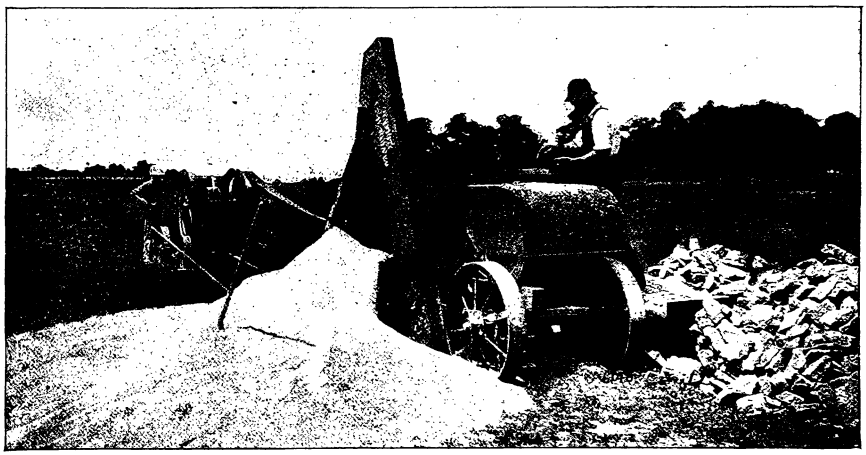
POPULAR EDITION.

BULLETIN No. 400. MARCH, 1915.

New York Agricultural Experiment Station.

GENEVA, N. Y.



PORTABLE LIMESTONE GRINDER.

GROUND LIMESTONE FOR SOUR SOILS.

SUMMARIZED BY
F. H. HALL.
FROM BULLETIN BY
J. F. BARKER AND R. C. COLLISON.

PUBLISHED BY THE DEPARTMENT OF AGRICULTURE.

POPULAR EDITION*

OF

BULLETIN NO. 400.

GROUND LIMESTONE FOR SOUR SOILS.

F. H. HALL.

WHY USE THIS FORM OF LIME?

Liming needed. Many New York soils need lime. On probably three-fourths of the cultivated area of the State, the lime content has become so much reduced that legumes, the better grasses, beets and many other crops fail or give poor yields where once they may have grown well, because the soil has become acid or because the crops no longer find the lime they actually require as plant food.

Success with these crops is fundamental to profitable agriculture; and if, by moderate expense, the soils outside the limestone belt can be made to produce good yields of these better crops, the level of the agriculture of the entire State will be notably raised.

Liming inexpensive. Ground limestone can now be obtained very readily and very cheaply. New quarries have been opened in many places (see pages 4 and 5), dozens of grinding plants have been put in operation, the equipment has been simplified and improved, the output of limestone of excellent quality is very great, and the costs of production and distribution have been greatly reduced. Limestone ground fine enough for general use now costs only $1.25 to $3.00 a ton at the railroad stations of most farmers in the State.

Ground limestone efficient. Ground limestone has been thoroughly proved an efficient and economical aid to crop production by long continued experiments in Ohio, Illinois, Pennsylvania, New Jersey, Rhode Island and many other States; and data are rapidly accumulating to show the same favorable results in this State.

Already this form of lime has shown itself effective in aiding the establishment of alfalfa on the poor hill lands of southern New York, as useful as much more expensive forms.

In Ohio, in twelve years of testing on many plats, moderate applications of limestone once in a crop rotation of five years, on soils only moderately acid, have given average net profits of $15 an acre

* This is a brief review of Bulletin No. 400 of this Station on Ground Limestone for Acid Soils, by J. F. Barker and R. C. Collison. Anyone interested in the detailed account of the investigations will be furnished, on application, with copies of the complete bulletin, so long as these are available.

Names of those who so request will be placed on the Station mailing list to receive future bulletins, popular or complete, as desired.

when used alone, and of from $2 to $5 more than this when used with phosphorus, with barnyard manure, with phosphorus and potassium, or with complete commercial fertilizers.

In New Jersey, the value of the increase in general farm crops in five years after a two-ton application of ground limestone was placed at $25 an acre, and the value of the increase in vegetables at $48.

Limestone and quicklime.

Ground limestone is as efficient as burned lime, if ground moderately fine and used in quantity to give the same amount of calcium and magnesium per acre. Nine years of comparative trials at the Ohio Station, four at the Tennessee Station, eleven years at the Maryland Station and much other evidence both from this country and from abroad prove that the limestone gives at least as good and sometimes better results than its lime equivalent in other forms. Quicklime occasionally appears to injure land or crops through its caustic properties; but ground limestone, being chemically neutral, can never harm either soil or crop. It should be said here, though, that, like most other forms of lime, the ground stone may increase the virulence of potato scab.

Limestone convenient to use.

Ground limestone is more convenient to handle than other forms of lime. When ground fine enough for farm use — so all the material from the grinder passes a 10-mesh sieve — the stone can be shipped and handled in bulk, without the expense for bagging necessary when finely ground freshly-burned lime, hydrated (slaked) lime or air-slaked lime is used. The ground limestone can be easily distributed, either by hand or by a lime-sower, without the unpleasant effects on skin and eyes that follow the handling of caustic lime.

Low cost offsets smaller lime content.

The decidedly lower cost of ground limestone than of other forms of lime more than counterbalances its lower lime content. Undoubtedly freshly burned lime from a pure stone contains the essential soil-sweetening compounds, calcium and magnesium oxide, in most concentrated form. This is an advantage that must be considered when freight haul or wagon carry are very long; but usually the price for the ground stone, with its 800 pounds or so to the ton of inert carbon dioxide, is so decidedly less than that of other forms of lime that it is far more economical to use although freight and haulage expenses have to be paid on some useless material. When made from impure stone, any advantage for the burned lime is lessened, since the percentage of impurity is increased by the burning.

In the soil the quicklime very soon absorbs carbon dioxide to replace that driven off by heat and becomes again chemically and practically the same as ground limestone from the same source.

COMPOSITION OF GROUND LIMESTONE FOR SALE IN NEW YORK STATE.

Name of company.	P. O. address.	Location of quarry.	Calcium carbonate.	Magnesium carbonate.	Total carbonates.	Calcium carbonate equivalent.	Geological formation.
Adams & Duford Co. . .	Chaumont.	Chaumont.	92.9	.7	93.6	93.8	Lowville limestone.
B. & B. Lime & Stone Co.	Mellenville.	Mellenville.	70.3	7.7	78.0	79.4	Manlius limestone.
Buffalo Cement Co.	Buffalo.	Buffalo.	52.0	39.0	91.0	98.3	Cobleskill dolomite limestone.
Beardsley, W. S., & Co. . .	Auburn.	Auburn.	84.5	2.9	87.3	88.0	Onondaga limestone.
Burkdorf, H. J.	St. Johnsville.	St. Johnsville.	89.4	3.0	92.4	92.9	Trenton limestone.
[1] Caledonia Chemical Co. . .	Caledonia.	Caledonia.	85.0	1.6	86.6	86.9	Marl.
Callanan Road Imp. Co. . .	South Bethlehem. .	South Bethlehem. .	75.2	6.3	81.5	82.7	Manlius limestone.
Canajoharie Stone Co.	Canajoharie.	Canajoharie.	78.8	6.6	85.4	86.7	Glens Falls limestone.
Chazy Marble Lime Co. . . .	Chazy.	Chazy.	91.1	2.2	93.3	93.7	Valcour limestone.
Conley Stone Co.	Utica.	Munnsville.	94.1	.3	94.4	94.5	Manlius limestone.
Conley Stone Co.	Utica.	Blakeslee.	91.0	1.8	92.8	93.2	Manlius limestone.
Dutchess Co. Lime Co. . . .	Dover Plains.	Dover Plains.	53.8	34.0	87.8	94.1	Stockbridge limestone.
DeVoe Limestone Co.	Accord.	Accord.	68.3	10.3	78.6	80.5	Decker's Ferry limestone.

Fretz, M. W.	Richfield Springs	Richfield Springs	89.7	.4	90.1	90.1	Onondaga limestone.
Geneva Limestone Co.	Geneva	Oaks Corners	59.7	28.4	88.1	[2]93.4	Cobleskill limestone.
Harris, John	Saratoga Springs	Rollins Hollow	88.1	3.0	91.1	[3]91.7	Glens Falls limestone.
Langdon & Co.	Elmira	Pekin	84.8	6.6	91.4	92.6	Wolcott limestone.
LeRoy Limestone Co.	LeRoy	LeRoy	89.1	1.7	90.8	91.2	Onondaga limestone.
Medina Limestone Co.	Medina	Medina	53.7	43.3	97.0	105.1	Lockport dolomite limestone.
Norton Stone & Lime Co.	Cobleskill	Cobleskill	75.9	2.2	78.1	78.5	Coeymans limestone.
Otsego & Herkimer R. R. Co.	Cooperstown	Cullen	88.9	1.5	90.4	90.7	Onondaga limestone.
Rock Cut Stone Co.	Syracuse	Rock Cut	70.3	15.0	85.3	88.1	Manlius limestone.
Roberts, George H.	17 State st., New York City	LaGrangeville	56.2	36.5	92.7	99.5	Wappinger limestone.
Sasman, Christopher	Salisbury Center	Salisbury Center	89.7	trace	89.8	89.8	Trenton limestone.
Solvay Process Co.	Syracuse	Jamesville	90.1	2.5	92.6	93.1	Manlius limestone.
Smith, N. T.	Sharon Springs	Sharon Springs	91.4	.9	92.3	92.4	Manlius limestone.
Sugar River Stone Co.	Boonville	Boonville	90.9	1.3	92.2	92.4	Lowville limestone.
Upper Hudson Stone Co.	26 Courtlandt St., New York City.	Verplanck Point	50.4	34.6	85.0	91.6	Inwood limestone.
Worlock Stone Co.	Canastota	Canastota	93.6	.9	94.5	94.7	Manlius limestone.

[1] Marl.
[2] Average analysis of samples taken from face of quarry before company began grinding.
[3] Samples sent in by Mr. Harris.

Hydrated lime is less concentrated than burned lime, as the quicklime takes up about one-fourth of its weight of water in hydrating, or slaking.

Speaking generally, a ton of ground limestone, 1500 pounds of hydrated lime, or 1200 pounds of burned lime, contain the same amount of soil-sweetening chemicals.

Air-slaked lime, when the process is fully complete, is the same in chemical composition as ground limestone, as it has taken from the air the carbon dioxide driven from the limestone by burning, and has again become lime carbonate. It is of equal value with ground limestone from the same quarry; and of no *greater* value unless fineness be financially worth while.

Marl is also lime carbonate and equal to ground limestone in value, if of similar purity.

Great fineness not required.

The greater coarseness of the particles of ground limestone is not a disadvantage in rational liming. Theoretically, the extremely fine particles in burned lime should be more readily distributed through the soil and thus more quickly come in contact with the acid compounds there, neutralizing them and sweetening the soil. Practically, the fineness, below a certain point, is of little or no advantage. Limestone, ground so all the material will pass through a sieve with ten meshes to the linear inch, includes more than 40 per ct. of particles that will pass a 40-mesh sieve, and from 70 to 90 per ct. that will pass a 20-mesh sieve. Applied in considerable quantity, once in a three-year to five-year rotation, ground limestone of this fineness adds to the soil a large amount of fine particles to act promptly, and leaves a reserve supply of larger grains to dissolve more slowly in the soil solution and thus to keep the soil sweet for subsequent crops. The many experiments at various stations prove that the extra fineness of slaked and hydrated limes gives no better results in a rotation than the somewhat coarser particles of the ground stone that pass the 10-mesh sieve. All the fine material produced by grinding must be included, however; none must be sifted out to sell as finer grade.

HOW USE GROUND LIMESTONE?

Use freely.

On most soils of the State that are in need of lime at all, at least two tons to the acre of ground limestone should be used as an initial application, to be followed by a ton to two tons once in every rotation of three to six years. On some soils, however, particularly the hill lands of southern New York, three or even four tons may be found necessary and profitable. In preparing for alfalfa, particularly on poor soils, four to six tons of limestone may be advisable; since the alfalfa should remain on the land for several years and requires large amounts of

lime for plant food, as well as enough to correct soil acidity. It is not easy to supply the necessary lime after the alfalfa is established.

Grading limestones. Limestone is composed of calcium oxide or calcium and magnesium oxides in combination with carbon dioxide, or what we know as a carbonate. As the calcium present is always greater in quantity, and usually much greater, than the magnesium, we generally speak of limestone as calcium carbonate. But for soil sweetening power magnesium is of nearly one-fifth more value than an equal weight of calcium. Accordingly in estimating the agricultural value of limestones we use the calcium carbonate as a basis and add to this the amount of magnesium multiplied by 1.19. This gives the " calcium carbonate equivalent ", previously referred to, which is printed in heavy type in the table.

Where obtain limestone ? Ground limestone of excellent quality may now be obtained from many companies in this State. The table on pages 4 and 5 gives a list of the limestone quarries of the State, with the companies owning them or handling the products and with chemical analyses showing their relative value. This is expressed as the " calcium carbonate equivalent " as shown in next to the last column. Companies from nearby States also furnish limestone ranging from 86 per ct. to 96 per ct. " calcium carbonate equivalent " as follows: Kelly Island Lime & Transport Co., Youngstown, O.; Security Cement & Lime Co., Berkeley, W. Va.; J. E. Baker & Co., Bainbridge, Pa.; Carbon Limestone Co., Youngstown, O.; Edison Portland Cement Co., Stewartsville, N. J.; Grangers Lime & Marble Co., West Stockbridge, Mass.; Bessemer Limestone Co., Youngstown, O.

How and when apply. Some field tests may be used to ascertain the need of liming. Soils with a light color, gray, grayish brown, or yellowish in shade are usually in need of lime; and wherever serious difficulty is experienced in growing good crops of red clover or alfalfa a lack of lime is strongly indicated.

If in doubt, the litmus test gives quite reliable indications. It may be made as follows: Obtain a ball of wet soil about the size of the fist, break it open and insert a double thickness of blue litmus paper (obtainable at any drug store). Press the ball firmly together and allow to stand as much as a half hour. If at the end of this time the paper in contact with the soil has distinctly changed to a pink color there is positive evidence of acidity and it may safely be assumed that benefit will follow liming. Of course it is best to make a number of tests in different parts of the field and the subsoil should be examined as well as the surface. The practice sometimes recommended of placing a piece of filter paper between the litmus paper and the soil renders the test of no value. The litmus must come in direct contact with the soil.

Limestone can best be applied by means of a special lime or fertilizer distributor; as it can be spread more thoroughly and with less labor in this way than if applied by hand or by a manure spreader. The fertilizer attachment of a grain drill has too small capacity for practical use in distributing limestone. It is best to apply the limestone to the rough ground after plowing, thus mixing it more thoroughly with the soil by disking and harrowing. It is in the line of good practice to apply any form of lime as long as practicable before seeding the first crop to be benefited by its application. Fall-plowed land furnishes an excellent opportunity for the application of limestone. Also summer-plowed land, to be seeded to grain in the fall and to clover or grass the following spring, furnishes a good opportunity for its application. In general it is much better to apply limestone in the summer and fall when the roads are good, the land firm, and work not so pressing, rather than in the spring when there is haste to get in the crops and conditions are not so good for hauling and applying.