

Lime-Sulphur--Its Use as a Fungicide and an Insecticide

—By—
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FIFTH INSTALLMENT.

Other Important Compounds.

Besides the important compounds of sulphur produced by boiling lime and sulphur together, we have some others which are of considerable importance in the treatment of insect pests and fungus diseases. Probably the one which promises to be most valuable in the treatment of mildew in general is the iron sulphide spray. It is now considered a most valuable spray for preventing apple mildew infection. Iron sulphide, as the term would indicate, means a combination of iron with sulphur, the chemical formula being FeS. Iron sulphide also occurs in nature and is known as troilite, but, for our purpose we do not consider it as found in its native state. When commercial lime-sulphur solution is added to a solution of iron sulphate (FeSO4), or copperas, the black ferrous sulphide is precipitated, and, since lime-sulphur solution is composed chiefly of polysulphides of calcium, namely, penta-sulphide (CaS5), and tetra-sulphide (CaS4), there is, therefore, an excess of sulphur which is thrown down in the reaction. Both the free sulphur and iron sulphide which is formed by the combination of the lime-sulphur and the copperas, are in a very finely divided flocculent form and the precipitated sulphur may be very largely responsible for the fungicidal properties of this mixture.

In addition to the ferrous sulphide (FeS) and free sulphur (S), there is produced a large amount of calcium sulphate (CaSO4) or gypsum, and there are also present other compounds, notably calcium thio-sulphate (CaS2O3), which has been previously mentioned in discussing the reaction which takes place when the penta-sulphide of calcium breaks down. As soon as the black flocculent precipitate settles, the supernatant liquid is poured off, and, by doing so, the soluble polysulphides and thio-sulphates are removed and also, to some extent, the partly soluble calcium sulphate. The black precipitate is then used to spray upon the trees by adding to it sufficient water to keep it in suspension by good agitation. When the matter of treating the specific fungus trouble for which this spray is used is discussed, more will be given about it, especially the manner of making it up and the strength which is to be used in applying it to the trees.

Another valuable compound of sulphur has been used as a remedy for mildew, especially the mildew of the gooseberry. This is potassium sulphide (K2S) or what is commonly known as liver of sulphur. This compound is never made up by the grower, but is usually purchased at a drug store. It is dissolved in water, usually at the rate of one ounce of potassium sulphide to three gallons of water. In order to use potassium sulphide and to get the best results, it should be applied immediately after mixing, since on standing, the mixture deteriorates very rapidly. It may be stated that potassium sulphide is used when it is undesirable to have the foliage discolored.

One more compound of sulphur will be mentioned, namely, carbon bisulphide (CS2). While carbon bisulphide cannot be considered an insecticide in general, it is very effective in killing any insects that may injure stored grain, fruits, etc. It is easily used by throwing it upon the grain or by putting it into shallow dishes. The gas is much heavier than air and sinks down, killing any insects that may be there. It is especially effective in destroying grain weevil, and for killing certain insects in stored fruit.

There are several other compounds containing sulphur which may be used more or less as insecticides and fungicides, but they are really of so little importance for practical purposes that we do not feel it necessary to mention them here. As a matter of fact, the desire is rather to state very clearly as many of the facts as would seem necessary in discussing the lime-sulphur compound and its uses.

Action of Lime-Sulphur on Insects.

Before leaving the chemistry of lime-sulphur, it may be interesting to the general reader to know something about the action of the lime-sulphur on insects and in general the chemical changes which take place when the lime-sulphur is exposed to the action of the air. We have seen, from the discussion given in the preceding chapters, that the calcium penta-sulphide (CaS5) tends to break down, forming calcium thio-sulphate (CaS2O3), the thio-sulphate in turn breaking down so as to form calcium sulphite (CaSO3). In each case free sulphur is given up. Now, in dry climates, especially on the coast, in southern Oregon and in California, the products of decomposition remain on the tree a long time. This is on the supposition, of course, that the lime-sulphur has been applied in the

spring after the winter rains have ceased.

Among the products of decomposition is free sulphur, which has been deposited in a very finely divided condition and which has a great insecticidal value, but just how this is exerted we do not know. Besides the sulphur, it is a well known fact that the sulphite acts as an antiseptic agent. Probably the first important act of the lime-sulphur is to loosen the scales from the tree and expose the insects. This is probably due to excess of lime in the wash. However, we do not find that this loosening process always takes place. The active killing agents, therefore, are really the free sulphur, the thio-sulphate (so long as it remains) and the sulphite. The fact that this breaking down process takes place, causing the deposition of free sulphur to take place, is a very good reason why lime-sulphur does not stick well on the trees during the wet season, since the free sulphur is washed away, and we also know that the penta-sulphide, the tetra-sulphide and the thio-sulphate are all soluble. Experiments have shown that if very heavy rains follow the spraying of lime-sulphur, the effects of the spray are never so good. This is why the writer advises very strongly against lime-sulphur as a remedy for anthracnose of the apple, and advises Bordeaux instead, the Bordeaux being much more insoluble and sticking longer and better to the trees. The writer does not say, however, that lime-sulphur is not more or less effective in preventing this disease, but it is certainly less effective than Bordeaux. This has been proven by experiments. The same is true of the peach blight or shot-hole disease, Bordeaux spraying being much more effective than lime-sulphur where rains are heavy and washing. It is easily seen that after the lime-sulphur wash has been applied, its efficiency would be reduced just in proportion to the amount of thio-sulphate, penta-sulphide and sulphite washed away. It has been suggested that the efficiency of the lime-sulphur wash was due almost entirely to the finely divided sulphur set free on the decomposition of the penta-sulphide. The action of the free sulphur of the wash has been attributed to the gradual oxidation of the sulphur which gives rise to sulphur dioxide (SO2) or sulphuric acid where moisture is present, and that it is these constituents that do the work.

Everyone had noticed that on a sultry day, in the vicinity of orchards which have been sprayed with lime-sulphur, there is a peculiar odor resembling sulphur dioxide. It is quite probable, however, that sulphur dioxide is not formed to any great extent, but that on hot, sunny days the sulphur is really sublimed and passes off as a gas, which would explain the odor.

Of course, a certain amount of oxidation of the sulphur takes place, but it is very doubtful whether this oxidation would be rapid enough to be of any great value as a fungicide or insecticide. Experiments have shown that for a considerable period of time there has been practically no loss of sulphur on the trees by oxidation. As a matter of fact, it has been noted that there is an increase greater than would correspond to the amount of sulphur formed by the breaking up of thio-sulphate. We must, therefore, conclude that the oxidation of the sulphur has very little to do with the killing properties of the wash.

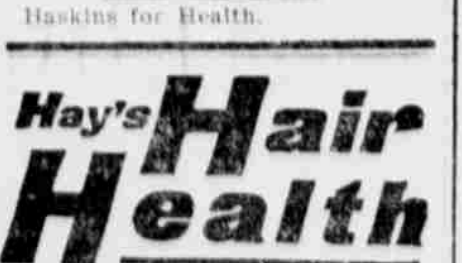
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PORTLAND BAD MEN CAUGHT

Former Bartender and Friend Under Arrest Charged With Burglary of Jewelry Store—Mueh of Loot is Recovered by Police.

PORTLAND, Or., Feb. 17.—Charged with the daylight robbery of the Diamond Palace jewelry store, when \$4000 in cash and jewels were stolen after James Gilbert, a clerk, was knocked senseless, William Johnson and F. S. Duplessis formerly a bartender, are under arrest here today. Part of the stolen jewelry was found on the prisoners and Andrew McDonald, a hotel porter, who was arrested while trying to dispose of some of the gems, has confessed his part in the matter and told the police that the other prisoners are the ones who did the work. Both of them have repeatedly declined to talk of the matter and the police have not ascertained whether it was Duplessis or Johnson who slugged Gilbert.

When detectives took Johnson and McDonald into custody at Second and Morrison streets after shadowing them for two days, Johnson pulled a short nickel-plated revolver from his pocket. Detective Coleman, however, pressed his own weapon against the man's back and prevented any overt moves by Johnson.

Practically 75 per cent of the jewelry remains unaccounted for. It is believed that it will be all recovered. Johnson and Duplessis are suspected of other robberies that have occurred in Portland recently.

Deny Rumor J. D.'s Death.

NEW YORK, Feb. 17.—Rumors that John D. Rockefeller was dead caused a slight slump in the stock market late today. The Standard Oil headquarters here at once issued an official denial.

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When you arrange your eastern trip be sure to include the Sunset Route through New Orleans, El Paso, Los Angeles and San Francisco for return. It is a splendid educational journey, and at this time of the year especially delightful because so warm and comfortable. Every mile is through the sunny southland—the rice and cotton fields of Louisiana and Texas, the vast mirage mesas of New Mexico and Arizona now spread with bright green, the orange groves and semi-tropic charm of California, miles and miles along the ocean shore, and several of the most interesting cities on the continent. Ask your local railroad agent all about it. **292***

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This young lady is playing the Autopiano. She is rendering music which, even after five years of conscientious study under the most competent tutors, she would not be able to render as artistically as she is doing now by means of the music roll. The faces of five great composers, whose music is being played, are hidden in this picture. Can you find three of them?

Adhere strictly to the rules.

DIRECTIONS—Trace out the lines of each face on this or separate sheet of paper and mark them 1, 2, 3, etc. The eight nearest correct answers will be given the eight grand awards above mentioned and the others in the order named. Each contestant to abide by the rules. The decision of the judges to be final. In case of a tie, prizes of similar value to be given to each contestant. Professional artists, music trade employees and winners of first prizes in previous contests barred. Submitting more than one answer from any one family bars all. All answers must be mailed or brought in to us by Feb. 20, 1911, at 4 P. M. Be sure your name and address is plainly written on your answer, and addressed to CONTEST MANAGER.

THE PRIZES ARE AS FOLLOWS:

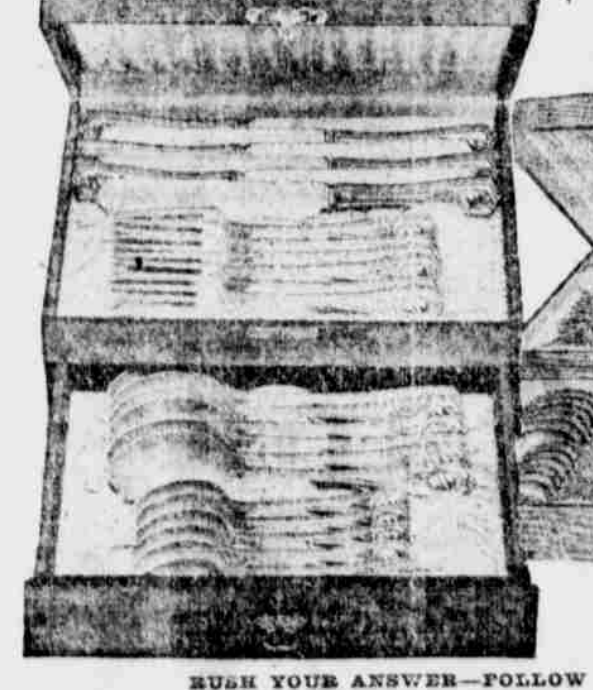
- FIRST PRIZE—Eilers Orchestral Piano or \$400 cash purchase check toward payment of a genuine Autopiano.
 - SECOND PRIZE—Elegant chest of silver and \$200 cash purchasing check.
 - THIRD PRIZE—Lady's gold watch and \$100 cash purchasing check.
 - FOURTH PRIZE—Beautiful Music Cabinet and \$125 cash purchasing check.
 - FIFTH PRIZE—Handsome chest of silver and \$120 cash purchasing check.
 - SIXTH PRIZE—Lady's gold watch and \$115 cash purchasing check.
 - SEVENTH PRIZE—Fancy scarf pin and \$110 cash purchasing check.
 - EIGHTH PRIZE—Fancy scarf pin and \$105 cash purchasing check.
- Then, in order of merit, 90 Special Advertising Cash Purchasing Checks, ranging in value from the above down to 25c.



Elegant Eilers Orchestral Piano Free.



Chests of Silver Free. Second and Fifth Prizes.



RUSH YOUR ANSWER—FOLLOW THE RULES

EILERS MUSIC HOUSE

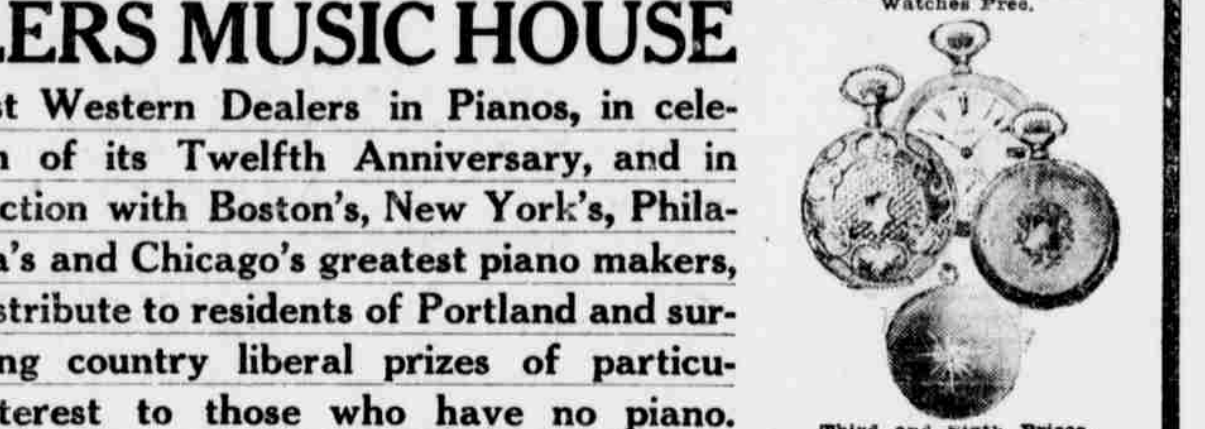
Largest Western Dealers in Pianos, in celebration of its Twelfth Anniversary, and in conjunction with Boston's, New York's, Philadelphia's and Chicago's greatest piano makers, will distribute to residents of Portland and surrounding country liberal prizes of particular interest to those who have no piano.

Why It Is Done

Our purpose in holding this contest is to acquaint the people of this section with the many far-famed makes of pianos we handle. The manufacturers of these pianos are convinced that this form of advertising is far more effective than spending large amounts in magazine and newspaper advertising, subsidizing concert pianists, etc., etc. We, too, know that the best advertisement for a good Piano is a satisfied customer, and believe, further, that the advertising allowance should go to the person who buys a piano. We want every one to know that ours are the only stores in the West that sell the famous Chickering, the oldest and most expensive of American Pianos; the beautiful toned Sohmer, the now celebrated Lester of Philadelphia; the world-renowned Kimball (given the Highest Grand Award at the Chicago Exposition, and again at the Seattle Exposition last year), the genuine Decker, and our own Eilers Orchestral Piano, as well as the famous Autopiano, which every one can play without practice. The Smith & Barnes Pianos, the Bush & Gerts and the Story & Clark Pianos also are sold only by us. And we want every one to know that we sell these fine dependable makes of instruments for less than they are obtainable elsewhere.



Ladies' and Gentlemen's Watches Free.



Third and sixth Prizes.

Attach this slip (or one similar) to your answer, writing plainly.
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If possible, give below the names and addresses of two or more of your friends who you believe might consider the purchase of a Piano, Autopiano or Organ.
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Name P. O. Address
Name P. O. Address
Also one or more who might consider the purchase of a Phonograph.
Name P. O. Address
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References: First National Bank, Grants Pass Banking & Trust Co.