients of digestibility of a ration containing corn products and one consisting of corn products alone.

Kind of food.	Entire ration.			Corn products alone.		
	Protein.	Carbohydrates.	Heat of combustion of digested material.	Protein.	Carbohydrates.	Heat of combustion of digested material.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Hominy in simple diet	89.2	99.0	96.4	84.3	98.2	94.4
Hominy in mixed diet	93.6	98.8	96.3	....	....	....
Hasty pudding in simple diet	89.2	99.0	95.9	83.9	98.3	93.1
Hasty pudding in mixed diet	94.0	98.9	96.9	....	....	....
Johnnycake in simple diet	94.9	98.7	93.8	93.2	98.9	93.5
Johnnycake in mixed diet	94.8	99.3	93.9	....	....	....
Brown bread in simple diet	94.7	98.7	93.5	92.8	98.6	93.4
Brown bread in mixed diet	95.5	99.4	92.9	....	....	....
Hoecake in simple diet	93.9	98.7	93.7	88.9	98.6	93.8
Hoecake with sirup	92.6	99.2	95.5	90.0	98.7	94.0
Hoecake in mixed diet	94.6	98.8	92.6	....	....	....
Wheat bread in simple diet	94.0	98.9	94.0	89.8	98.9	94.0
Wheat bread in mixed diet	96.1	99.0	98.2	....	....	....

In every case but one the protein of the mixed diet was more completely digested than that of the simple diet. The low digestibility of a simple diet has been often noted in previous experiments. With a simple diet the protein of the johnnycake and the brown bread seems to have been slightly more digestible than that of the white bread. With the mixed diet, the white bread shows a digestibility distinctly greater than that of the corn breads.

The use of sirup with the hoecake to a slight degree depressed the digestibility of the protein. This is in accordance with other experiments in which the digestibility of the protein apparently varied with the ration existing between the protein and the other nutrients. * * *

The use of large amounts of butter, pork, or other fatty foods in connection with corn foods is to be deprecated, since the difficulties in the way of establishing a proper balance between the protein and other nutrients is thus increased. The effect of sirup in depressing the digestibility of protein has already been alluded to. Sugar and molasses are open to the same objection and for the same reason. The craving for these food accessories [in such large amounts] is an example of the fact that the appetite is not always a safe guide.

The coarsely milled forms in which corn is placed upon the market naturally call for more prolonged cooking, not only to break down the starch grains, but to rupture the walls of the cells, and thus expose their contents to the action of the digestive juices. It is probable that much of the difficulty occasionally experienced in digesting corn breads might be avoided by a careful attention to these facts. At present there is but little difference to the consumer in the retail cost of corn meal and wheat flour. Both are among the cheapest of our foods. The question of economy need not be considered in choosing between the corn and wheat breads. In general it may be said that the corn products are more digestible than is commonly supposed. Not only their digestibility, but their cheapness and the readiness with which they may be converted into palatable foods suggest a more extended use and entitle them to a much higher place in the popular estimation.

The characteristics of breakfast foods prepared from corn and the composition and digestibility of such materials as compared with breakfast foods made from other grains and related questions are taken up in a Farmers' Bulletin of this Department, entitled "Cereal Breakfast Foods."[a]

STORING PRESERVES, CANNED FRUITS, AND CANNED VEGETABLES.[b]

Mrs. L. H. Adams and E. P. Sandsten, at the Wisconsin Experiment Station, have made a number of studies of home methods of canning and preserving fruits and vegetables and have paid especial attention to the use of such native fruits as wild plums and seedling apples. In connection with this work, considerable attention has been devoted to methods of handling and storing the canned goods in order that they might not deteriorate in quality.

It appears that the condition of the fruit when preserved has a marked effect upon the keeping quality of the product.

> It is important that the fruit intended for canning should be in the right stage of ripeness. This stage is difficult to describe, though in general the fruit should be firm, having attained its full size and normal color. It should be free from all kinds of blemishes, such as scab, rust, rot, and all forms of insect life. Fruit intended for canning in any way should be utilized as soon as possible after it is picked. If left standing for hours, even if the fruit is not overripe, the fine flavor is lost and the keeping qualities greatly impaired.
>
> In selecting fruit for canning it is advisable not to mix the different varieties together—for example, if plum preserves are made each lot should be made from a distinct variety or a combination of flavor will be the result; besides some varieties require more heat than others, thus giving the preserved product a lack of uniformity so undesirable.

Vegetables intended for canning and pickling should be picked at a suitable stage of ripeness and should be of uniform size and quality. For instance, in canning tomatoes the fruit should all be equally ripe and of good color, yet should not be overripe. Corn for canning should not be too tender and watery and, on the other hand, should not be so old that it is glazed and tough. For making pickles young cucumbers are generally considered more satisfactory than the larger sizes.

As regards the question of storage, the bulletin referred to says:

> The keeping qualities of preserved fruits and vegetables are greatly impaired by being stored in full daylight. This is especially true when glass jars are used. The jelly will soon become cloudy and dark when thus exposed. Marmalade and other preserves are apt to sour and become moldy. No matter how well the fruit has been put up and how carefully sterilized and sealed, slow changes in the preserve will take place which sooner or later work their destruction.

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[a] U. S. Dept. Agr., Farmers' Bul. 249.

[b] Compiled from Wisconsin Sta. Bul. 130.

The careful housekeeper will keep close watch over her preserved fruits, and if indication of spoiling appears the tops should be removed and all mold and spoiled fruit removed and tops again replaced, after which the jars should be resterilized by placing them in a pan of cold water, with cover over, and then gradually apply heat until the boiling point is reached.

There are a number of excellent makes of fruit jars on the market. The main point to bear in mind in selecting jars is that the tops or covers fit tightly, as the fruit will not keep in leaky jars. Jars with large mouths or mouths of the same size as the rest of the jar are preferable to jars with small mouths, as it is much easier to put in the fruit and to take it out. A clear glass jar is preferable to one of colored glass, as one can watch the keeping qualities of the preserves much better.

Several simple devices for tightening and for opening cans are now on the market, which are used in much the same way as a wrench is used for tightening or loosening bolts. Such devices do away with the difficulty often experienced in opening glass fruit jars with metal tops.

In the above discussion no reference has been made to the use of tin cans for home canning, yet they are often used, particularly when some one of the home canning outfits is employed to sterilize the fruits or vegetables. The use of an inexpensive canning outfit is described in an earlier bulletin[a] of this series.

When preserved fruits and similar goods are manufactured on a wholesale scale, tin cans are more commonly used in the United States than glass or earthen jars, though many manufacturers put up certain special grades in glass. In Europe the preference is decidedly in favor of the earthen or glass jars. A recent German publication[b] specifies a number of qualities which a serviceable preserve jar for commercial use should possess. The jar must be provided with a simple sealing device which must be unobjectionable from the standpoint of hygiene and serviceable from the manufacturer's standpoint. Whether a machine should be required for sealing the jars or whether the jar is self-sealing is of secondary importance. A method of sealing jars is to be preferred which enables one to determine whether or not the contents of the jar are spoiled. The jars must be well adapted for use on a large scale and must be reasonably cheap. Little stress is laid by the manufacturers on the possibility of using the jars again. Indeed, so far as can be learned, American manufacturers do not collect the jars or bottles for use a second time. The cover must fit in such a way that after the can has been opened it will still protect the contents from dirt and contamination. The jar must be of such shape and made of such grade of glass that the contents present a pleasing appearance and remain

[a] U. S. Dept. Agr., Farmers' Bul. 259.

[b] Konserv. Ztg., 1906, No. 41; abs. in Pure Products, 3 (1907), No. 1, pp. 24, 25.

of good quality. It must be of such shape that it can be packed for shipping purposes with a minimum waste of space.

NATURAL AND ARTIFICIAL INCUBATION OF CHICKENS.[a]

Climate must always be an important factor in poultry raising, and it is self-evident that the practice which is successful in Maine or Canada may well be different from that suitable for Virginia, West Virginia, or some other State with a still warmer climate. At the Rhode Island, Utah, West Virginia, and other experiment stations the relative value of natural and artificial methods for hatching chickens has been studied with a view to developing methods which will enable the poultry raiser to hatch chickens in large numbers under profitable conditions. The Ontario Agricultural College in connection with its poultry work has also devoted much attention to the question of incubators and various methods concerned with natural and artificial methods of hatching poultry.

In order to raise chickens successfully, whether by natural or artificial methods, it is very essential to secure eggs which will hatch well and produce strong, vigorous chicks. As Stewart and Atwood, of the West Virginia Experiment Station, pointed out—

> If the germs are naturally weak no amount of attention and good care during the incubation of the eggs and the brooding of the chicks will make up for the original lack of vigor. In spite of all that can be done the hatch will be poor, if the germs are weak, and many of the chicks which do hatch will die. As one can not determine by an examination of the unincubated egg whether the germ is strong or weak, the only thing that can be done in practice is to select the breeding stock with such care and give it such attention that eggs suitable for hatching must of a necessity result.
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> Breeding stock should be mature. The first eggs laid by pullets should not be used, but when the eggs have attained their normal size and the fowls have reached the age of 1 year or more the eggs should hatch well, provided that all of the other conditions which influence the production of fertile eggs are favorable.

The fowls should be fed a sufficient amount of a ration containing the proper proportion of the different food elements required. Green food, grit, pure water, pure air, and the opportunity to take exercise are all important.

That chickens may be raised in large numbers by the natural method is shown by the tests in Rhode Island and Massachusetts, particularly in the former State. Where this method is followed the chicks are hatched largely during the months of May and June, and when from 50 to 1,500 hens are kept there is little difficulty in secur-

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[a] Compiled from Maine Sta. Bul. 100; Rhode Island Sta. Rpt. 1903, p. 269; West Virginia Sta. Bul. 98; U. S. Dept. Agr., Bur. Anim. Indus. Bul. 90; Ontario Agr. Col. and Expt. Farm Bul. 151; Cornell Countryman, 3 (1906), No. 6, p. 139.

ing a sufficient number of broody hens. Many of those who are keeping large numbers of hens seem satisfied with the natural method of incubation, yet there is little doubt that the number of incubators in use is increasing from year to year.

In a series of incubation experiments at the Rhode Island Station 8,677 eggs were set in incubators. Of these, 86 per cent were fertile, and 46 per cent of the fertile eggs, or 38.6 per cent of the total number of eggs, hatched, the efficiency of hatch under various conditions of management ranging from 0 to 84 per cent.

Whether it will pay to use incubators and brooders for hatching chickens depends very largely upon circumstances. Where chickens are wanted earlier than April 15, Prof. W. R. Graham, of the Ontario Agricultural College, considers that under Canadian conditions an incubator is practically a necessity, as it seldom happens, in northern regions, at least, that any considerable number of hens become broody until after the 1st of April. Again, if it is desired to hatch more than 150 chicks, an incubator is, in many cases, considered cheaper and better than the natural method, and is a necessity when nonsetting varieties of hens are kept.

In Professor Graham's opinion, on an average the incubator will hatch as large a percentage of eggs as the hen, though there is little doubt that certain hens will hatch a higher percentage than the machine. Tests carried on at the Ontario Agricultural College have shown that when 240 eggs were placed in an incubator and the same number under 20 hens the number of chicks hatched was about equal.

The average hatch is probably one chicken from every two eggs set. This, of course, varies with the different seasons, also with the percentage of fertile eggs, and the strength of the germ. We have found during the months of February and March, when the ground is covered with snow and the fowls are closely housed, that the percentage of fertile eggs is small, and that the germs are very weak. Under such conditions we have very poor hatches and chicks that are very hard to rear. Much better eggs are obtained in December and early January, or when the fowls get out into the fresh air and are able to pick some grass. Thus it will be seen that, as a general rule, as the percentage of fertile eggs increases, the vitality of the germ increases, the percentage hatched is larger and the mortality among the young chicks smaller. For example, we would expect to get a much larger percentage hatch of the fertile eggs from eggs that were 90 per cent fertile than from those that were 60 per cent fertile; and, moreover, we would figure on raising a much larger percentage of chicks from the former eggs than from the latter, owing to the chicks being stronger and having greater vitality.

When hens are used to hatch the eggs it is generally conceded that in order to secure the best results the hen must be placed where other poultry will not disturb her.

As a rule, we seldom get good hatches where other hens lay in the nest with the sitter. Some farmers do not set a hen until one becomes broody on a nest where no others lay, which often necessitates late chicks. The difficulty can be overcome by making a new nest for the broody hen. Get a box about 12 inches square and 6 inches deep; put some earth, or an overturned sod, in the bottom, taking care to have the corners very full so that no eggs can roll out from the hen and get chilled; next put on about 2 inches of straw or chaff; and then put a few earthen eggs into the nest. Place the nest in some pen where nothing can disturb the hen, and put her on after dark. Feed and water must be within easy reach, and a dust bath should also be convenient. If the hen is * * * [on the nest the next day and quiet], you will be safe in putting the eggs under her. In our experience we get 90 per cent of the hens to sit by following this method.

It should be remembered that the hen will be in better condition if dusted with insect powder when set, and also a few days before the hatch comes off. This will usually keep the lice in check, especially if some tansy or mint leaves are used in making the nest.

As Professor Graham points out, little definite information is available regarding the management of incubators, some persons succeeding in obtaining large hatches while others, under apparently the same conditions, meet with failure. The real reason for this variation is not known. "This much, however, can be said: The machine should not be placed in a direct draft, nor yet in a building where there is a lack of ventilation. Fresh air is one of the most important things in an incubator room. * * * Hardly any two people agree as to which is the best place to operate the machine," good hatches being sometimes obtained in cellars, in kitchens, and in other rooms.

As a general rule it is wise to follow the manufacturer's directions in managing an incubator. The Canadian work shows "that different makes of incubators require different treatment, both as to temperature and otherwise, and we generally get the best results when running closely to the directions. Where possible the temperature in the room should vary but little; for if it varies 30° to 40° in twenty-four hours it is very hard to keep an even temperature in the machine, and it is absurd to expect that the machine will not vary with such changes in the surrounding temperature."

According to G. M. Gowell, of the Maine Experiment Station—

Incubators have been so much improved that there are several kinds on the market that will hatch as many chicks from a given lot of eggs as can be done by selected broody hens. They require little care, maintain an even temperature, and are easily adjusted to meet the increase in temperature arising from the developments going on in the eggs. In some machines the moisture supply is automatic and adapted to the requirements; in others it has to be supplied, and skill is necessary in determining the quantity needed. The economy of the incubator is very great. A 360-egg machine will do the work of nearly thirty broody hens and can be kept at work continually if desired.

In this connection it is interesting to consider some work carried on at Cornell Agricultural College to determine how frequently the sitting hen turns her eggs. From a considerable number of observations it appeared that in every instance the eggs were moved about two or three times a day by the hen and did not remain in the same part of the nest for more than three days. "The thorough manner in which the hen turns the eggs may well furnish us a clew to the most natural and proper treatment of the eggs when under the artificial conditions of the incubator."

Chickens hatched in an incubator can be reared either with hens or with a brooder. Professor Graham considers the use of broody hens for mothers preferable.

The best plan to get the broody hens to take the chicks is to give the hen two or three eggs out of the incubator on the eighteenth or nineteenth day and allow her to hatch them. When your incubator hatch is over take a dozen or fifteen chickens and put them under the hen after dark. Even if they happen to differ in color from those she has hatched she will mother them all the same. If you give them to her in the daytime, she may not do so. Never neglect to give the hen a thorough dusting before giving her any eggs. If there is one thing more than another that requires careful attention in rearing young chickens, it is to keep them free from lice. If lice get upon them, from the hen or elsewhere, a large proportion of them will be almost sure to die.

At the Maine Station brooders have proved very satisfactory, and indoor brooders are preferred. "The style used has the cover and part of one side arranged to turn down, making an inclining run the whole width of the brooder, up and down which the little chicks can go without crowding.

"Most kinds of brooders as now made keep the chicks comfortable at desired temperatures and have good means of ventilation."

"In brooding chicks," as Stewart and Atwood point out, "either in individual brooders or in brooder houses, the main thing which must be watched is the temperature, for if the temperature is either too high or too low the results will be totally unsatisfactory, even though all of the other conditions governing the health of the chicks are ideal." * * *

The temperature of the brooder or brooder house when the chicks are first transferred from the incubator should be practically as high as the temperature of the incubator from which the chicks have just been removed, or from 95° to 100° F. This temperature should be maintained for the first week, never allowing it to fall below 95°. The second week the temperature should not be allowed to drop lower than 90°. These temperatures refer to the air temperature taken on a level with the chicks. After the second week the temperature should be reduced gradually until the chicks are old enough and hardy enough to do without artificial heat.

Where the chicks are to be raised on a large scale the brooder house heated by hot water pipes is the most economical, for in this case there is only one fire to attend, and the work of feeding and watering the chicks can be done much easier than when the chicks are scattered about in individual brooders.

The Department of Agriculture has recently published a Farmers' Bulletin entitled "Incubation and Incubators," by R. H. Wood,[a]

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[a] U. S. Dept. Agr., Farmers' Bul. 236.

which summarizes much useful information regarding incubator construction, management, and related questions.

BARE-LOT METHOD OF RAISING LAMBS TO AVOID NODULE DISEASE.[a]

A parasitic worm known to scientists as *Œsophagostoma columbianum* causes the appearance of nodules in the intestines of sheep. This worm is generally distributed throughout the United States, and becomes a serious scourge in the sheep business, especially when conditions are favorable for the infestation of young lambs. It has been shown by the Louisiana Experiment Station that when sheep infested by this parasite are placed on clean pasture and allowed to remain for some time the pasture becomes contaminated and will cause an infestation of healthy sheep which may subsequently graze upon it. It was also found that when an infested pasture was plowed up and cultivated for one season danger of infestation with the parasitic worm which causes nodule disease was entirely removed.

This indicates a successful method of treating infested land. On account of the wide distribution of this parasite, however, and the general infestation of breeding ewes, it was desirable to find a method by which lambs could be raised from these ewes without becoming seriously infested with the parasite.

In order to accomplish this purpose a bare-lot system was adopted. This consists simply in keeping the ewes with their lambs on a plat of ground from which all grass or other green vegetation has been removed. The lambs, therefore, have no temptation to pick up anything from the ground and do not run the risk of infesting themselves with the nodule-producing parasites which may be upon the ground. In the experiments carried on at the Louisiana Station the ewes were fed grain once a day, and a rack was provided for feeding green forage of different kinds. All green forage which was pulled out of the rack by the sheep was carefully removed from the feed lot each day. Fresh water was always present in a wooden trough, and the feed lot was leveled so as to prevent the accumulation of water in pools from which the lambs might drink. In this feed lot nine ewes were placed with six lambs, the lambs being born in February and March. At the end of June, all lambs being weaned, the ewes were slaughtered and all found to be infested with the parasitic worms. The lambs were slaughtered and carefully examined at ages varying from 88 to 155 days. In three of these lambs two or three nodules of minute size were found in the intestines. The others were entirely free from nodules, but all six of the lambs were infested to a greater or less extent with stomach worms. The infestation of stomach

[a] Compiled from Louisiana Stas. Buls. 79, 83, 89.

worms, however, was not sufficient to influence perceptibly the development and fattening of the lambs. It is difficult to understand how infestation with stomach worms took place. The bare-lot method appears, from these experiments, to give promise as a means of raising lambs for market at an early age from mothers infested with the nodule-producing parasite without danger of serious infestation of the lambs. It is recommended that in addition to maintaining the infested ewes with their lambs in a bare lot the lambs should be given some vermifuge with their food, or at least common salt, to assist in the removal of possible stomach worms.

SOME MILK TERMS.[a]

The following notes are offered in the nature of explanations of certain terms which, though very frequently heard among dairymen and regularly met with in dairy literature, are nevertheless often used inaccurately and sometimes in a way intentionally misleading.

The many terms, such as aerated milk, filtered milk, etc., which are everywhere well understood are not included. Other terms, such as malted milk and lacto preparations, are omitted because they apply to manufactured food products rather than to forms of milk.

Standard milk.—The variable nature of milk makes it impossible to state without chemical analysis the quantity of fat or other constituents to be found in any given sample. While numerous factors such as the breed of cows and the stage of lactation affect the composition of the milk, the variations, nevertheless, are within limits capable of being defined with sufficient accuracy and fairness for practical purposes. Nearly every country has found it necessary to establish in one way or another certain minimum requirements. Milk to be considered unadulterated in Great Britain, for instance, must contain 3.5 per cent of milk fat and 8.5 per cent of solid matter other than fat. In this country the requirements vary in the different States. In matters concerning the National Government, milk in order to be designated standard must conform to the following definition proclaimed by the Secretary of Agriculture:

"Milk is the fresh, clean, lacteal secretion obtained by the complete milking of one or more healthy cows, properly fed and kept, excluding that obtained within fifteen days before and ten days after calving, and contains not less than eight and one-half (8.5) per cent of solids-not-fat, and not less than three and one-quarter (3.25) per cent of milk fat."

Standard milk is therefore milk which conforms to certain require-

[a] Compiled from various sources including Alabama Col. Sta. Bul. 97; Illinois Sta. Buls. 75, 92; New Hampshire Sta. Bul. 103; Michigan Sta. Bul. 228; U. S. Dept. Agr. Circ. 19.

ments. These are commonly but not always of a chemical nature. In some cities bacteriological standards have been established. These specify usually a maximum number of bacteria per cubic centimeter allowable in milk offered for sale.

Standardized milk, Blended milk.—These terms are applied to milk which has been so modified as to contain a definite amount of one or more of its constituents. The most important and at the same time the most variable constituent is fat. To standardize milk as regards fat it is simply necessary to add or remove a certain amount of this constituent or to add or remove a certain amount of skim milk. Detailed directions for this purpose are given in Bulletin 75 of the Illinois Station. To cite an illustration from this bulletin, 1,600 pounds of milk containing 3.2 per cent of fat may be standardized to 4 per cent of fat by removing 320 pounds of skim milk. A simple method of determining the amounts of skim milk and whole milk, or of milks containing different percentages of fat which should be mixed in order to secure a product having a desired fat content is given by Prof. R. A. Pearson in a reading-course bulletin of Cornell University.

> Draw a rectangle and write at the two left-hand corners the percentages of fat in the fluids to be mixed, and in the center place the required percentage. At the upper right-hand corner put the number which represents the difference between the two numbers standing in line with it—i. e., the number in the center and the one at the lower left-hand corner. At the lower right-hand corner put the number that represents the difference between the two numbers in line with it. Now let the upper right-hand number refer to the upper left and the lower right hand to the lower left, then the two right-hand numbers show the relative quantities of the fluids represented at the left-hand corners that must be combined to give a fluid of the desired standard which is represented in the center. * * *
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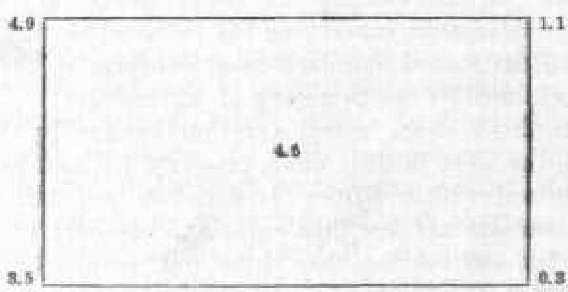
> If it is wanted to mix the milks from two dairies testing 4.9 per cent fat and 3.5 per cent fat to produce a 4.6 per cent milk, the diagram shows these milks must be mixed in the proportion of 1.1 to 0.3 or 11 to 3. Thus:



> If we have 120 pounds of the 4.9 per cent milk we must mix with it 32.7 pounds of 3.5 per cent milk, as is shown by this proportion: 11 : 3 : : 120 : 32.7.

Modified milk, Humanized milk.—These terms are applied frequently to cow's milk specially prepared for infant feeding. The most important difference between cow's milk and human milk lies in the proteids or nitrogenous constituents which are greater in amount in cow's milk. By allowing cow's milk to stand for several hours, taking the top portion, and diluting this with water with the addition of milk sugar, a product may be obtained which corresponds in percentages of fat, proteids, and milk sugar to human milk. The modifications which have been suggested and the ways of making them are very numerous.

Certified milk.—This term, though registered as a trade-mark in 1894, is now quite generally used with reference to milk produced and handled under conditions approved by some responsible organization such as a medical society. An organization of this kind exercises supervision over the health of the cows, the cleanliness of the dairy, the health of employees, the chemical composition and bacterial content of the milk, and other matters having a bearing upon the wholesomeness of the milk and furnishes a dairyman, complying with the specified requirements, a statement certifying to the purity of his product.

Guaranteed milk.—The term "guaranteed" is often applied to milk in its ordinary sense. It merely means that the producer agrees to deliver milk of a certain composition or quality, and it should carry weight only in proportion to the reliability of the party making the guaranty.

Sanitary milk.—This is a term applied somewhat indefinitely to milk produced and handled under conditions considered necessary to secure a pure, wholesome product. It is often applied by dealers, for purposes of advertising, to milk produced under decidedly insanitary conditions. The term "hygienic" is similarly abused.

Pasteurized milk.—This term should be applied only to milk which has been heated sufficiently to destroy most of the active organisms present. Bacteria of one kind or another are invariably present in milk obtained under ordinary conditions. Some of these cause souring of milk, while others may occasionally be disease-producing forms, such as the tubercle bacillus. Milk may be heated enough to destroy all the organisms present, but when this is done it has acquired a cooked taste which is more or less undesirable. To avoid this the temperature of heating should not exceed 185° F., and at the same time to secure the destruction of any considerable number of the organisms present, it must not be below 140° F. When the higher temperature mentioned is used the period of heating may be very short, but when the lower temperature is employed it must be prolonged in order to secure the same results. Pasteurization therefore merely checks fermentation. It does not destroy all of the organisms present. It should, however, destroy all disease-producing organisms likely to gain access to milk.

Sterilized milk.—This is milk in which all organisms have been destroyed. It is not always accomplished by merely boiling the milk unless the boiling is repeated on two or three successive days. Higher temperatures than the boiling point are necessary to assure sterilization or the complete destruction of all organisms at one application of heat of fifteen to thirty minutes' duration. Much of the so-called sterilized milk is by no means free of living organisms.

Clarified milk.—In passing through a centrifugal separator much of the solid impurities in milk remains in the separator slime. A mixture of the skim milk and cream so obtained is often referred to as clarified milk.

Carbonated milk.—This is milk put up in bottles and charged with carbon dioxid or carbonic-acid gas.

Homogenized milk.—This is milk in which the fat globules have been broken up by mechanical means into very fine particles, which show no tendency to rise to the surface, as do the fat globules of ordinary size. In accomplishing this purpose the milk is usually forced through capillary tubes and against a resisting surface. The force of impact causes the breaking up of the globules and thus makes a more perfect emulsion out of the milk. The process is protected by patents in various countries.

Condensed milk, Evaporated milk.—This is defined by the Secretary of Agriculture as milk from which a considerable portion of water has been evaporated and which contains not less than 28 per cent of milk solids, of which not less than 27.5 per cent is milk fat. The sweetened product contains varying percentages of added sugar.

Desiccated milk.—This product, which is usually referred to in this country as milk powder, is prepared from whole or skim milk by patented processes.

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