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Report on Commercial Insecticides and Fungicides

1922

I. The Examination of Some Materials Sold as Insecticides and Fungicides. By E. M. Bailey and R. E. Andrew.

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November, 1922.

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I. The Examination of Some Materials Sold as Insecticides and Fungicides.

By E. M. Bailey and R. E. Andrew.

No laws have been enacted in this State to control the manufacture, sale or distribution of insecticides and fungicides. An Act concerning the testing and labeling of disinfectants was passed by the legislature in 1917, and it is probable that such materials can be controlled also by the provisions of our food and drug law under the definition of the term "drug"; but the law cannot be interpreted to include insecticides and fungicides. The terms of the Federal Insecticide Act of 1910 amply provide for the control in interstate commerce of materials to be used for insecticidal or fungicidal purposes, but do not operate for the control of such materials as are now, or may be, made and sold within this state.

The general and increasing use of spraying materials for the control of insect pests and fungus diseases makes the question of the composition of such materials of interest and importance. A bulletin[1] on this subject was issued by this Station in 1907, but no systematic survey has been made since that time. Occasional samples of substances used for spraying or dusting purposes have been examined for individuals interested, but these have been published in regular reports from this laboratory, together with other miscellaneous materials. Such scattering analyses, so far as they are of interest, have been collected and are presented here in addition to the results of new analyses.

MATERIALS EXAMINED.

A classification of the materials examined is as follows:

Samples Collected in 1922.

Paris Green	8
Lead Arsenate	16
Calcium Arsenate	1
Copper-Calcium Arsenate	2
Bordeaux Mixture	3
Bordeaux Mixture—Paris Green	2
Bordeaux Mixture—Lead Arsenate	3
Bordeaux Mixture—Zinc Arsenate	1
Nicotine Products and Tobacco	14
Hellebore	5
Miscellaneous	25

[1] Conn. Agr. Sta., Bull. 157, Sept., 1907.

Cited from Earlier Reports of This Station, But Subsequent to 1907.

Paris Green, Lead Arsenate and Miscellaneous	15
Total from all sources	95

Of samples secured this year, 49 were collected by our Station agent, Mr. Churchill, and the remainder were submitted by purchasers or others interested. A considerable number have been referred to us by the department of entomology of this Station.

METHODS OF ANALYSIS.

The methods used for the analysis of these preparations are those authorized by the Association of Official Agricultural Chemists unless otherwise stated.

RESULTS OF EXAMINATION.

For the sake of uniformity where like materials are tabulated together, dissimilar chemical terms used in statements of guaranty

TABLE I. ANALYSES OF

Station No.	Date.	Brand, Manufacturer or Distributor.
		Sampled by Station Agent:
18445	1922	James A. Blanchard Co., New York. Lion Brand
18091	1922	Bob-White Chemical Corp., New York. Bob-White
18458	1922	Devoe & Raynolds Co., Inc., New York. Devoe.
18099	1922	The Glidden Co., Cleveland. Glidden
18100	1922	Morris Herrmann & Co., Chicago. Hi-Grade
18443	1922	Interstate Chem. Co., Jersey City. Hillside
18090	1922	Leggett & Brother, New York. Anchor Brand
18455	1922	The Sherwin-Williams Co., Cleveland
		Sampled by Purchaser:
17320	1921	Leggett's
19319	1921	Raynold's

have been reduced to a common basis. Where products are treated individually the composition found by analysis has been stated in terms conforming to those used in the guaranties.

PARIS GREEN.

Chemically, Paris green is the aceto-arsenite of copper, and, under the provisions of the Federal Insecticide Act and the laws of many states where numerical standards for insecticides are fixed, this product is deemed to be adulterated: first, if it does not contain at least fifty per cent of arsenious oxide; second, if it contains arsenic in water-soluble forms equivalent to more than three and one-half per cent of arsenious oxide; third, if any substance has been mixed and packed with it so as to reduce or lower or injuriously affect its quality or strength.

From the tabulated analyses given in Table I it is evident that the guaranties conform to the federal numerical standards and are met with a liberal margin of safety in all cases. The ratio of copper oxide to arsenious oxide in pure copper aceto-arsenite is 1 : 1.87. For the products examined this year this ratio is closely approximated except in samples **18445** and **18091,** where it is about 1 : 2; in the two samples examined in 1921 the ratio of 1 : 2 is considerably exceeded.

PARIS GREEN.

Arsenious Oxide, As_2O_3.				Copper Oxide, CuO.		Station No.
Total.		Water-soluble.				
Found.	Guaranteed not less than.	Found.	Guaranteed not more than.	Found.	Guaranteed not less than.	
%	%	%	%	%	%	
57.92	50.00	1.98	3.50	28.85	....	18445
59.40	50.00	2.57	3.50	29.65	....	18091
55.94	50.00	1.98	3.50	29.65	....	18458
55.69	50.00	1.58	3.50	29.45	....	18099
56.18	50.00	1.19	3.50	29.45	....	18100
55.69	50.00	1.98	3.50	30.25	....	18443
54.95	50.00	2.37	3.50	28.85	29.00	18090
55.69	50.00	2.57	3.50	29.65	....	18455
56.00	....	...	...	26.80	....	17320
56.50	....	...	...	26.60	....	19319

ARSENATE OF LEAD.

Chemically, commercial arsenate of lead consists of products derived from arsenic acid by replacing one or more hydrogen atoms by lead. The Federal Insecticide Act deems arsenate of lead to be adulterated: first, if it contains more than fifty per cent of water; second, if it contains total arsenic equivalent to less than twelve and one-half per cent of arsenic oxide (As_2O_5); third, if it contains arsenic in water-soluble forms equivalent to more than seventy-five one-hundredths per cent of arsenic oxide (As_2O_5); fourth, if any substances have been mixed and packed with it so as to reduce, lower, or injuriously affect its quality or strength; *provided, however,* that extra water may be added to lead arsenate (as described in this paragraph), if the resulting

TABLE II. ANALYSES OF

Station No.	Date.	Brand, Manufacturer or Distributor.
		Sampled by Station Agent:
18452	1922	Acme White Lead & Color Works, Detroit. Acme.
18451	1922	Bowker Insecticide Co., Boston. Bowker's .....
18456	1922	Corona Chemical Co., Milwaukee. Corona Dry ....
18454	1922	Detroit White Lead Works, Detroit. Rogers.....
18088	1922	Devoe & Raynolds Co., Inc., New York. Devoe...
18094	1922	General Chemical Co., New York. Orchard .....
18102	1922	The Glidden Co., Cleveland. Glidden .....
18459	1922	The Grasselli Chemical Co., Cleveland. Paste.....
18441	1922	Interstate Chemical Co., Jersey City. Key-Dry.....
18105	1922	Leggett & Brother, New York .....
18106	1922	Leggett & Brother, New York .....
18449	1922	Merrimac Chemical Co., Boston. Swift's .....
18089	1922	Nitrate Agencies Co., New York. Naco .....
18110	1922	Powers-Weightman-Rosengarten Co., Philadelphia.
18447	1922	The Sherwin-Williams Co., Cleveland .....
		Sampled by Purchaser:
20920[1]	1908–9	Disparene .....
20564[1]	1908–9	Grasselli Chemical Co. .....
22163[1]	1908–9	Grasselli Chemical Co. .....
22382[1]	1908–9	Thomsen Chemical Co. .....
22701[1]	1908–9	Thomsen Chemical Co. .....
.....[2]	1913	Merrimac Chemical Co., Boston. Swift's .....
19373	1922	Brand and Mfr. not known. Sent by County Agent, Middletown .....

[1] Conn. Exp. Sta. Report 1911, p. 218.
[2] Conn. Exp. Sta. Report 1913, p. 305.

mixture is labeled lead arsenate and water, the percentage of extra water being plainly and correctly stated on the label.

Most of the samples examined this year were in powder form. From the analyses given in Table II it appears that all samples meet the requirements of their guaranties with respect to the active ingredient. One sample contains a slight excess of water.

The method of stating guaranties is not uniform as regards the chemical terms used. The arsenic content is sometimes stated in terms of the metal and in other cases in terms of the oxide; and it is not always clear which form is indicated in stating the limit of water-soluble arsenic. Uniform practice in this respect would enable purchasers to compare statements of composition more readily and save the analyst some uncertainty.

ARSENATE OF LEAD.

Water.		Arsenic Oxide, As_2O_5.				Lead Oxide, PbO.		Station No.
		Total.		Water-soluble.				
Found.	Guaranteed not more than.	Found.	Guaranteed not less than.	Found.	Guaranteed not more than.	Found.	Guaranteed not less than.	
%	%	%	%	%	%	%	%	
....	....	33.12	30.00	0.14	1.00	63.65	....	18452
....	....	30.59	30.00	0.38	0.77	66.31	....	18451
....	....	32.20	30.00	0.18	0.77	64.25	....	18456
....	....	31.51	30.00	0.18	1.00	63.23	....	18454
....	....	32.66	31.00	0.97	1.00	63.65	63.00	18088
....	....	31.74	30.00	0.18	1.50	65.07	....	18094
....	....	31.97	31.00	0.44	0.77	63.46	....	18102
43.73	50.00	17.80	15.00	0.29	0.50	36.47	....	18459
....	....	31.74	30.00	0.28	0.75	61.86	....	18441
44.23	50.00	18.03	14.00	0.11	0.75	36.43	30.00	18105
....	....	32.66	30.00	0.28	1.00	64.50	61.00	18106
50.43	50.00	14.61	12.50	0.26	0.75	33.48	31.50	18449
....	....	30.59	30.00	1.10	1.53	65.50	62.00	18089
....	....	32.78	30.00	0.77	2.30	64.59	....	18110
....	....	31.06	30.00	0.28	1.00	63.95	....	18447
36.61	....	18.80	....	...	...	42.05	....	20920
40.70	....	15.24	....	...	...	....	....	20564
45.57	....	15.38	....	...	...	37.25	....	22163
51.73	....	13.81	....	...	...	32.04	....	22382
45.76	....	16.10	....	...	...	35.71	....	22701
42.20	....	17.67	....	...	...	37.81	....	.....
....	....	32.18	....	...	...	64.45	....	19373

INSECTICIDES AND FUNGICIDES OTHER THAN PARIS GREEN AND LEAD ARSENATE.

The federal Act holds an insecticide or fungicide other than Paris green and lead arsenate to be adulterated: first, if its strength or purity falls below the professed standard or quality under which it is sold; second, if any substance has been substituted wholly or in part for the article; third, if any valuable constituent of the article has been wholly or in part abstracted; fourth, if it is intended for use on vegetation and shall contain any substance or substances which, although preventing, destroying, repelling, or mitigating insects shall be injurious to such vegetation when used.

The Act further requires such of these preparations as contain arsenic to declare on the label in terms of metallic arsenic the total amount thereof and the amount in water-soluble forms; it also requires to be stated the name and amount of each and every inert ingredient or, in lieu of this, the name and amount of each active ingredient, together with the total percentage of inert ingredients. Under the laws of some states an insecticide or fungicide, other than Paris green or lead arsenate, is misbranded if it does not declare the name and percentage of each and every active ingredient.

Calcium Arsenate.

18101. The Glidden Co., Cleveland, O.

This sample was found by analysis to be arsenate of lead instead of arsenate of calcium, evidently a mistake in labeling or packing.

Copper-Calcium Arsenate.

19136. *Copper-Calcium Arsenate* dust, 13-8-79. Dosch Chemical Co., Louisville, Ky. Stock of the department of entomology of this Station.

Analysis:

	Found.	Guaranteed.
	%	%
Copper, metallic	5.20	4.40 (not less than)
Arsenic oxide, total	1.39	3.00 (not less than)
Arsenic, metallic, water-soluble	...	0.50 (not more than)

19428. *Niagara Potato Dust Mixture.* Labeled as containing monohydrated copper sulphate, 19.5 per cent; tricalcium arsenate, 17.5 per cent, and inert ingredients, 63 per cent.

Analysis:

	Found.	Guaranteed.
	%	%
Copper, metallic	7.97	6.95
Arsenic, metallic	5.28	6.25
Arsenic, water soluble, metallic	...	0.50

Bordeaux Mixtures.

18104. *Anchor Brand.* Leggett and Brother, New York.

18108. The Grasselli Chemical Co., Cleveland, O.

18448. *Sterlingworth.* Sterling Chemical Co., Cambridge, Mass.

Table III. Analyses of Bordeaux Mixtures.

Station No.	Condition.	Water.	Copper, Metallic.	
			Found.	Guaranteed not less than.
		%	%	%
18104	Paste	58.03	4.79	4.50
18108	Dry	....	14.78	13.00
18448	Dry	....	11.96	10.00

Bordeaux Mixture—Paris Green.

18107. Leggett and Brother, New York.

18093. *Naco.* Nitrate Agencies Co., New York.

Table IV. Analyses of Bordeaux—Paris Green.

Station No.	Copper Oxide, CuO.		Arsenious Oxide, As_2O_3.			
			Total.		Water-soluble.	
	Found.	Guaranteed not less than.	Found.	Guaranteed not less than.	Found.	Guaranteed not more than.
	%	%	%	%	%	%
18107	17.37	17.50	17.69	16.50	2.72	2.64[1]
18093	16.23	18.00	17.32	17.00	0.82	2.00

[1] Calculated from amount guaranteed as metallic arsenic.

Bordeaux Mixture—Lead Arsenate.

18111 and **18442.** *Key Brand Bordo-Lead.* Interstate Chemical Co., Jersey City, N. J.

18096. *Glidden Bordo-Arsenate.* The Glidden Co., Cleveland, O.

TABLE V. ANALYSES OF BORDEAUX—LEAD ARSENATE.

Station No.	Condition.	Water.	Arsenic Oxide, As_2O_5.				Copper Oxide, CuO.	Lead Oxide, PbO.
			Total.		Water-soluble.			
			Found.	Guaranteed not less than.	Found.	Guaranteed not more than.		
		%	%	%	%	%	%	%
18111	Paste	60.85	6.65	4.45[1]	0.60	0.77[1]	7.57	13.76
18442	Paste	60.83	7.82	7.67[1]	0.09	0.77[1]	3.74	....
18096	Dry	....	17.54	15.50	0.20	0.50[1]	11.66	31.71

[1] Calculated from amount guaranteed as metallic arsenic.

BORDEAUX MIXTURE—ZINC ARSENITE.

19729. *Zinc Bordeaux, Orchard Brand,* General Chemical Co., New York.

Analysis:

	Found.	Guaranteed.
	%	%
Arsenic, total, metallic	10.22	10.16 (not less than)
water-soluble, metallic ...	0.25	1.00 (not more than)
Copper, metallic	16.07	15.70 (not less than)
Zinc, metallic	14.41	13.31[1] (not less than)

[1] Guaranteed zinc arsenite 30.00.

NICOTINE PRODUCTS AND TOBACCO.

19748. *Black Leaf 40.* Tobacco By-Products and Chemical Corporation, Inc., Louisville, Ky. Sampled by Station agent.

Nicotine found 40 per cent; guaranteed 40 per cent.

19370. *Black Leaf 40.* Sample submitted by department of entomology of this Station.

Nicotine found 40.70 per cent; guaranteed 40 per cent.

19608. *Jebl.* Made by J. H. Rice, Ashtabula, O.

This is an emulsion guaranteed to contain nicotine 0.80 per cent and inert ingredients 99.20 per cent.

Partial analysis showed the following composition:

Water and volatile at 100° C.	79.29%
Solids	20.71
Ash	7.85
Nicotine (as alkaloid)	1.08

19152. *Garden Dust.* Dosch Chemical Co., Louisville, Ky. The sample was submitted by the Station department of entomology. It is a mixture of lead arsenate, sulphur and nicotine, but

was examined only for nicotine. Nicotine found 2.24 per cent; guaranteed 2.00 per cent.

19427. *Niagara Nicotine Contact Mixture.* Niagara Sprayer Co., Middleport, N. Y. Sampled by the Station agent. Nicotine found, 2.38 per cent; guaranteed, 2.20 per cent.

19658. *Tobacco Dust.* Hall Tobacco Chemical Co., St. Louis, Mo. The sample was submitted by E. M. Ives, Meriden. Sixty per cent passed a 200 mesh sieve. Nicotine content found, 1.30 per cent.

19742. *Tobacco Dust.* Sample submitted to the Station entomologist by Lewis Cheeseman, Hatfield, Mass.

The sample was examined as follows:

Total ash	39.60%
Ash insoluble in dil. acid (sand, etc.)	15.30
Nitrogen	1.99
Nicotine (as alkaloid)	1.72

19099 and **19100.** *Tobacco Dust.* Submitted by Prof. G. H. Lamson, Storrs. The samples contained 1.09 and 0.50 per cent of nicotine respectively.

19188. *Low Grade Leaf Tobacco.* Supplied by L. B. Hass Co., Hartford.

Partial analysis showed the following composition:

Moisture	5.63%
Ash, crude	20.13
Nitrogen, in nitrates	1.17
in ammonia	0.77
in nicotine	0.55
in other organic matter	1.89
Ether extract	3.98
Nicotine	3.10

Analysis of the crude ash showed the following composition:

Sand, silica, etc.	22.67%
Iron and aluminum (Fe_2O_3 and Al_2O_3)	1.86
Manganese (Mn_3O_4)	0.62
Magnesium (MgO)	4.69
Calcium (CaO)	20.74
Potassium (K_2O)	22.44
Sodium (Na_2O)	0.80
Sulphuric acid (SO_3)	6.09
Chlorine (Cl)	0.71
Phosphoric acid (P_2O_5)	3.62
Carbonic acid (CO_2)	14.50
Undetermined including moisture	1.26
Deduct oxygen=chlorine	0.16
Total	100.00

Cigarettes.

In connection with a study of methods for the determination of nicotine in tobacco and other products a number of brands of cigarettes were examined.

Table VI. Analyses of Cigarettes.

Station No.	Brand.	Loss at 100° C.	Ash.	Nitrogen.	Nicotine.
		%	%	%	%
19298	Lucky Strike	7.63	16.54	2.23	1.83
19311	Melachrino	7.34	17.74	2.58	1.43
19316	Camel	7.98	15.30	2.24	1.80
19317	Fatima	8.25	13.63	1.99	1.72
19318	Murad	7.33	17.14	2.72	1.46

Hellebore.

19730. *White Hellebore Root.* J. L. Hopkins & Co., New York.

19736. *Key Brand Hellebore.* Interstate Chemical Co., Jersey City, N. J.

18109. *Anchor Brand Hellebore.* Leggett & Brother, New York.

18098. *Hellebore Root.* S. B. Penick & Co., New York.

19731. *Hellebore Root Powder.* S. B. Penick & Co., New York.

Table VII. Analyses of Hellebore.

Station No.	Ash.		Total alkaloids.		Total nitrogen.
	Total.	Insol. in acid.	Found.	Guaranteed not less than.	
	%	%	%	%	%
19730	11.83	6.97	1.07	0.79	1.21
19736	10.56	5.03	1.43	0.25	1.29
18109	7.50	3.23	1.26	0.20	1.59
18098	9.25	5.40	1.27	1.14	...
19731	4.46	1.05	2.70	1.00	1.48

The method used for the determination of alkaloids of *Veratrum* (hellebore), was as described by Viehoover and Clevenger[1].

Miscellaneous Insecticides and Fungicides.

The following spray materials were made by the Niagara Sprayer Co., Middleport, N. Y. and were sampled by the Station agent from the stock of H. D. Peters, Highwood.

[1] Jour. Am. Phar. Assoc., **11**, 3, 169, March 1922.

19425. *Niagara Potato Dust Mixture,* without poison. Labeled monohydrated copper sulphate, 19.5; inert ingredients, 80.5.

Analysis:

	Found.	Guaranteed.
Copper, metallic	7.56%	6.50%

19426. *Niagara "All in One."* Labeled sulphur, 19; nicotine, 1.1; lead arsenate, 9.5; Bordeaux, 19; inert ingredients, 51.4.

Analysis:

	Found.	Guaranteed.
	%	%
Copper, metallic	6.30	4.00
Arsenic, metallic	1.82	1.80
Arsenic, water-soluble	...	0.50
Nicotine	1.11	1.10

19429. *Niagara 80-10-10 Mixture.* Labeled sulphur, 78; lead arsenate, 9.8; inert ingredients, 12.2.

Analysis:

	Found.	Guaranteed.
	%	%
Arsenic, metallic	2.26	1.95
Arsenic, water-soluble	...	0.50

19430. *Niagara 85-15 Dusting Mixture.* Labeled sulphur 83; lead arsenate, 14.70; inert ingredients, 2.30.

Analysis:

	Found.	Guaranteed.
	%	%
Arsenic, metallic	3.02	2.92
Arsenic, water-soluble	...	0.50

Other miscellaneous materials sampled by the Station agent are as follows:

18453. *Pyrox.* Bowker Insecticide Co., Boston.

18446. *Naco Kalibor.* Nitrate Agencies Co., New York.

18086. *Hexpo.* H. J. Smith & Co., Utica, N. Y.

19739. *Key-Cide.* Interstate Chemical Co., Jersey City.

TABLE VIII. ANALYSES OF MISCELLANEOUS MATERIALS.

Station No.	Condition.	Water.	Arsenic, Metallic.				Copper, Metallic.		Lead, PbO.	
			Total.		Water-soluble.					
			Found.	Guaranteed not less than.	Found.	Guaranteed not more than.	Found.	Guaranteed.	Found.	Guaranteed.
		%	%	%	%	%	%	%	%	%
18453	Paste	68.40	4.53	3.42	0.06	0.75	3.02	1.50	....	12.00
18446	Dry	....	17.25	18.20	0.19	0.75	5.13	3.50	....	....
18086	Dry	....	4.78	4.50	0.37	0.33	19.27	15.40	14.33	....
19739	Dry	....	3.75	2.75	0.12	....	10.06	10.00	9.90	....

18450. *Slug Shot.* Hammond's Slug Shot Works, Beacon, N. Y.

Analysis:

	Found.	Guaranteed.
	%	%
Sulphur	...	6.00
Arsenic, metallic	0.89	0.79
Water-soluble arsenic, metallic	0.12	trace
Copper, metallic	1.01	0.91[1]
Nicotine	0.04	trace
Carbolic acid, crude	present	0.40

18087. *Bug Death.* Danforth Chemical Co., Leominster, Mass.

Analysis:

	Found.	Guaranteed.
	%	%
Zinc oxide	54.15	47.00
Lead oxide	14.11	5.00

18092. *Sterlingworth Cut Worm Killer.* Sterling Chemical Co., Cambridge, Mass.

Analysis:

	Found.	Guaranteed.
Arsenious oxide	1.99	1.00 (not less than)
Water-soluble arsenic, metal	1.40	0.07 (not more than)

The arsenic in this sample is largely in water-soluble form.

18444. *He-Bo.* Sterling Chemical Co., Cambridge, Mass.

Analysis:

	Found.	Guaranteed.
	%	%
Barium carbonate	34.41	36.00
Arsenic, metallic	1.35	2.00
Arsenic, water-soluble, metal	0.12	0.30

18103. *Mag-O-Tite.* Randall-McLaughlin, Seattle, Wash.

Analysis:

	Found.	Guaranteed.
	%	%
Arsenic, metallic	...	0.06
Arsenic, water-soluble, metal	0.06	0.002
Napthalene	6.35	4.39

Napthalene was determined by extracting the material with ether, dissolving the ether extract in boiling 95 per cent alcohol and precipitating the napthalene by means of a saturated solu-

[1] Calculated from copper-sulphate and copper arsenite guaranteed.

tion of picric acid. The naphthalene picrate was dried at 50° C. and weighed[1].

18457. *.Sulfocide.* B. G. Pratt Co., New York.

This is a liquid fungicide guaranteed to contain 30 per cent of sulphur combined as sodium polysulphide and sodium thiosulphate.

Analysis showed the following distribution of sulphur[2]:

Sulphur, total	29.25%
as thiosulphate	1.84
as sulphate	0.10
as sulphide, by diff.	27.31

The following miscellaneous materials were submitted from various sources:

19173. *Nickel Carbonate.* Submitted by the Station entomologist.

It was found to contain 44.64 per cent of nickel, which is equivalent to 90.28 per cent of nickel carbonate. The material contained also a trace of sulphates. Nickel was determined by the dimethylglyoxime method[3].

17257. *Borecide.* Mason Drug and Chemical Co., Hancock, Md.

According to descriptive literature concerning this insecticide, the vapors which it gives off are toxic to borers and other tree pests.

Partial analysis was made as follows:

Ash	58.14%
Loss on ignition	41.86
Insoluble in boiling water	65.35
M. P. of sublimate	31.0°C.

The material has the odor of naphthalene and the sublimate combined with picric acid. The melting point, however, was not correct for naphthalene, but approximated that of the methyl derivative.

19732. *Mechlings P. T. B.* Mechling Bros. Mfg. Co., Camden, N. J.

This is a preparation of paradichlorobenzine, the vapors of which are destructive to peach tree borers and other tree pests. The melting point of the compound was observed to be 56°C.

19683 and **19684.** *Fish Oil Soap.* Made by the General Chemical Co., New York, and submitted by the Station entomologist. Differentiated by the sodum cobaltinitrite and potas-

[1] Allen Comm. Org. Analysis, **3**, p. 243 et seq.
Mulliken. Identification of Pure Organic Compounds, **1**, p. 201.

[2] Analysis by H. J. Fisher.

[3] Griffin, Technical Methods of Analysis, p. 121.

sium pyroantimonate tests, **19683** was indicated to be a soda soap, while **19684** was indicated to be largely a potash soap.

18898. A *paste* made by the Garden Chemical Co., New York, and examined for the Station entomologist. It appeared to be composed largely of an emulsion of soap and pyridine.

Dusting Powder, made by the Niagara Sprayer Co., Middleport, N. Y., was submitted by E. M. Ives, Meriden. By the U. S. P. assay it contained 99.09 per cent of sulphur; 98.2 per cent of the powder passed a 200 mesh sieve.

19404. *Bordeaux mixture,* thought to have decomposed or to have been mixed with other material. The sample, which was a black powder, contained 24.02 per cent of calcium oxide and 21.23 per cent of copper, largely in the form of cupric oxide.

19339. *Bees* and **19340,** *Soil,* submitted by O. N. Whitehead, Wallingford. The bees were thought to have been killed by arsenical spray on blossoms of peach trees. No conspicuous amounts of arsenic were found in either the bees or the soil.

18095. *Kayso.* California Central Creameries, San Francisco. A prepared casein spreader to be used with spraying mixtures. The material contained 25.26 per cent of casein (calculated from nitrogen by the factor 6.38), and 73.78 per cent of ash, which consisted chiefly of calcium.

19492. *Ace-Hy.* General Chemical Co., New York. The active ingredient is not stated, but the inert ingredient is stated to be water, of which there is not more than 40 per cent. The preparation is an emulsion in which a cyanide, equivalent to 2.29 grams CN per 100 cc. is the chief active ingredient detected. The ash, 3.58 per cent, consisted chiefly of iron and copper oxides. Water and volatile matter (at 100° C.), made up 77.3 per cent of the material.

Salairacine. Made by J. D. McGregor, Stamford.

A sample, **17745,** submitted by a purchaser in 1921, and one, **19740,** supplied by the Station entomologist, have been examined as follows:

	17745 %	19740 %
Moisture	0.90	....
Insoluble in dilute acid	0.56	....
Nitrogen (in nitrates)	none	1.95
Lead oxide (PbO)	24.21	....
Arsenic oxide (As_2O_5)	11.73	10.54
Oxides of iron and aluminum (Fe_2O_3 and Al_2O_3)	0.50	....
Calcium (CaO)	25.64	17.67
Magnesium (MgO)	17.33	....
Carbon dioxide (CO_2), by difference	19.13	....

The analysis made in 1921 indicated that the material was composed essentially of lead arsenate and dolomitic lime. The sample analyzed in 1922 showed a considerable amount of nitrogen in nitrates, indicating a change in the formula. Advertising literature submitted with the first sample states: "Salairacine destroys the insects in the soil and gives new life to young and old trees. It has been used with great success on trees which were absolutely riddled with borers." It is directed to loosen the soil two inches deep around trees and dust salairacine into the soil; or sprinkle on the surface of turf and water thoroughly.

There is nothing shown by our analyses to indicate any insecticidal value in this product not supplied by lead arsenate as well; or any fertilizing value not equally well supplied by nitrate of soda and lime.

The following were submitted by the Station entomologist during 1921 and are cited from Bulletin 233 of this laboratory, p. 109:

16420. *"Sulco-V. B."* Contained 3.97 per cent of phenol.

16740. *Niagara Contact Special Dusting Mixture* was found to contain 1.62 per cent nicotine.

Four *nicotine mixtures* were found to contain 0.29, 0.30, 0.84 and 0.71 per cent of nicotine.

16946. *Formaldehyde solution* submitted by the Station botanist, was found to contain 33.7 per cent of formaldehyde by weight.

II. Recent Developments in the Use of Insecticides.

By W. E. Britton, *Entomologist.*

In connection with the analyses reported in the preceding pages, it might be well to call attention to some tendencies of the present day in the use of insecticides and fungicides. In 1907, when Bulletin 157 was published, no arsenical poisons were used except paste lead arsenate and Paris green. At the present time to kill chewing insects, most Connecticut orchardists and vegetable growers prefer and use lead arsenate in its dry or powdered form, which is easier to handle and seems to be just as effective. As an insecticide, Paris green has largely been replaced by lead arsenate. Moreover, several other poisons are now on the market, such as calcium arsenate, copper-calcium arsenate, and zinc arsenite which are sometimes, though probably not extensively, used.

In 1907, nicotine sulphate preparations were little used, whereas now they have come into almost universal use to kill sucking insects. Casein spreaders were then unknown and are now coming into rather general use. Dusting in orchards is a recent practice in Connecticut, which will probably not wholly supplant spraying; and there are many proprietary insecticides and fungicides now on the market, and many possible and advantageous combinations of standard materials, unheard of fifteen years ago. Likewise in those days the lime-sulphur mixture was used only as a dormant spray to kill San José scale, but now this mixture diluted as a summer spray is the most common fungicide used on the foliage in Connecticut apple orchards.

Arsenical Poisons.

Arsenical insecticides are commonly employed as stomach poisons to kill chewing insects, such as grasshoppers, caterpillars and leaf-beetles. The poison is placed upon the food plant, and must be swallowed by the insect in order to be effective as an insecticide. Lead arsenate is by far the most common one now in use, is generally non-injurious to the plant, and may be applied as a dust or in liquid form at the rate of one ounce of paste or one-half ounce of the powder in a gallon of water. This is nearly equivalent to three pounds of the paste or one and one-half pounds of the powder in a barrel holding fifty gallons.

Paris green contains a sufficient amount of water-soluble arsenic to be generally unsafe for vegetation except in the presence of lime. Lime should also be added to a mixture of calcium arsenate when used on most kinds of foliage, but both Paris green and

calcium arsenate may be used in combination with Bordeaux mixture on potatoes without fear of injury. Several times in our Station tests calcium arsenate has injured apple foliage even where lime was added. Zinc arsenite was used as a poison on ten rows of potatoes at the Station Farm at Mount Carmel in 1914, in comparison with lead arsenate. Both killed the larvae of the Colorado potato beetle, and there was no injury to the foliage. Magnesium and barium arsenates have not been used in Station tests.

Hellebore.

Hellebore is the powdered rootstock of an herbaceous plant, *Veratrum*. It acts as a stomach poison and has slight value as a repellant. Its virtue depends upon a volatile alkaloid; hence only fresh material should be used. The larvae of the sawflies, like the currant worm, are particularly susceptible to death from eating it. It may be applied dry and undiluted or mixed with water at the rate of one ounce in two gallons.

Nicotine Preparations.

Though nicotine is a stomach poison if taken in sufficient amounts, it is chiefly employed to kill sucking insects by contact. It is often used in the form of tobacco dust, finely ground, but as tobaccos vary widely in their nicotine content and few manufacturers have attempted to place a uniform product on the market, nicotine is generally purchased as a liquid in the form of nicotine sulphate containing 40 per cent nicotine. There are several commercial preparations on the market sold under trade names, "Black Leaf 40" being one of those best known in Connecticut. When diluted at the rate of one teaspoonful per gallon, or one-half pint per barrel, and applied as a spray, it will kill most soft-bodied aphids, but this quantity may need to be doubled to kill some other sucking insects. Even in stronger applications it does not injure most kinds of foliage. When used alone it is more effective if common laundry soap, one-half ounce per gallon, or two pounds per barrel, is dissolved and added, but this is unnecessary when used with calcium caseinate or with lime-sulphur.

Combinations of Insecticides and Fungicides.

Though each different material may be recommended and used to control some particular pest, the grower cannot conveniently make a separate application for this purpose, and has practiced applying them in combination to control those chewing and sucking insects and fungi which may simultaneously attack his crops. For instance, he can combine lead arsenate, nicotine solution and