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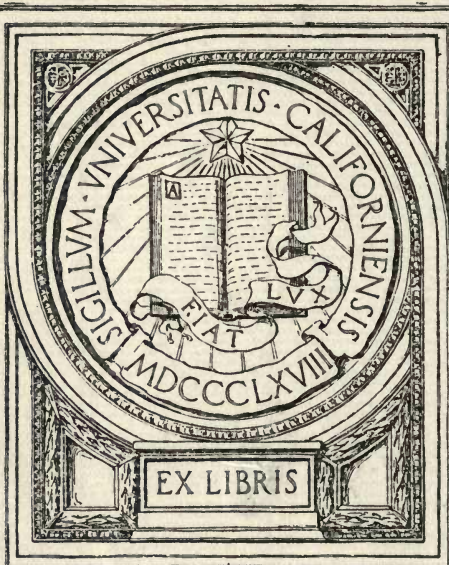
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OFFICIAL PUBLICATION OF
IOWA STATE COLLEGE OF AGRICULTURE
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VOL. XVII

MAY 7, 1919

NO. 49

AN INVESTIGATION OF THE PROTECTIVE VALUES
OF STRUCTURAL STEEL PAINTS

By
J. S. COYE

EXCHANGE
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BULLETIN 54
GOOD ROADS SECTION
ENGINEERING EXPERIMENT STATION

Ames, Iowa

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The purpose of the Engineering Experiment Station is to afford a service, through scientific investigations, evolution of new devices and methods, educational technical information, and tests and analyses of materials:

For the manufacturing and other engineering population and industries of Iowa;

For the industries related to agriculture, in the solution of their engineering problems;

For all people of the State in the solution of the engineering problems of urban and rural life.

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AN INVESTIGATION OF THE PROTECTIVE VALUES OF STRUCTURAL STEEL PAINTS.

This investigation was undertaken at the special request of the Iowa State Highway Commission who were in need of reliable data on the comparative protective properties of various prepared paints when properly applied to structural steel exposed to normal atmospheric conditions. Its purpose was primarily to analyze most of the paints then in common use for painting highway structures to determine their suitability for this purpose, from a laboratory standpoint. So many technical points arose concerning the effect of the various combinations that actual service tests of panels coated with various paints were found to be highly desirable.

It must be kept in mind that in specifying paints for structural steel, or for almost any other purpose, the quality of both vehicle and pigment must be considered. The vehicle determines the life, elasticity and imperviousness of the film while the pigment adds strength to the film and increases or decreases the tendency of the metal to corrode according to the stimulative or inhibitive character of the pigment.

In general the pigment of the paint applied as a first coat on steel would be strongly inhibitive and the proportion of the pigment to vehicle should be greater than in subsequent coats.

The following is a list of some of the inhibitive pigments arranged in the approximate order of their apparent decreasing inhibiteness:

- Zinc chromate
- Basic lead chromate
- Red lead
- Sublimed blue lead
- Sublimed lead sulfate
- Leaded zinc
- Basic lead carbonate
- Cement
- Lithophone

Some principal stimulative pigments are:—

- Graphite
- Carbon (other than willow carbon and bone black)
- Calcium sulfate (gypsum)
- Ultramarine blue
- Prussian blue

Some principal inert pigments are:—

- Silica
- Magnesium silicates
- Calcium carbonate
- Crystalline barium sulfate
- China clay
- Mineral black

Theoretically, the best protective paint coating for structural steel would be obtained by applying a paint rich in inhibitive pigment as a first coat and subsequently covering this with one or more coats of a paint less rich in pigment but containing a considerable amount of inert pigment.

The analogy which R. S. Perry* has drawn between a scientifically prepared paint and a well proportioned concrete in the formulation of his Law of Minimum Voids, is valuable as a guide in preparing a specification for a protective paint coating for structural steel. The following summary of Perry's Theory is sufficient to show the close similarity between concrete and a paint film :

Law No. 1. The law of minimum voids to be observed in constructing a paint formula. This law has already been accepted as mathematically correct and technically proved in the technology of concrete and cement.

Corollary. The requisite thickness of a paint film together with the utmost attainable strength and impermeability can best be obtained by a properly proportioned blend of pigments of three or more determinate sizes.

Law No. 2. The law of the flat arch in paint coating, i. e., the fact that, in studying the fundamental physical principles governing the strength and durability of a paint coating, it is necessary to regard the coating as consisting of a series of flat arches, in which the pigment particles of largest characteristic size serve as the piers or supports for the flat arches of which the continuous film is composed.

Corollary A. The strength and durability of a paint coating is determined by the strength and durability of the piers or supports, which consist of the characteristic pigment particles of the largest size.

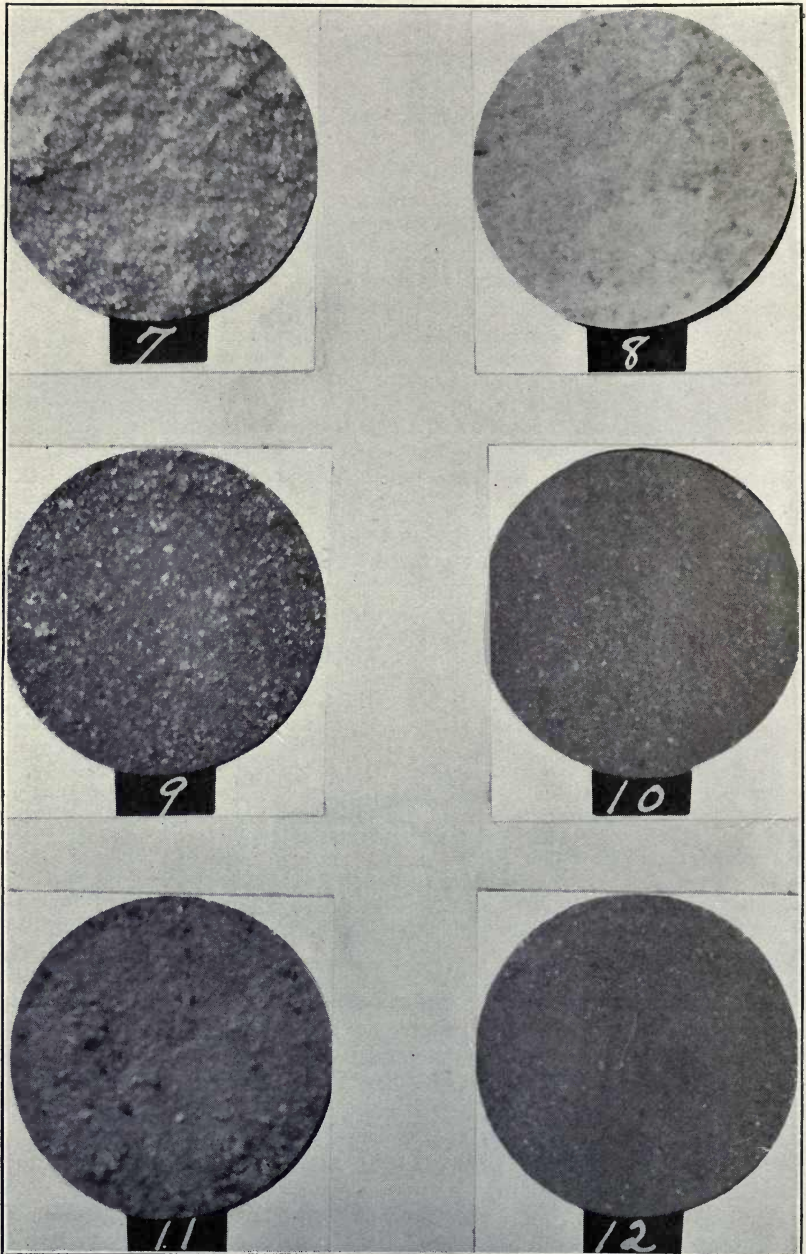
Corollary B. Owing to their inherent strength and durability the pigment particles of largest characteristic size which serve as supports for the paint coating should consist, in part at least, of chemically inert pigments, such as asbestine, silica, and china clay.

Corollary C. It follows directly that the thickness of a paint coating is determined by the particles of pigments having the largest characteristic size, even if that pigment be present only in moderate percentage. Upon this principle depends the comparatively great thickness of film and moderate spreading rate of paints composed of such pigments as basic carbonate—white lead, red lead, barytes, etc., and the strongly contrasted thinness of film and high spreading rate of paints composed of the sublimated pigment such as lamp black, sublimed blue lead, zinc oxide, basic sulphate, white lead, zinc lead white, and leaded zinc.

Since the advancement of the above principles and their acceptance by paint manufacturers, the manufacture of prepared paints should no longer be a rule of thumb process but rather a scientific process. Because of this fact and the recognition of the principle that scientific preparation on a large scale is conducive to the production of better and more standard products, it was considered desirable to carry on this investigation by using standard paints manufactured by reputable concerns rather than to attempt to produce paints on a small scale, which could not be considered strictly standard.

All of the paints used may be readily obtained on the market and the results here obtained can be duplicated to a reasonable degree, if these same paints were again applied under similar conditions.

*Physical Characteristics of the Paint Coating. Mich. Chapter Amer. Inst. of Archl 1907.



Microphotographs of Panels 7 to 12
Exposure about two years

DESCRIPTION OF TESTS

Metal for Panels. Mild steel sheets of No. 10 gauge were freed from all mill scale by means of the sand blast. These sheets were finally cut to produce the final test panel, one foot square. Panels 129 to 136B inclusive were not sand blasted before being painted.

Types of Paint Used. Various paint manufacturers were requested to submit samples of their standard paints recommended for structural steel coatings for both shop and field coats. These paints were analyzed completely in regard to the pigment and in a general way in regard to the quality of vehicle. The results of these analysis together with the name of manufacturer (when known), the date when panel was first exposed to the weather, the trade name or number of the paint, and other like information will be found in Table I.

Method of Painting. Each panel was given two coats, allowing one week or more for the first coat to dry thoroly before applying the subsequent coat. Each coat was well brushed with a No. 2 round brush in order to produce a uniform coating. All painting was done under cover at fairly warm summer temperature and the panels were allowed to stand until they were thoroly dry, when they were exposed to weather conditions in a vertical position with an east and west exposure. Various combinations of paints for shop and field coats were made, but the combination recommended by the manufacturer was always used for one or more panels when such a combination was recommended or could be assumed naturally.

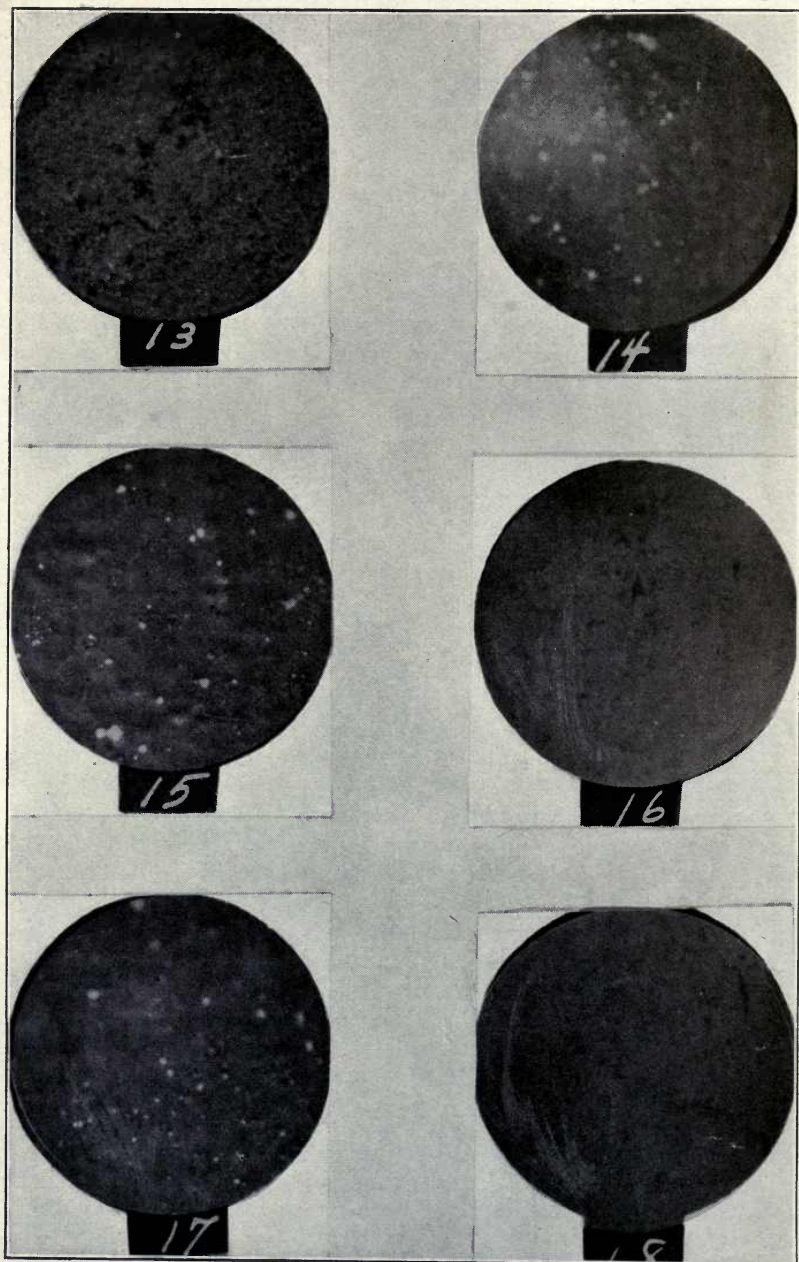
Weather Conditions. The weather conditions during the time the panels have been exposed have been normal for Iowa. The samples have been exposed to severe cold, ice sheet, blizzards, hail storms, sleet, rain, wind and extreme heat.

Inspections. Two complete inspections have been made. After from one and one-half to two years exposure, microphotographs of each panel were taken, copies of which are shown herewith.

In May, 1917, a thoro inspection of each panel was made, the results of which are given in Table II: Another inspection was made in May, 1918, the results being tabulated in Table III.

In the inspection reports, the panels are rated on a scale of 10, based upon the degree to which the metal has been protected from corrosion by the paint film. This rating is, of course, only approximate as it is purely a personal estimate. While some panels have shown rust early in the test, the surface and nature of the rusting may be such as can be remedied by repainting. Again rusting may have appeared later in the test but is of such a nature that it can be remedied only with difficulty. These two cases are typical of two classes of paint.

Sublimed lead sulfate, sublimed blue lead and white lead illustrate the former case in that the rusting begins in the checks and is of



Microphotographs of Panels 13 to 18
Exposure about two years

a soft, powdery nature easily removed by brushing before repainting. The latter case is typical of graphite, carbon, and some grades of iron oxide paints, particularly those containing large amounts of gypsum or whiting. Here rusting usually begins under the paint film and is not noticeable until it has progressed so far as to make it necessary to remove the paint film entirely by burning and scraping or sand blasting before the rusting can be arrested and the surface satisfactorily repainted. This was taken into consideration in rating the panels. In fact, the condition in which a paint leaves the surface for future repainting should be a prime consideration in selecting paint for any purpose.

ANALYSIS OF INSPECTION DATA

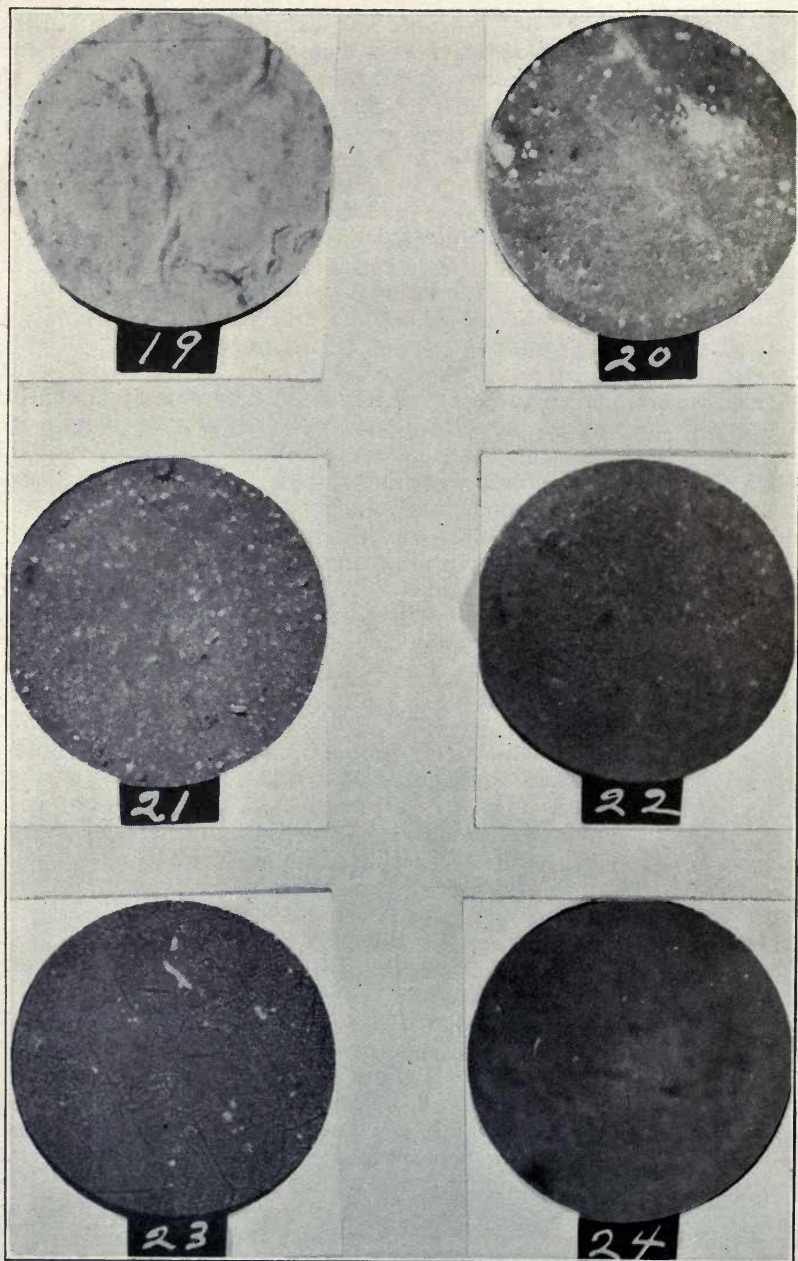
Coal tar paints proved to be absolutely worthless as a steel coating. In every case they checked and alligatored badly and developed corrosion of the metal very early in the test. Furthermore, it is impossible to repaint over coal tar paint unless the same type of paint is used. Consequently, in order to repaint with a good oil paint it is necessary to burn and scrap off all old paint. This condition is enough in itself to exclude coal tar paints as a coating for steel structures exposed to the ordinary atmospheric agents. This type of paint does, however, serve admirably under some conditions where linseed oil paint would not hold up at all; namely for coating under ground pipes, warm smoke stacks, etc. Note panels 34, 129, 130 and 133 for this class of paint.

Asphaltic base paints are similar to coal tar paints but do furnish considerable protection if properly made. Panels No. 1, 104 and 49 were coated with a paint containing an asphaltic base and are still giving good protection. However, panels 23, 124 and 125 coated with asphaltic base paints, have failed completely and must be burned, scraped and repainted. Gilsonite paint produces a brittle film which allows water to pass through to the metal; then corrosion proceeds rapidly.

While there may be some good asphaltic base paints, as a class they should not be used as structural steel coatings without a thoro service test.

Carbon paints are very serviceable and when properly and scientifically prepared produce a very elastic and impervious film. However, the results of these tests show that this class of paint should not be used as the first coat on metal, as rusting, altho delayed for several years, will begin beneath the paint film unless very careful attention is paid to keeping the surface repainted. As a field coat carbon paints are very valuable. See panels 1, 14, 17, 30, 36, 81, 108 and 134.

What has been said of carbon paints is also true of graphite paints. While some panels which were painted with graphite as the first coat are still in good condition, the same paint on other panels has



Microphotographs of Panels 19 to 24
Exposure about two years

allowed rusting to develop so rapidly that the panel should be burned and scraped for repainting. Graphite paints are excellent for field coats. See panels 3, 5, 7, 9, 38, 44, 45, 60, 64, 47, 51, 56, 60, 62, 64, 65, 68, 69, 70, 73, 78, 79, 80, 86, 87, 88, 89, 90, 94, 103, 105, and 106.

Red lead paints have proved to be excellent for first coats but as they discolor, fade and chalk badly they should be covered with a good field coat. It is also evident that red lead should not be diluted with more than 25 per cent of inert silicates and that calcium carbonate injures its protective power if present in too large amounts. See panel 27. The higher degree of purity of red lead the longer it will keep its natural color. There is no panel, however, with a final red lead coat which did not fade badly within a year and a half. See panels 3, 4, 6, 8, 10, 16, 25, 27, 37, 40, 42, 46, 51, 56, 57, 84, 100, 110, 115.

Sublimed blue and white lead paints have a strong tendency to check and chalk and because of this fact, rusting often begins in from two to three years. This rusting is easily remedied by brushing and repainting so that the objection does not have the importance it would if the surface were not left in this good condition for repainting. For field coats, this class of paints has not proved altogether satisfactory because of the soft chalky film which they produce and the necessity for frequent repainting.

For sublimed blue lead see panels 9, 11, 20, 22, 24, 41, 39, 43, 45, 47, 61, 82, 87, 90, 92, 95, 101, 105, 111, 123 and 131.

For sublimed lead sulfate see panels 19, 39, 59, 63, 85 and 89.

What has been said of sublimed blue and white lead is also true of white lead and white lead and zinc. See panels 16, 18, 24, 33, 54 and 75.

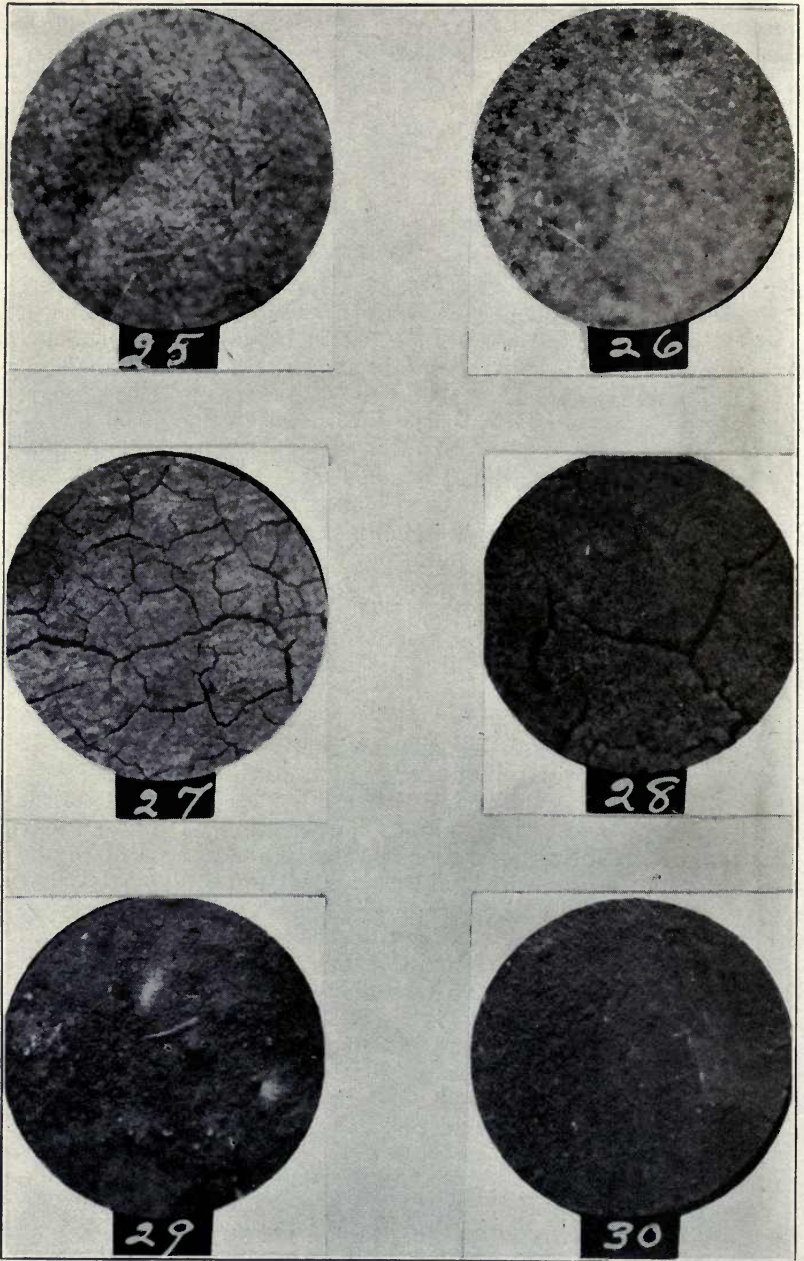
Iron oxide paint is probably the most extensively adulterated class of paint. The natural oxide has such a high coloring power that large amounts of gypsum and whiting are used in compounding the cheap grades of iron oxide paints. The results of the service tests show that such additions sacrifice the quality of the paint to such an extent as to make them worthless for structural steel coatings, whereas if the natural oxides are used without such addition this class of paints is very serviceable. See panels 6, 11, 13, 26, 29, 31, 32, 35, 36, 41, 43, 48, 53, 55, 56, 74, 76, 78, 91, 92, 93, 99, 101, 102, 112 and 126.

Certain mixed pigments gave very good results. A graphite pigment to which 20 per cent of zinc or lead chromate has been added makes a very good and serviceable shop coat over which an ordinary graphite paint may be used. See panels 5 and 50. Other combinations, such as carbon with the addition of lead oxide or lead sulfate, give fair results. See panels 14, 15, 17, 20, 108 and 134.

CONCLUSIONS

The tests have demonstrated that :

1. Too much emphasis cannot be placed upon the fact that gypsum and whiting are harmful when present to a much greater extent than



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Microphotographs of Panels 25 to 30
Exposure about two years

5 per cent of the pigment. In every case where these materials have been present to a considerable extent the paint has failed to protect and rusting usually begins underneath the film.

2. It is not safe to use carbon and graphite paints for the first coat on steel.

3. Coal tar paints are worthless for structural steel exposed to the atmosphere under ordinary conditions.

4. Asphaltic base paints as a class should not be specified as a general structural steel coating altho those which have withstood a good service test may be specified individually.

5. (a) Red lead, sublimed blue lead, subilmed lead sulfate and zinc and lead whites are very effective for first coats and produce good surfaces for repainting.

(b) Frequent repainting is necessary when they are used for field coats.

6. Red lead, sublimed blue lead, sublimed lead sulfate, zinc lead white, white lead or leaded zinc pigments are always safe pigments for a shop coat paint.

7. (a) Pure iron oxide paints may be safely used for a shop coat but should preferably be mixed with about 10 per cent zinc or lead chromate.

(b) Iron oxide paints containing gypsum or whiting in any considerable extent are not serviceable for either shop or field coats on structural steel.

8. There are certain carbon paints on the market which produce such a strong, elastic, and impermeable film that they may be used for both shop or field coats for structural steel, providing the painting is done in a thoroly good, workmanlike manner.

9. Graphite or carbon paints, the pigment of which contains 20 per cent of basic lead chromate, zinc chromate, lead oxide or sublimed lead sulfate, are good shop coat paints, and also prove very serviceable for field coats.

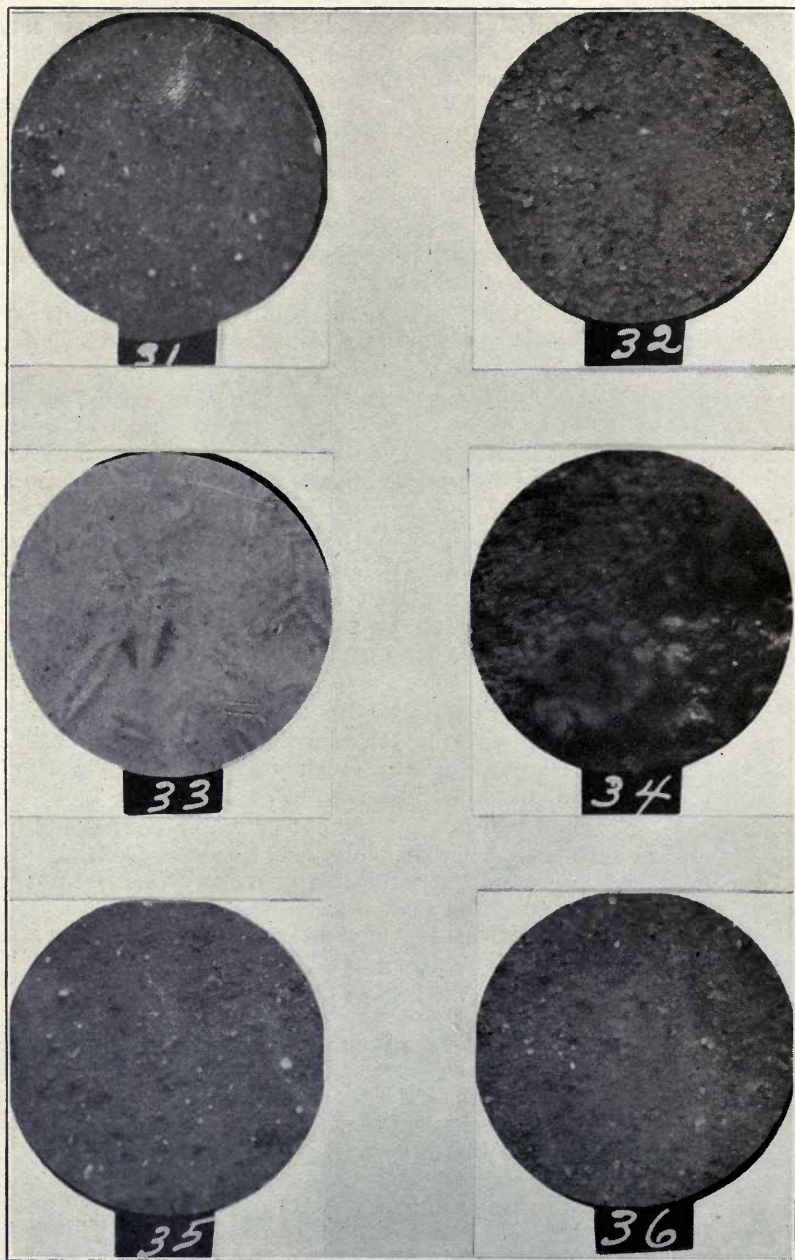
10. (a) The paint specifications* now being used by the Iowa State Highway Commission for structural steel bridges are good and when followed strictly will produce good preservative coatings for the steel structures.

(b) More attention should be given to the time and manner of repainting both old and new structures.

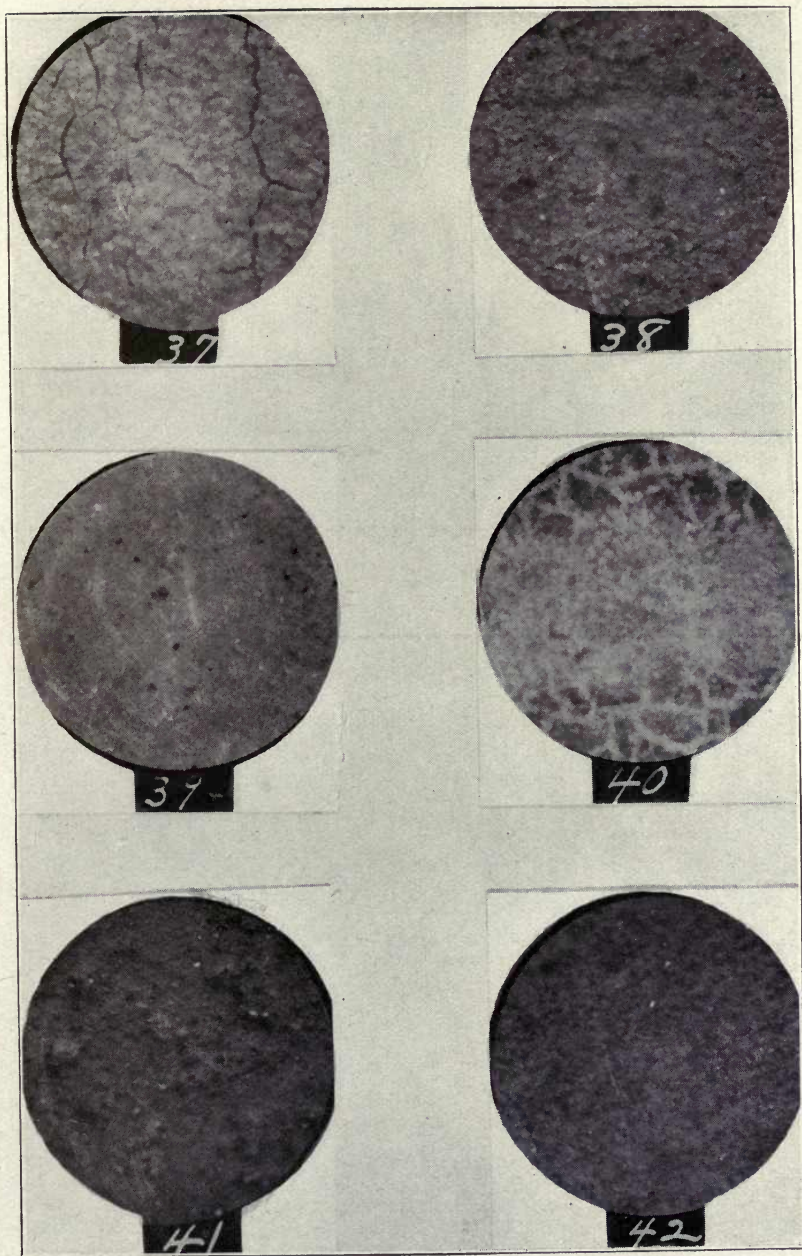
(c) There is some indication that china wood oil should be excluded as a vehicle for structural steel paints because of the fact that vehicles composed largely of this oil increase the tendency to check.

As a result of this investigation and of subsequent chemical analyses the Iowa State Highway Commission has formulated a list of paints which are known to be satisfactory for highway bridges. This list is reproduced in Appendix I hereafter.

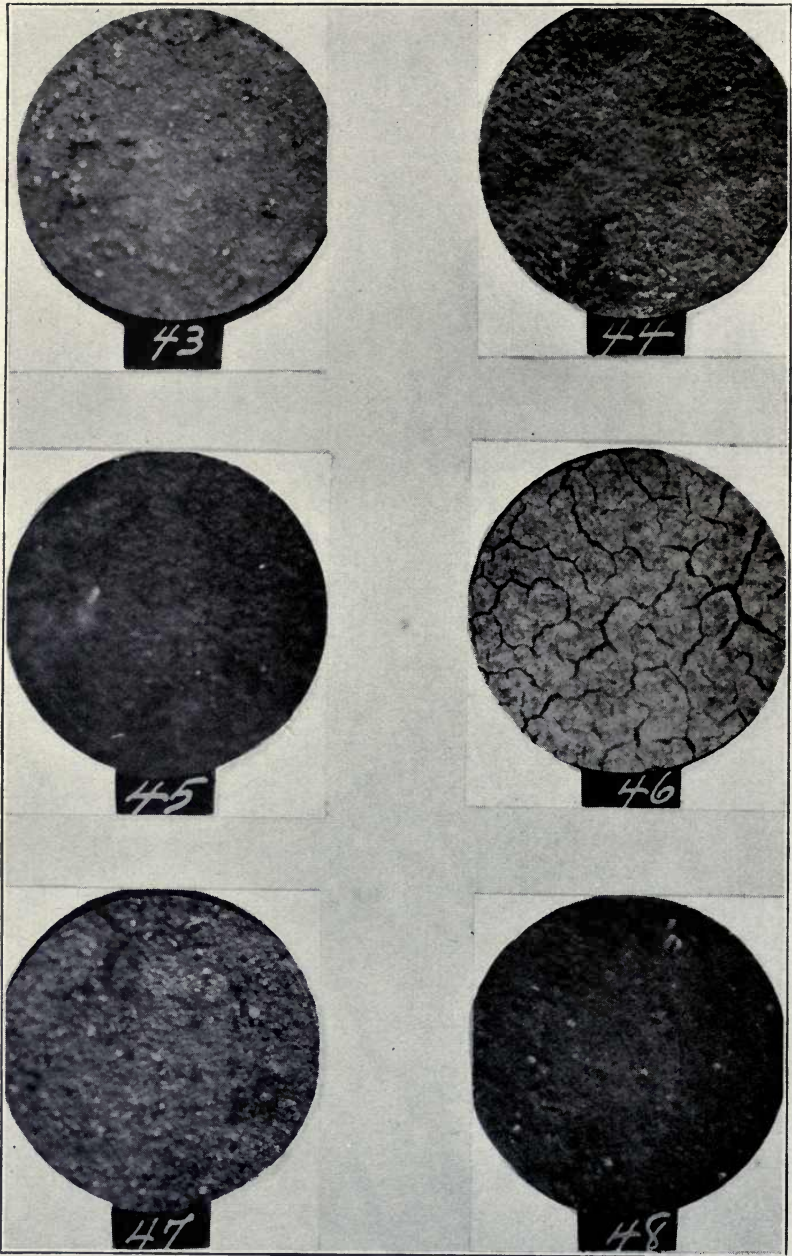
*Reprinted herein as Appendix II.



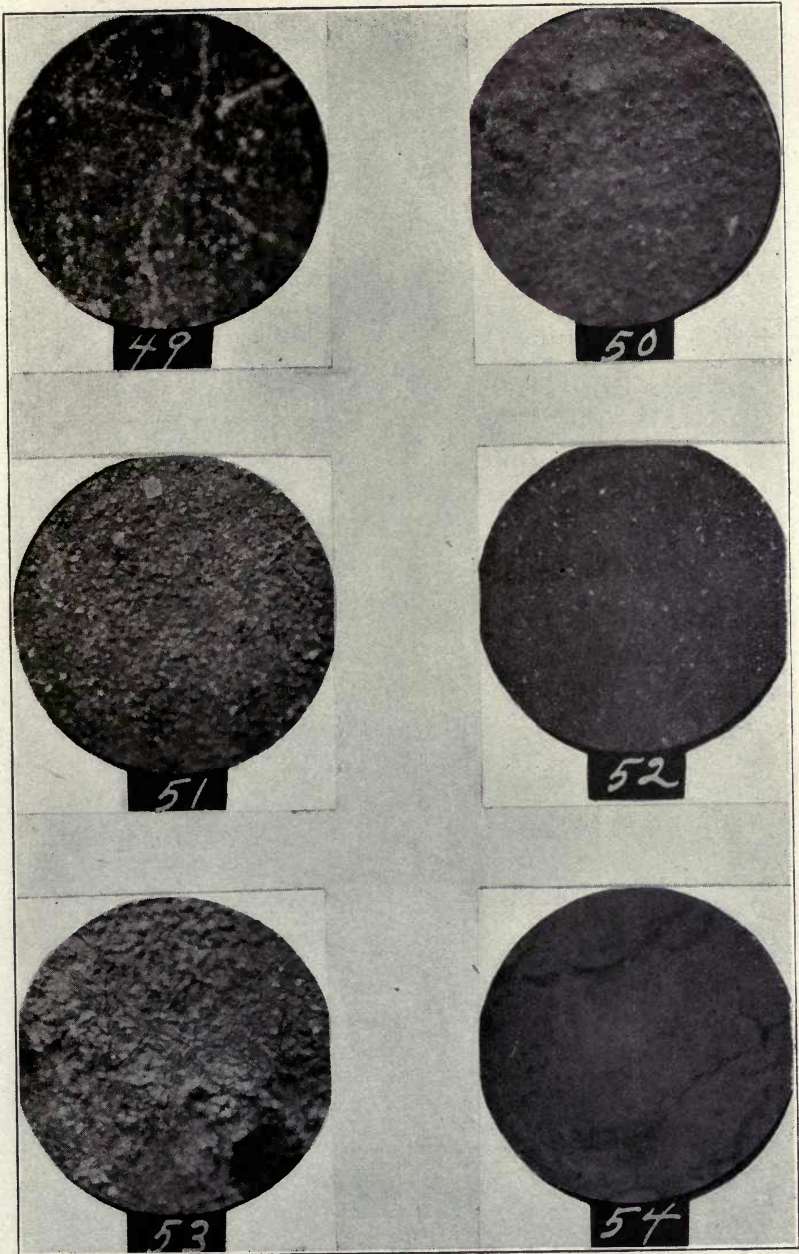
Microphotographs of Panels 31 to 36
Exposure about two years



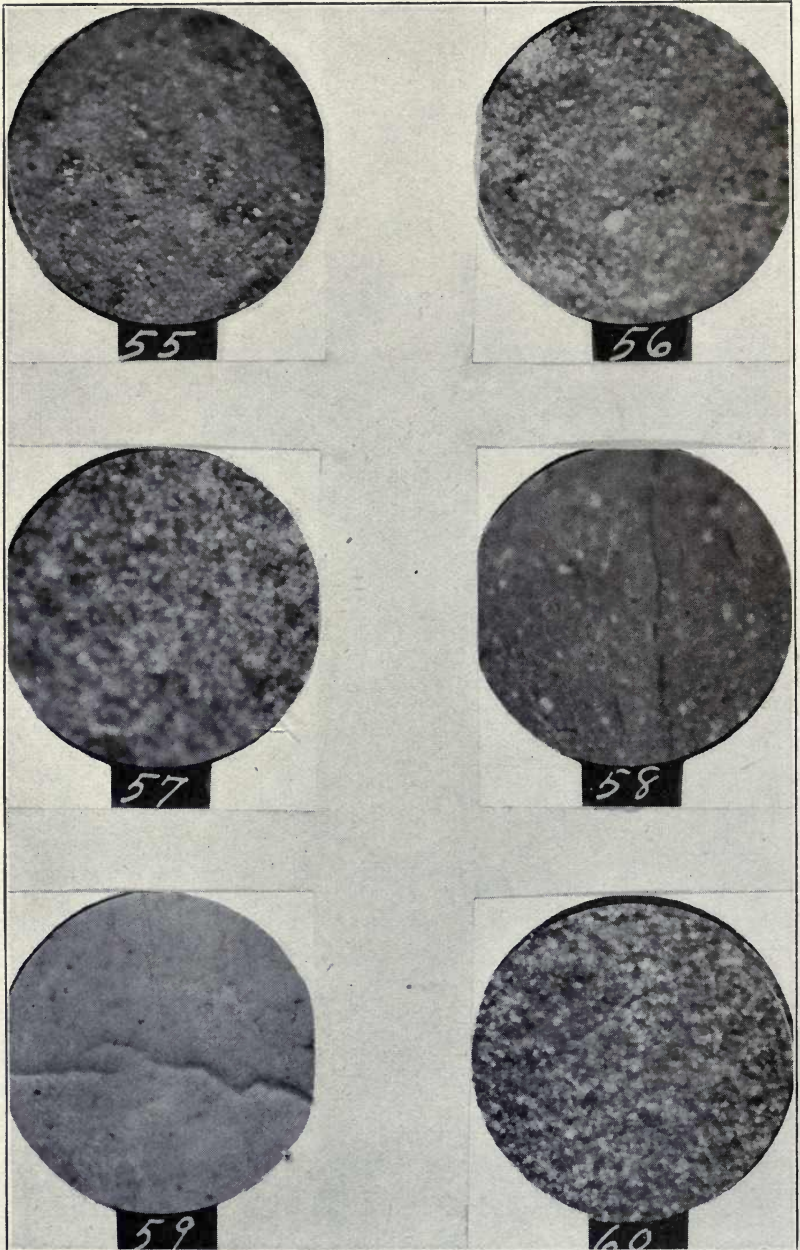
Microphotographs of Panels 37 to 42
Exposure about two years



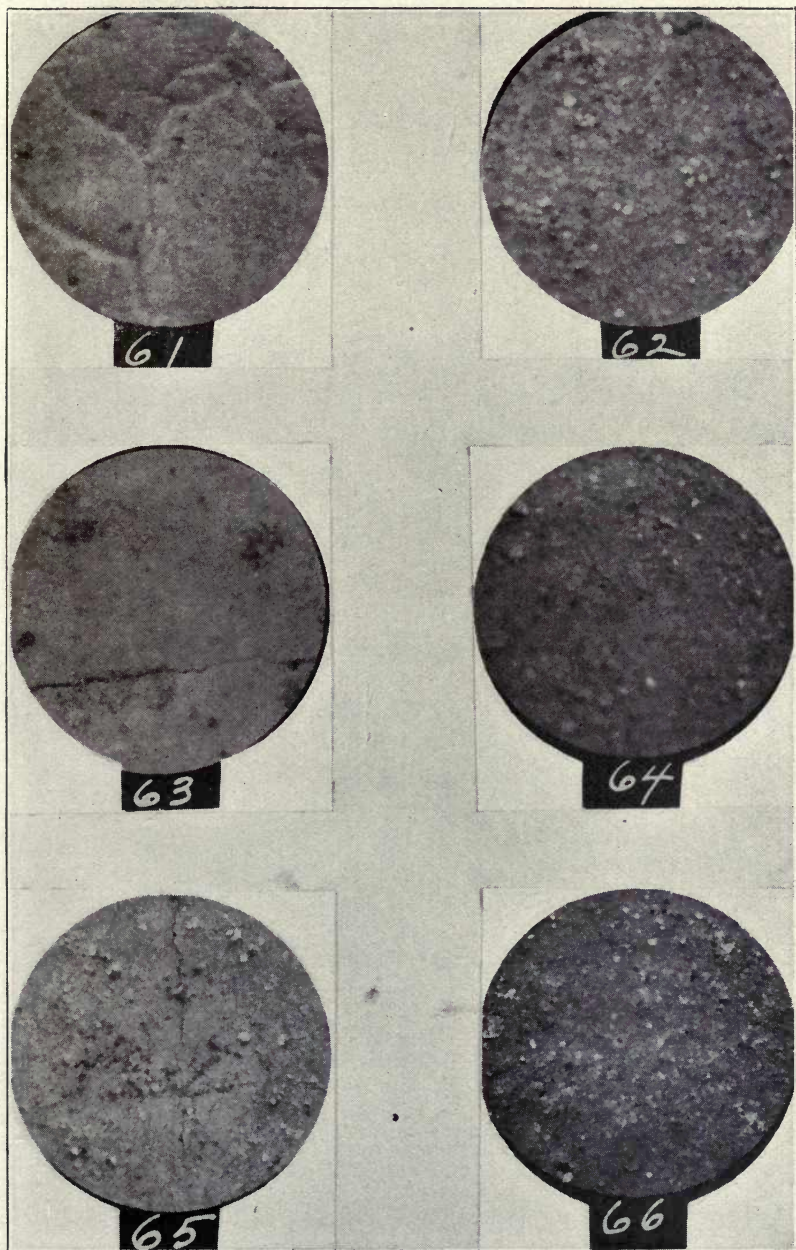
Microphotographs of Panels 43 to 48
Exposure about two years



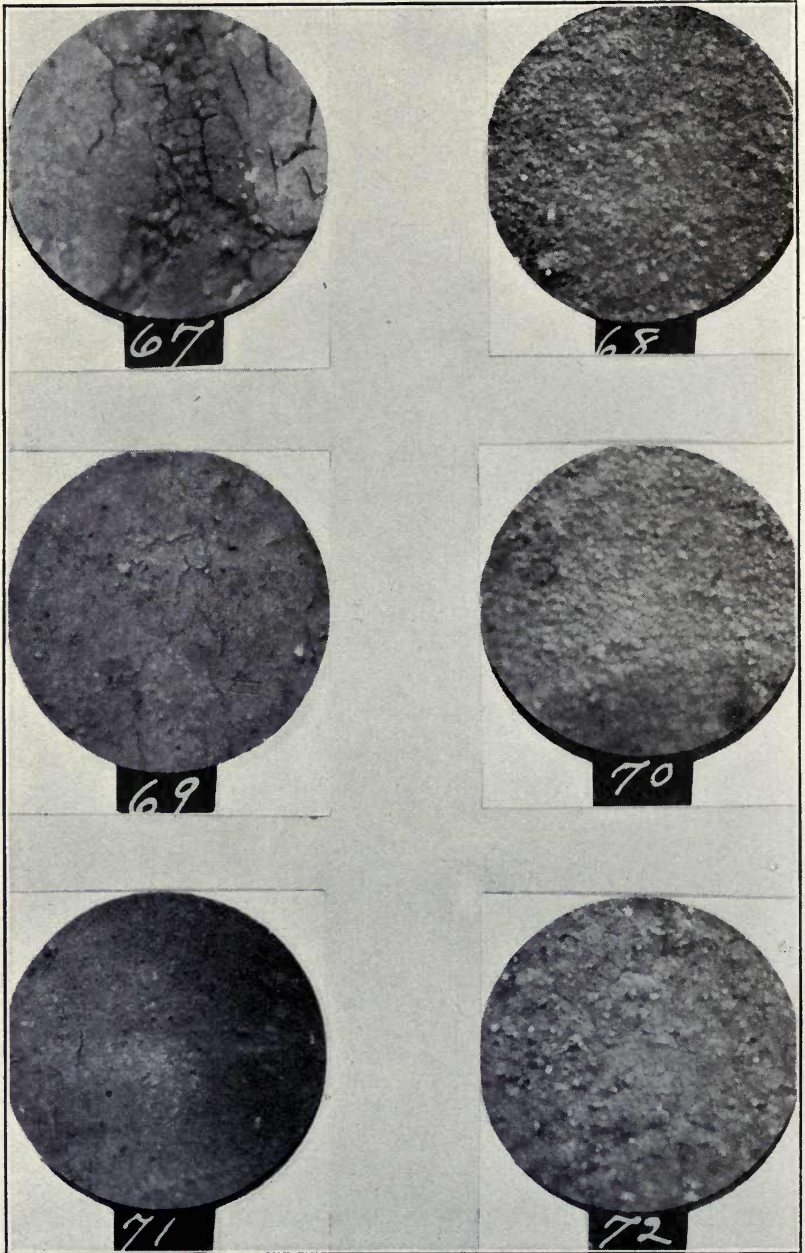
Microphotographs of Panels 49 to 54
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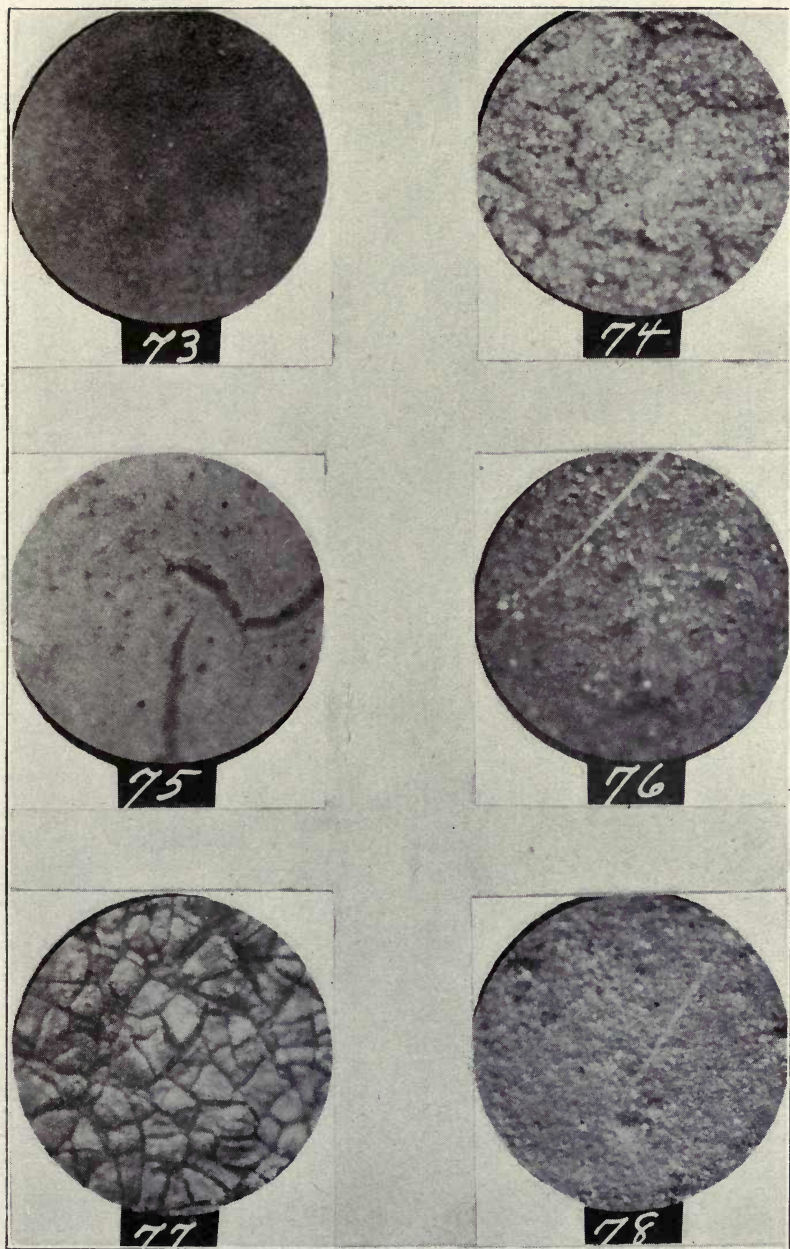
Microphotographs of Panels 55 to 60
Exposure about two years



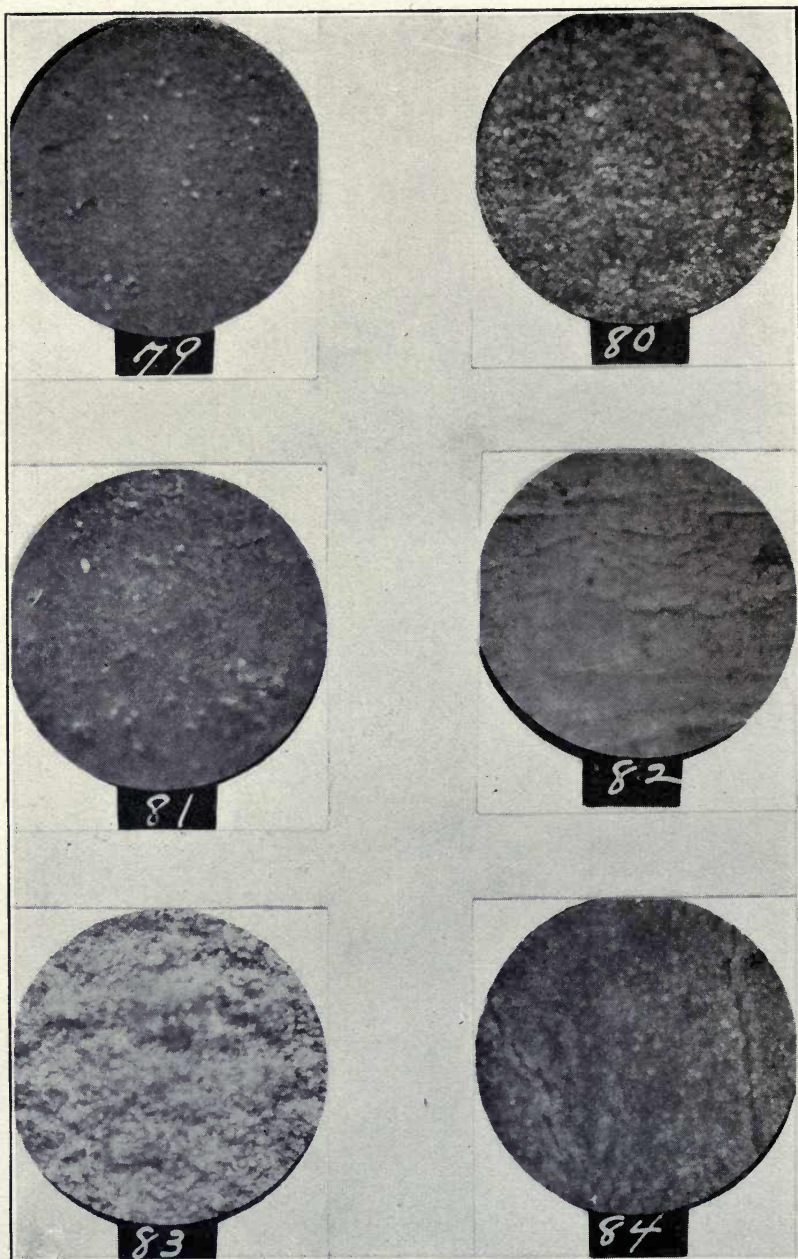
Microphotographs of Panels 61 to 66
Exposure: 61-64 about two years; 65-66 about twenty-two months



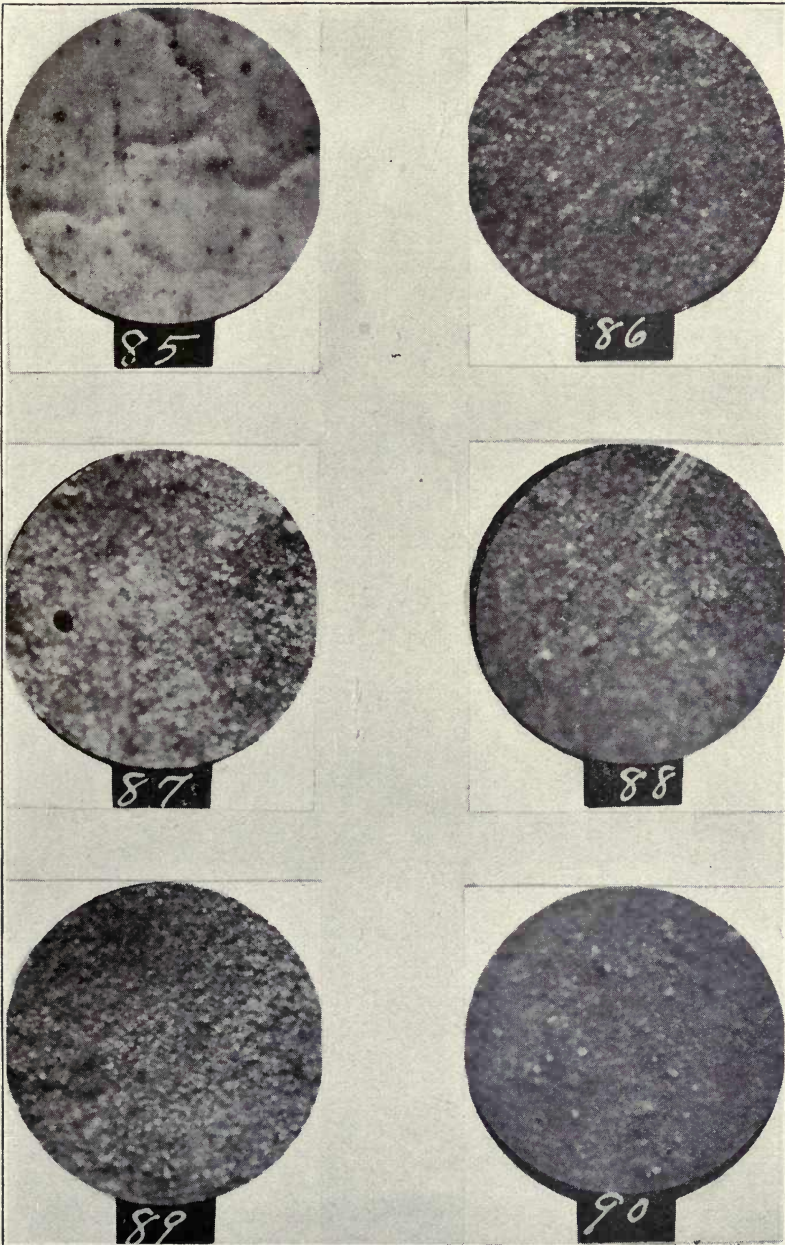
Microphotographs of Panels 67 to 72
Exposure about twenty-two months



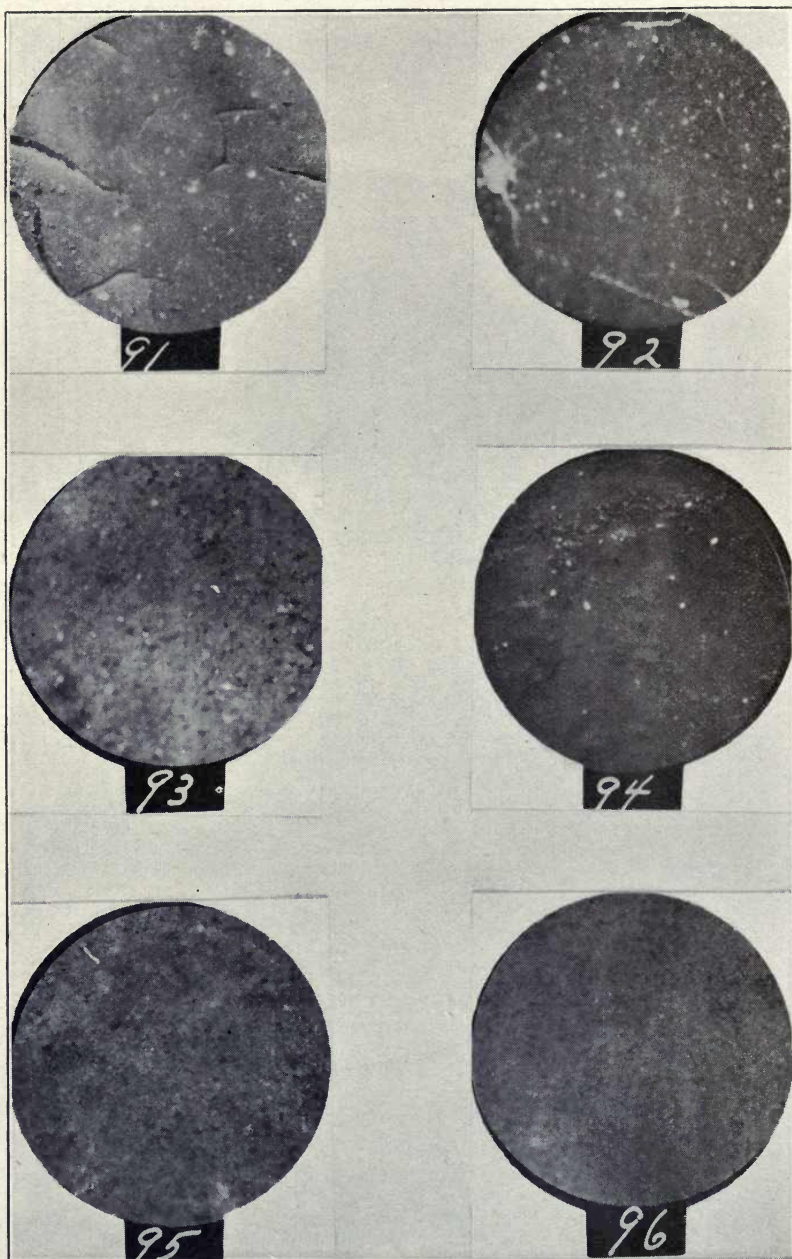
Microphotographs of Panels 73 to 78
Exposure: 73-about two years; 74-78-about twenty-two months



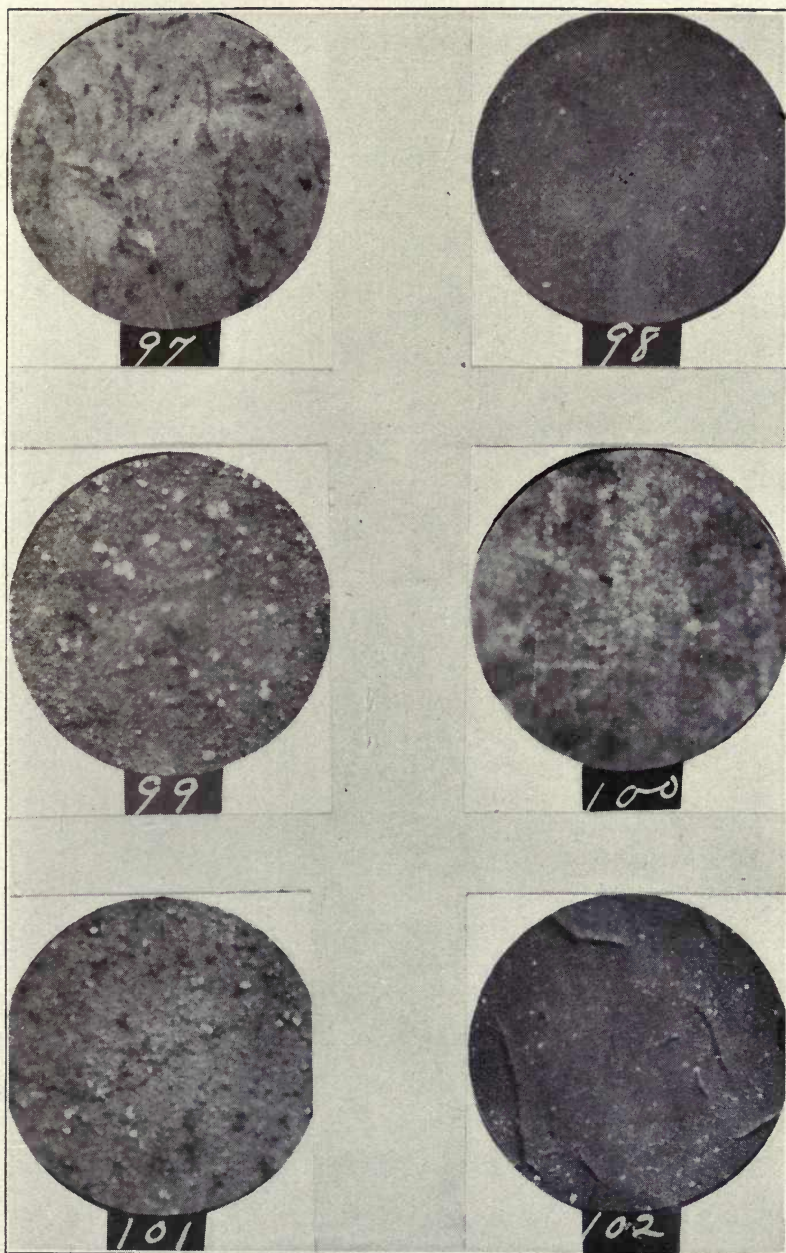
Microphotographs of Panels 79 to 84
Exposure: 79-80 about twenty-two months; 81-84 about twenty-one months



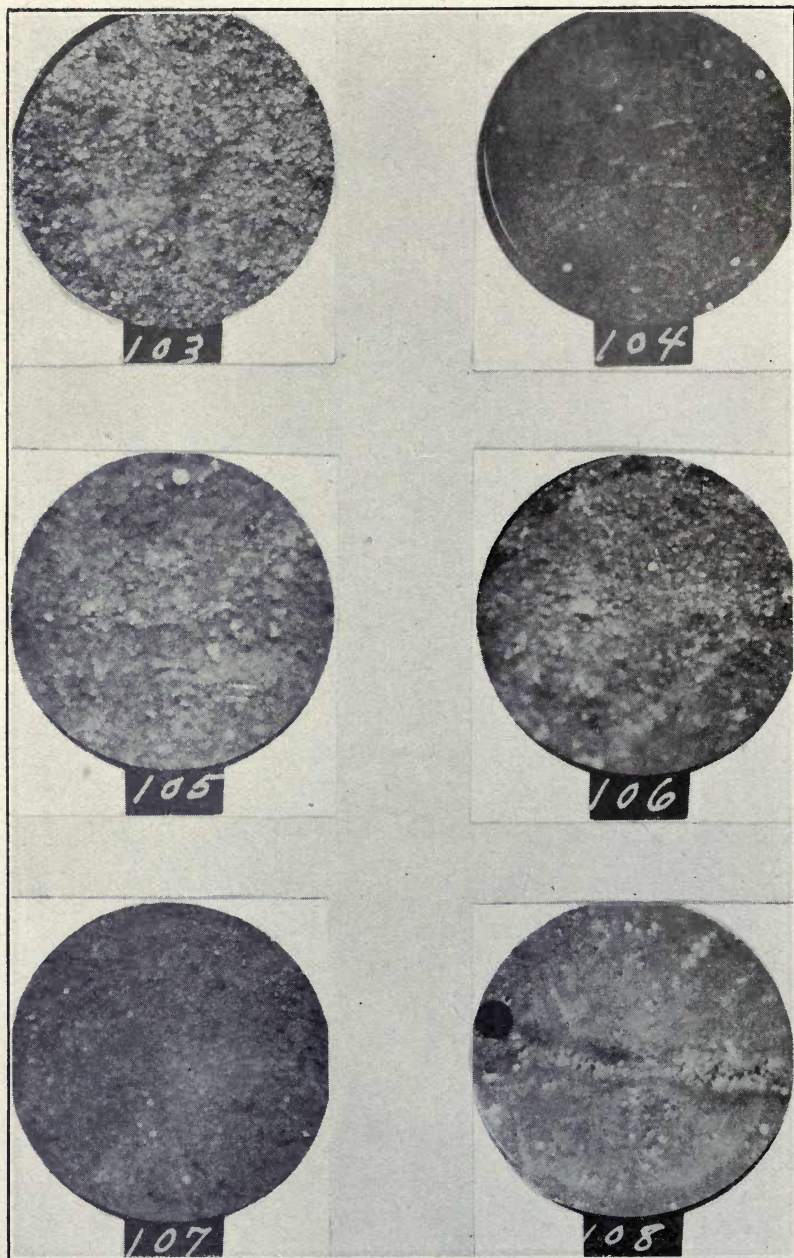
Microphotographs of Panels 85 to 90
Exposure about twenty-one months



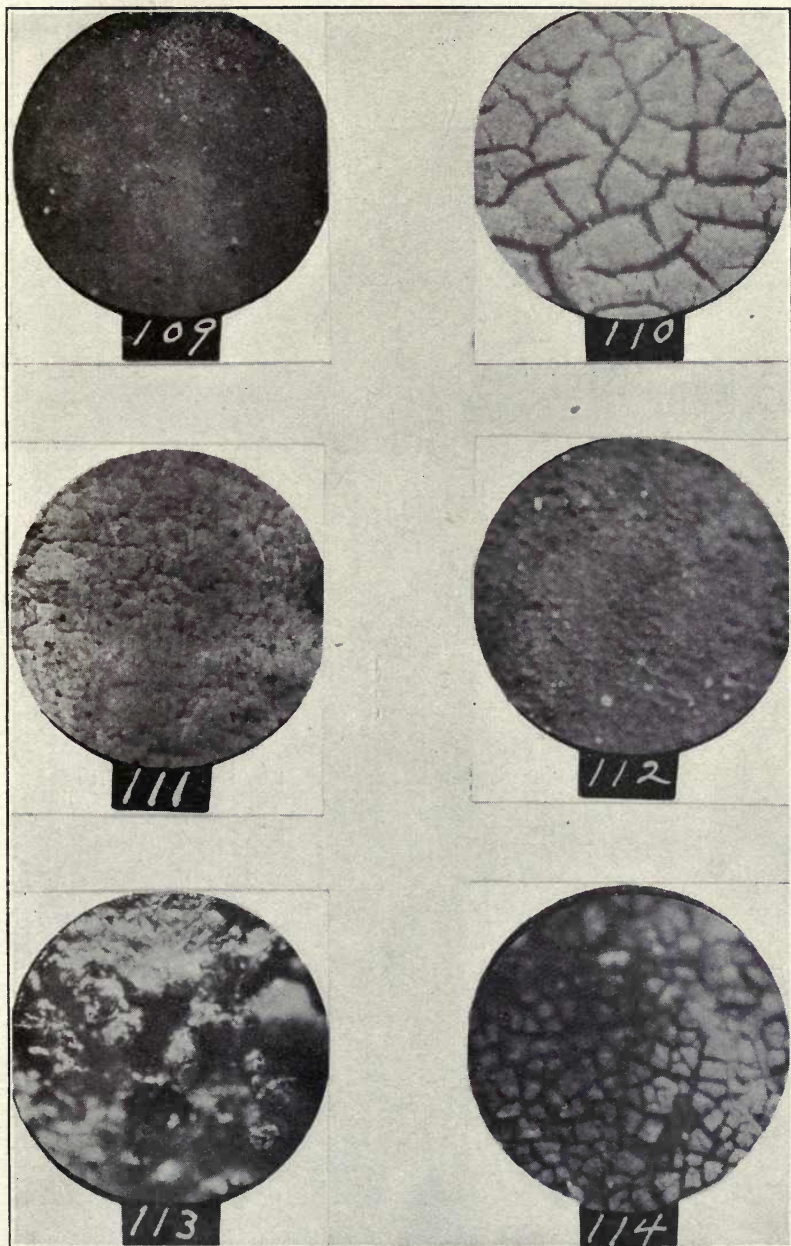
Microphotographs of Panels 91 to 96
Exposure about twenty-one months



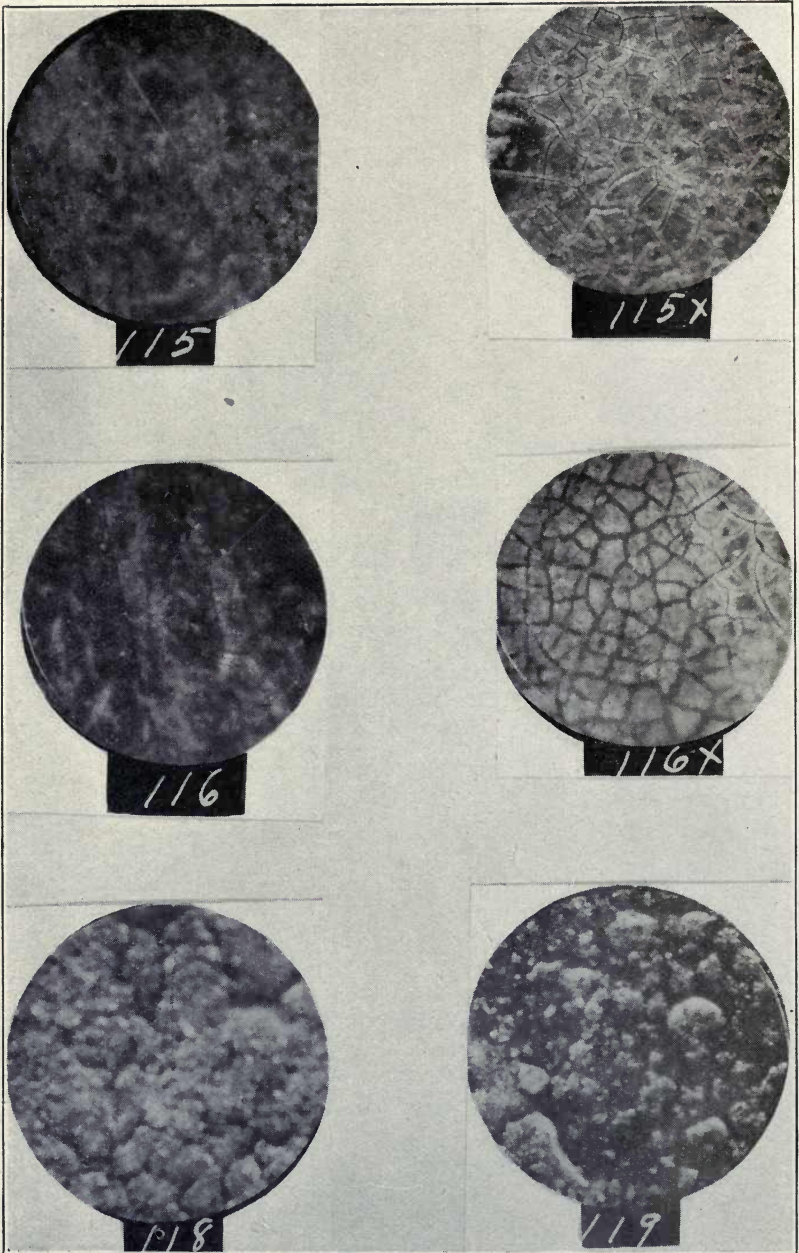
Microphotographs of Panels 97 to 102
Exposure about twenty-one months



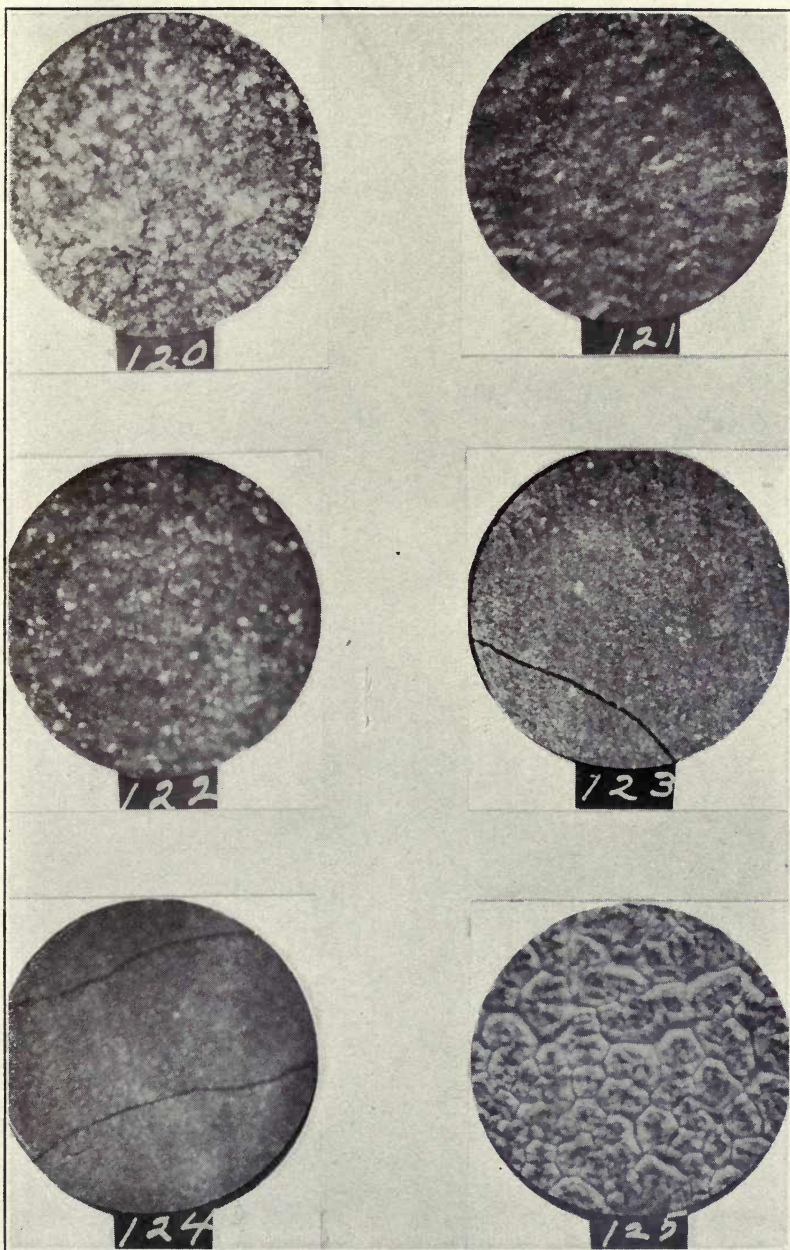
Microphotographs of Panels 103 to 108
Exposure: 103 and 106 about twenty-two months; 104, 105 107, 108 about twenty-one months



Microphotographs of Panels 109 to 114
Exposure about twenty-one months

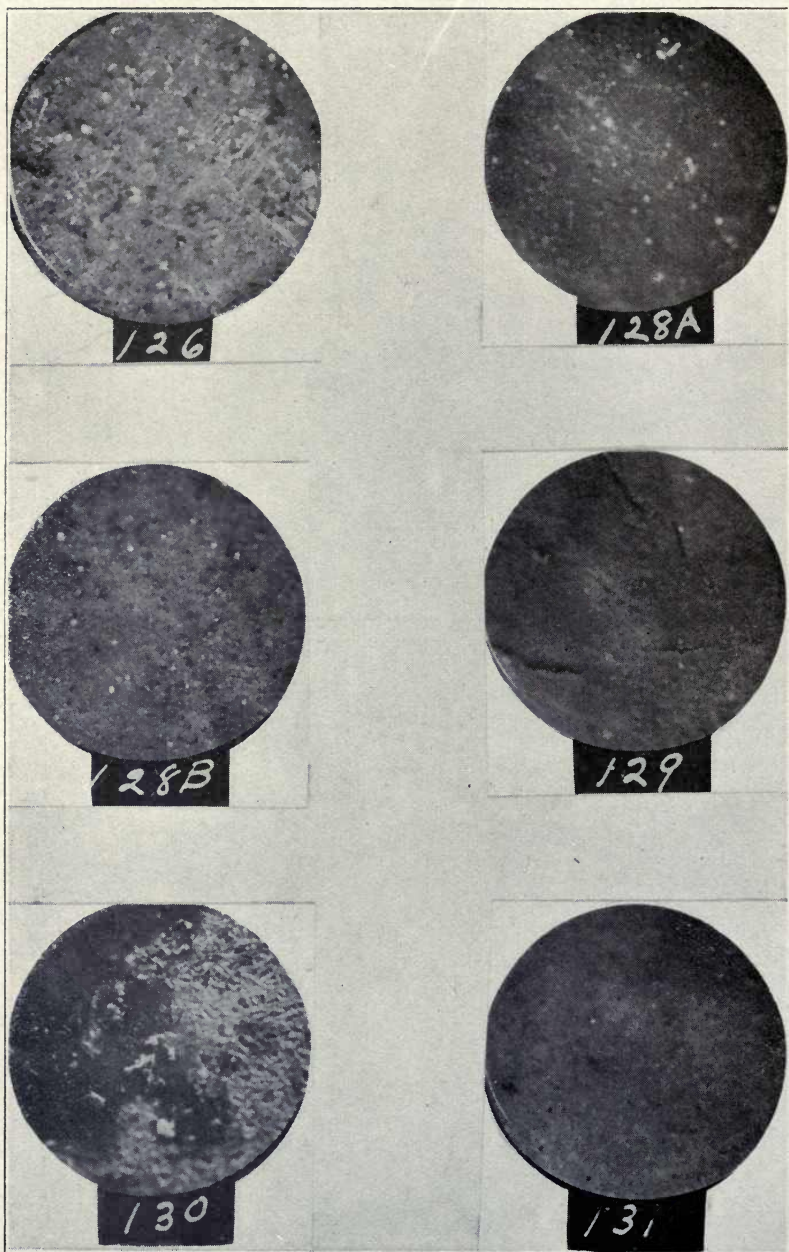


Microphotographs of Panels 115 to 119
Exposure about twenty-one months

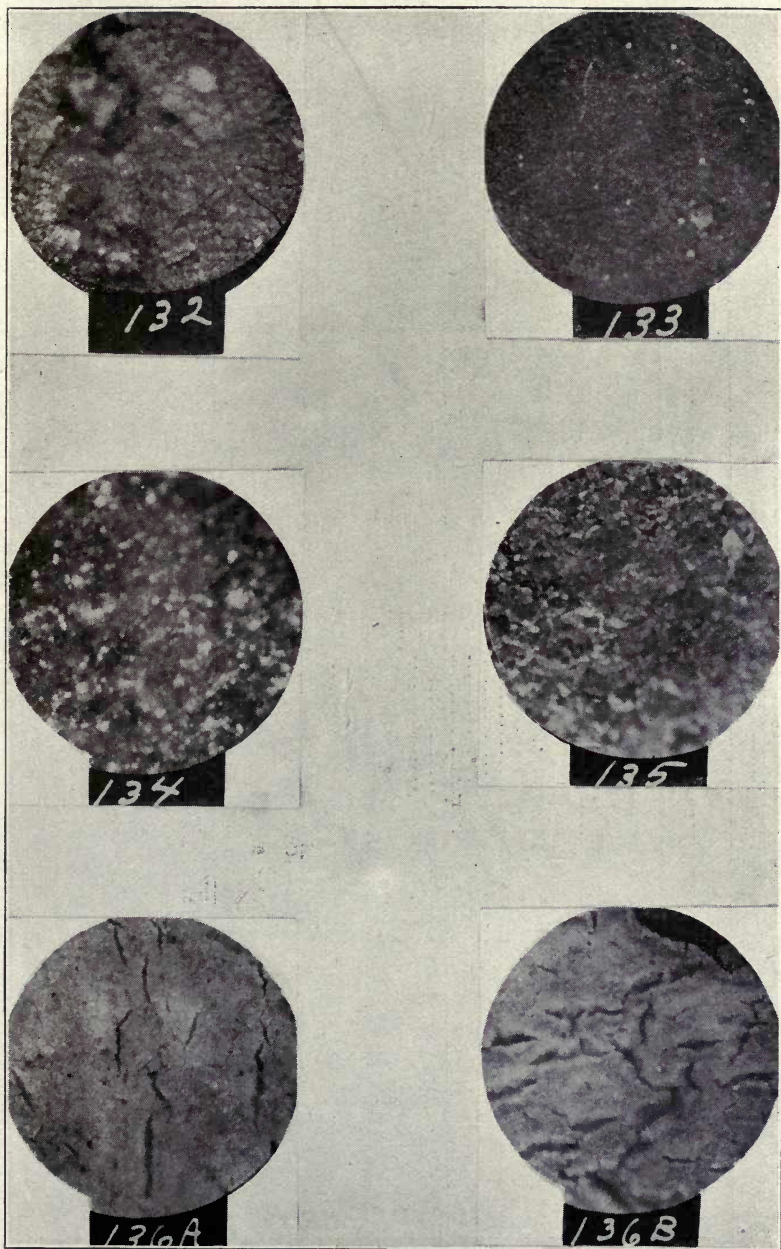


Microphotographs of Panels 120 to 125

Exposure: 120-122 about twenty-one months; 123-125 about eighteen months



Microphotographs of Panels 126 to 131
126-128 about eighteen months; 129-131 about two years



Microphotographs of Panels 132 to 136
Exposure about two years

TABLE I
CHEMICAL ANALYSES OF PANEL PAINTS

Panel No.	Date Placed to Weather	FIRST COAT.			SECOND COAT			
		Paint	Manufacturer	Analysis	Paint	Manufacturer	Analysis	
1	Sept. 15 1914	Red Elastikote	Tropical Oil Co., Cleveland, Ohio	Black Varnish Red Iron Oxide Para Red Whiting 100% Black Varnish Boiled Linseed Oil Turpentine Naptha No. 1 Japan Dryer Gilsomite Pigment	80% Black 10% Elastikote 5% 5%	Tropical Oil Co.	Black Varnish—same as for First Coat	
2	Sept. 15 1914	Nobrac	Patterson-Sargent Co., Chicago	Pigment Vehicle Lbs. Pigment to 1 gal. oil Iodine No. of Vehicle Pigment Analysis Carbon Silica Iron Oxide & Alumina Lime (CaO) Magnesia (MgO) Water & Vol. Matter	20% 80% 2 132 70.96% 21.55% 4.06% 0.85% 2.27% 0.37% 99.56%		Same as for First Coat.	
3	Sept. 15 1914	Special Red Lead	C. R. Cook Paint Mfg. Co., Kansas City, Mo.	Pigment Vehicle Lbs. pigment to 1 gal. Vehicle Iodine No. of Vehicle Pigment Analysis Red Lead (Pb3O4) Lead Oxide (PbO) Zinc Oxide (ZnO) Lime (CaO) Magnesia (MgO) Iron Oxide, etc. Insoluble Silicates	78% 27% 21 115 54.1% 3.7% 0.5% 0.2% 0.5% Trace 39.2% 98.2%	Special Graphite	Pigment Vehicle Lbs. pigment to 1 gal. Vehicle Iodine No. of Vehicle Pigment Analysis Carbon Silica Iron Oxide & Alumina Lime (CaO) Magnesia (MgO) Vol. matter and water	45.6% 54.6% 6.5 145 49.06% 28.54% 7.34% 18.20% 1.32% .10% 99.56%

4	Sept. 15 1914	Red Lead Lute	Lowe Bros. Co., Dayton, Ohio	Pigment Vehicle 70% Metalcote 30% Lbs. pigment to 1 gal. Vehicle 18.3 Iodine No. of Vehicle 88 Pigment Analysis Red Lead (Pb ₃ O ₄) 51.9% Lead Oxide (PbO) 9.8% Zinc Oxide (ZnO) 6% Calcium Carbonate 5.4% Magnesia (MgO) 1.4% Iron Oxide (Fe ₂ O ₃) Trace Insoluble Silicates 30.4% 99.5%	Lowe Bros Co, Dayton, Ohio Pigment Vehicle 19.5% Lbs. pigment to 1 gal. Vehicle 1.9 Iodine No. of Vehicle 137 Pigment Analysis Carbon 59.7% Silica 3.5% Iron Oxide 2.2% Lime (CaO)9% Lead Oxide (PbO) 28.2% Zinc Oxide (ZnO)7% Carbon dioxide 4.1% Sulfur trioxide7% 100.0%
5	Sept. 15 1914	Dark Green Color "B"	U. S. Graphite Co., Saginaw, Mich.	Pigment Vehicle 37.5% Natural Graphite Color "A" 62.5% Lbs. pigment to 1 gal. Vehicle 4.7 Iodine No. of Vehicle 134 Pigment Analysis Carbon 62.66% Silica 13.10% Lead Chromate (PbCrO ₄) 21.18% Lead Oxide & Alumina 1.10% Lime (CaO) 1.10% Magnesia (MgO) Trace Water & Vol. matter06% 98.20%	U. S. Graphite Saginaw, Mich. Pigment Vehicle 36.3% Lbs. pigment to 1 gal. Vehicle 4.5 Iodine No. of Vehicle 160 Pigment Analysis Carbon 76.24% Silica 18.40% Iron Oxide and Alumina 4.25% Lime (CaO) 9.45% Magnesia (MgO)09% Water and Vol. Matter11% 99.54%
6	Sept. 15 1914	Red Lead Lute	Lowe Bros. Co., Dayton, Ohio	Same as First Coat for Panel No. 4 Standard Metallic Brown	Lowe Bros.Co. Dayton, Ohio Pigment Vehicle 53.6% Lbs. pigment to 1 gal. Vehicle 9 Iodine No. of Vehicle 86 Pigment Analysis Insoluble Silicates 40.2% Iron Oxide (Fe ₂ O ₃) 39.8% Alumina (Al ₂ O ₃) 6.8% Calcium Oxide (CaO) 5.8% Sulfur Trioxide (SO ₃) 1.8% Carbon Dioxide (CO ₂) 4.2% Carbon and Vol. Matter 1.4% 100.0%

TABLE I
CHEMICAL ANALYSES OF PANEL PAINTS

Panel No.	Date Placed to Weather	FIRST COAT.			SECOND COAT		
		Paint	Manufacturer	Analysis	Paint	Manufacturer	Analysis
7	Sept. 15 1914	Dixon's Silica Graphite	Lowe Bros. Co., Dayton, Ohio	Pigment	33%	Same as for First Coat.	
				Vehicle	67%		
				Lbs. pigment to 1 gal. Vehicle	3.8		
				Iodine No. of Vehicle	115		
				Pigment Analysis			
				Carbon	59.07%		
				Silica	30.60%		
				Iron Oxide & Alumina	7.68%		
				Lime (CaO)	Trace		
				Magnesia (MgO)	1.40%		
				Water & Vol. Matter	0.24%		
					98.99%		
8	Sept. 15 1914	Red Lead Lute	Lowe Bros. Co., Dayton, Ohio	Same as First Coat for Panel No. 4		Same as for First Coat.	
9	Sept. 15 1914	Iron Primer	C. R. Cook Paint Co., Kansas City, Mo.	Pigment	65%	Same as for Second Coat, Panel No. 3	
				Vehicle	35%		
				Lbs. pigment to 1 gal. Vehicle	14.5		
				Iodine No. of Vehicle	115		
				Pigment Analysis			
				Lead Sulfate (PbSO ₄)	25.9%		
				Lead Sulfid (PbS)	Trace		
				Lead Sulfite (PbSO ₃)	1%		
				Lead Oxide (PbO)	14.5%		
				Lead Chromate (PbCrO ₄)	4.2%		
				Zinc Oxide (ZnO)	10.7%		
				Iron Oxide (Fe ₂ O ₃)	1.6%		
				Lime (CaO)	4.2%		
				Magnesia (MgO)	3.8%		
				Carbon dioxide (CO ₂)	3.1%		
				Insoluble Silicates	34.5%		
10	Sept. 15 1914	Red Lead Lute	Lowe Bros. Co., Dayton, Ohio	Same as First Coat for Panel No. 4	100.2%	Same as for First Coat.	
				Spectral Graphite		C. R. Cook Paint Co., Kansas City Missouri	
				Bronze Green No. 320		Lowe Bros. Co., Dayton Ohio	
				Pigment	48.6%	Same as for First Coat.	
				Vehicle	51.4%		
				Lbs. pigment to 1 gal. Vehicle	7.4%		
				Iodine No. of Vehicle	124		
				Pigment Analysis			

11	Sept. 15 1914	Gray 4690	Patton Paint Co., Milwaukee, Wis.	<p>Pigment Vehicle 22.0% 78.0%</p> <p>Lbs. pigment to 1 gal. Vehicle 2.2</p> <p>Pigment Analysis Lead Sulfate (PbSO₄) 49.2% Lead Sulfite (PbSO₃) 0.5% Lead Oxide (PbO) 9.8% Zinc Oxide (ZnO) 3.8% Ferric Oxide (Fe₂O₃) 22.4% Insoluble 8.5% Alumina (Al₂O₃) 1.9% Volatile & Comb. Matter.... 1.4%</p>	Inhibitive Red	Patton Paint Co., Milwaukee, Wis.	<p>Prussian Blue Small Lead Chromate considerable Zinc Oxide considerable Calcium Carbonate considerable Manganese small Iron and Alumina small Insoluble Silicates 55.0% Calcium or lead sulfate considerable Pigment 53.0% Vehicle 47.0%</p> <p>Lbs. pigment to 1 gal. Vehicle 9.0</p> <p>Pigment Analysis Ferric Oxide (Fe₂O₃) 40.3% Alumina (Al₂O₃) 10.3% Lime (CaO) 2.8% Silica and Silicates 27.5% Sulfur Trioxide (SO₃) 0.5% Lead Chromate (PbCrO₄) 7.0% Lead Oxide (PbO) 4.4% Loss on Ignition 6.9%</p>
12	Sept. 15 1914	Bronze Green No. 320	Lowe Bros. Co., Dayton, Ohio	<p>Same as Second Coat, Panel No. 10</p> <p>97.5%</p>			Same as for First Coat.
13	Sept. 15 1914	Metallic Red	Lowe Bros. Co., Dayton, Ohio	<p>Certified Analysis Ferric Oxide 16.7% Calcium Sulfate 14.8% Silica & Silicates 11.4% Calcium Carbonates 5.4% Linsseed Oil 36.7% Japan 15.0%</p> <p>100.0%</p>			Same as for First Coat.
14	Sept. 15 1914	Metalcoote	Lowe Bros. Co., Dayton, Ohio	<p>Pigment Vehicle 19.5% 80.5%</p> <p>Lbs. pigment to 1 gal. Vehicle 1.9</p> <p>Iodine No. of Vehicle.....137</p> <p>Pigment Analysis Carbon 59.7% Silica 3.5% Iron Oxide, etc..... 2.9% Lime (CaO) 9% Lead Oxide (PbO) 28.2% Zinc Oxide (ZnO) 2.7% Carbon Dioxide 4.1% Sulfur Trioxide 100.0%</p>			Same as for First Coat.

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CHEMICAL ANALYSES OF PANEL PAINTS

Panel No.	Date Placed to Weather	FIRST COAT.			SECOND COAT		
		Paint	Manufacturer	Analysis	Paint	Manufacturer	Analysis
15	Sept. 15 1914	Inhibitive Red	Patton Paint Co., Milwaukee, Wis.	Same as Second Coat, Panel No. 11	Finishing Black	Patton Paint Co., Milwau- kee.	Pigment 12.5% Vehicle 87.5% Lbs. pigment to 1 gal. Vehicle Pigment Analysis Carbon 76.9% Lead Oxide (PbO) 4.7% Lead Sulfate (PbSO ₄) 15.3% Silica, etc. 1.8% Vol. matter 1.8% 100.0%
16	Sept. 15 1914	Red Lead Lute	Lowe Bros. Co., Dayton, Ohio	Same as First Coat for Panel No. 4	White No. 328	Lowe Bros. Co., Dayton, Ohio.	Pigment 68.0% Vehicle 32.0% Lbs. pigment to 1 gal. Vehicle 16.6 Iodine No. of Vehicle 71 Pigment Analysis Basic Lead Carbonate 56.3% Zinc Oxide 31.0% Ferric Oxide 0.5% Calcium Carbonate 3.1% Insoluble Silicates 10.5% 100.0%
17	Sept. 15 1914	Finishing Black	Patton Paint Co., Milwaukee, Wis.	Same as Second Coat, Panel No. 15			Same as for First Coat.
18	Sept. 15 1914	White No. 328	Lowe Bros. Co., Dayton, Ohio	Same as Second Coat, Panel No. 16			Same as for First Coat.
19	Sept. 15 1914	Elastikote Outside White	Tropical Oil Co., Cleveland Ohio	Pigment 43% Vehicle 57% Pigment Analysis Basic Carbonate of Lead (PbCO ₃) ₂ (PbOH) ₂ 19.6% Lead Sulfate (PbSO ₄) 14.3% Zinc Oxide (ZnO) 37.7% Insoluble Silicates 26.3% 97.9%			Same as for First Coat.
20	Sept. 15 1914	Iron Primer	C. R. Cook Paint Co., Kansas City	Same as First Coat, Panel No. 9	Metalcote	Lowe Bros. Co., Dayton, Ohio	Same as First Coat, Panel No. 14

21	Sept. 15 1914	Elastikote Stone	Tropical Oil Co., Cleveland, Ohio	Pigment Vehicle 59.5% Vehicle 40.5% Lbs. pigment to 1 gal. Vehicle 11.5 Iodine No. of Vehicle 86 Pigment Analysis Zinc Oxide (ZnO) 44.6% Zinc Sulfid (ZnS)4% Iron Oxide 7% Lime (CaO) 14.4% Magnesia (MgO) 1.7% Sulfur Trioxide (SO ₃)8% Carbon dioxide (CO ₂) 10.0% Insoluble matter 16.9% Carbon, etc., 10.5% 100.0%	Red Elastikote	Tropical Oil Co., Cleveland Ohio	Same as First Coat, Panel No. 1
22	Sept. 15 1914	Iron Primer	C. R. Cook Paint Co., Kansas City	Same as First Coat, Panel No. 9	Bronze Green No. 320	Lowe Bros. Co., Dayton, Ohio	Same as Second Coat, Panel No. 10
23	Sept. 15 1914	Black Elastikote	Tropical Oil Co., Cleveland, Ohio	Same as Second Coat, Panel No. 1			Same as for First Coat.
24	Sept. 15 1914	Iron Primer	C. R. Cook Paint Co., Kansas City	Same as First Coat, Panel No. 9	White No. 328	Lowe Bros. Co., Dayton, Ohio	Same as Second Coat, Panel No. 16
25	Sept. 15 1914	Lincoln Liquid Red Lead	Lincoln Paint & Color Co., Lincoln, Nebr	Pigment Vehicle 52.5% Vehicle 47.5% Lbs. pigment to 1 gal. Vehicle 8.6 Water Trace Vol. Oils 3.7 Pigment Analysis Red Lead (Pb ₃ O ₄) 70.2% Lead Oxide (PbO) 9.2% Insol. matter 5.1% Loss on Ignition 15.4% Vol. matter 3% 100.4%			Same as for First Coat.
26	Sept. 15 1914	Standard Metallic Brown	Lowe Bros. Co., Dayton, Ohio	Same as Second Coat, Panel No. 6			Same as for First Coat.
27	Sept. 15 1914	No. 300 Red Lead	Atlas Oil Co., Omaha, Nebr.	Red Lead (Pb ₃ O ₄) 35.10% Lead Oxide (PbO) 7.32% Lime (CaO) 28.34% Carbon Dioxide 22.22% Insol. Matter 0.69% Organic Coloring Matter 6.33% 100.00%			Same as for First Coat.

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CHEMICAL ANALYSES OF PANEL PAINTS

Panel No.	Date Placed to Weather	FIRST COAT.		SECOND COAT		
		Paint	Manufacturer	Analysis	Manufacturer	
28	Sept. 15 1914			Pigment 46.5% Vehicle 59.5% Lbs. pigment to 1 gal. Vehicle 7.5 Iodine No. of Vehicle 147 Pigment Analysis Calcium Carbonate 80.18% Calcium Sulfate 1.07% Zinc Oxide 15.65% Insoluble 2.29% 99.19%		Same as for First Coat.
29	Sept. 15 1914	Standard Red Oxide	Patton Paint Co., Milwaukee	Pigment 71.8% Vehicle 28.2% Lbs. pigment to 1 gal. Vehicle 9 Iodine No. of Vehicle 140 Pigment Analysis Total Iron Calculated as Fe2O3 87.0% Fe3O4 84.0% Alumina (Al2O3) 2.0% Lime (CaO) 2.6% Magnesia (MgO) 1.7% Insoluble silica 5.9% Sulfur Trioxide (SO3) Trace		Same as for First Coat.
30	Sept. 15 1914	Nobrac	Patterson Sargent Co., Chicago	Same as First Coat, Panel No. 2		Same as for First Coat.
31	Sept. 15 1914	Vulcan Red Metal Paint	Atlantic Refining Co., Cleveland	Pigment 61.5% Vehicle 38.5% Lbs. pigment to 1 gal. Vehicle 12.5 Iodine No. of Vehicle 137 Pigment Analysis Calcium Carbonate (CaCO3) 48.3% Ferric Oxide (Fe2O3) 30.4% Alumina (Al2O3) 8.5% Insol. matter 11.5% Loss on ignition 6.3% 99.6%		Same as for First Coat.

32	Sept. 15 1914			Same as First Coat, Panel No. 28	Inhibitive Red	Patton Paint Co., Milwaukee, Wis.	Same as Second Coat, Panel No. 11
33	Sept. 15 1914	White Lead		Total Pigm't Liquid Lead Carbonate...28.35 45.0 Zinc Oxide.....28.35 45.0 Calcium Carbonate 6.30 10.0 Linseed Oil 31.85 86.07 Turpentine 2.20 5.57 Japan Drier 2.20 5.57 Petroleum Spirits .75 2.79 No Analysis			Same as for First Coat.
34	Sept. 15 1914	Coal Tar Paint		No Analysis			Same as for First Coat.
35	Sept. 15 1914	Venetian Red		Total Pigm't Liquid Calcium Carbonate 25.9 55.0 Ferric Oxide 21.2 45.0 78.2 Linseed Oil 41.4 10.6 Japan Drier 5.6 1.9 Turpentine 1.0 3.4 Nartha 1.8 3.4 Water 3.1 5.9			Same as for First Coat.
36	Sept. 15 1914	Ncbrac	Patterson Sargent Co., Chicago	Same as First Coat, Panel No. 2	Inhibitive Red	Patton Paint Co., Milwaukee	Same as Second Coat, Panel No. 11
37	Sept. 15 1914	No. 4 Extended Red Lead	Heath & Milligan Mfg. Co., Chicago	Pigment 67.2% Vehicle 32.8% Lbs. pigment to 1 gal. Vehicle 16.0 Iodine No. of Vehicle..... 139 Pigment Analysis Red Lead (Pb3O4) 41.0% Lead Oxide (PbO) 7.4% Zinc Oxide (ZnO) 0.6% Silicates 47.6% 96.6%			Same as for First Coat.
38	Sept. 15 1914	Graphite No. 1	Iowa Paint Mfg. Co., Ft. Dodge, Iowa.	Pigment 48% Vehicle 57% Lbs. pigment to 1 gal. Vehicle 5.9 Iodine No. of Vehicle 171 Water 0.25% Vol. Oils 2.0 % Pigment Analysis Ash 58.6% Carbon 37.2% Vol. matter 4.2% 100.0%			Same as for First Coat.

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CHEMICAL ANALYSES OF PANEL PAINTS

Panel No.	FIRST COAT.			SECOND COAT			
	Date Placed to Weather	Paint	Manufacturer	Analysis	Paint	Manufacturer	Analysis
39	Sept. 15 1914	Sublimed White Lead	Heath & Milligan Mfg. Co., Chicago	Pigment 74.0% Vehicle 26.0% Lbs. pigment to 1 gal. Vehicle 25.2 Iodine No. of Vehicle 148 Pigment Analysis Lead Sulfate (PbSO ₄) 75.2% Lead Oxide (PbO) 16.7% Zinc Oxide 6.4% Insol. matter 0.3% 98.6%	Blue Sub- limed Lead	Heath & Mil- ligan Mfg. Co., Chicago	Pigment 57.5% Vehicle 42.5% Lbs. pigment to 1 gal. Vehicle 10.5 Iodine No. of Vehicle 12r Pigment Analysis Lead Sulfate (PbSO ₄) 46.3% Lead Sulfite (PbSO ₃) 7.6% Lead Sulfid (PbS) 1.6% Lead Oxide (PbO) 40.4% Zinc Oxide (ZnO) 3.3% Insol. Matter 1.6% 100.8%
40	Sept. 15 1914	"Dutch Boy" Red Lead Paste	National Lead Co., St. Louis, Mo.	Pigment Analysis Red Lead (Pb ₃ O ₄) 95.60% Lead Oxide (PbO) 3.56% Iron Oxide Trace Lime (CaO) Trace Magnesia (MgO) Trace 99.16%			Same as for First Coat.
41	Sept. 15 1914	No. 2 Sublime Blue Lead	Platt & Thornburg	Pigment 82.1% Vehicle 17.9% Lbs. pigment to 1 gal. Vehicle 35.8 Pigment Analysis Barium Sulfate (BaSO ₄) 28.70% Lead Sulfate (PbSO ₄) 26.33% Lead Sulfite (PbSO ₃) 4.18% Lead Sulfid (PbS) 0.16% Lead Oxide (PbO) 26.68% Zinc Oxide (ZnO) 0.37% Lime (CaO) 0.44% Calcium Carbonate (CaCO ₃) 0.44% Iron Oxide 0.95% Magnesia Trace Carbon, Water, etc. 1.41% 95.66%	Standard Red Oxide	Patton Paint Co., Milwau- kee.	Same as for First Coat, Panel No. 29
42	Sept. 15 1914	No. 060 Red Lead	Patton Paint Co., Milwaukee, Wis	Pigment Analysis Red Lead (Pb ₃ O ₄) 62.3% Lead Oxide (PbO) 7.3% Lime (CaO) 2.7% Magnesia (MgO) 2.0%			Same as for First Coat.

43	Sept. 15 1914	Blue Sublimed Lead	Heath & Milligan Mfg. Co., Chicago	Silica (SiO ₂) 23.1% Iron Oxide small 97.4%	Standard Red Oxide	Patton Paint Co., Milwau- kee.	Same as for Panel No. 29
44	Sept. 15 1914	Natural Graphite Color A, Pure Blue Lead No. 1	U. S. Graphite Co. Saginaw, Mich.	Same as Second Coat, Panel No. 5			Same as for First Coat
45	Sept. 15 1914		Sherwin Williams Co. Chicago	Pigment 57.0% Vehicle 43.0% Lbs. pigment to 1 gal. Vehicle 10 Pigment Analysis Lead Sulfate (PbSO ₄) 48.7% Lead Sulfite (PbSO ₃) 12.9% Lead Sulfid (PbS) 1.2% Lead Oxide (PbO) 36.0% Zinc Oxide (ZnO) 1.6% Lime Oxide (CaO) 0.3% Insoluble 2.3% Loss on Ignition 1.9% 99.9%	Graphite No. 1	Iowa Paint Mfg. Co., Ft. Dodge, Iowa	Pigment 48% Vehicle 57% Lbs. pigment to 1 gal. Vehicle 5.8 Iodine No. of Vehicle 171 Water 0.25% Vol. Oils 2.0 % Pigment Analysis Ash 58.6% Carbon 37.2% Vol. Matter 4.2% 100.0%
46	Sept. 15 1914	Lincoln Liquid Red Lead	Lincoln Paint & Color Co., Lincoln, Nebr.	Same as for First Coat, Panel No. 25			Same as for First Coat
47	Sept. 15 1914	Sublime Blue Lead	Cheesman & Elliot New York	Pigment 48.4% Vehicle 51.6% Lbs. pigment to 1 gal. Vehicle 7.3 Iodine No. of Vehicle 140. Pigment Analysis Lead Sulfate (PbSO ₄) 24.0% Lead Sulfite (PbSO ₃) 6.5% Lead Sulfid (PbS) 1.7% Lead Oxide (PbO) 18.8% Zinc Oxide (ZnO) 0.1% Iron Oxide, etc. 0.8% Lime (CaO) 0.7% Magnesia (MgO) Trace Silica & Asbestine 49.7% Carbon & Vol. Matter 0.7% 100.0%	Pure Graphite	Cheesman & Elliot, New York	Pigment 46.5% Vehicle 53.5% Lbs. pigment to 1 gal. Vehicle 6.8 Iodine No. of Vehicle 164 Pigment Analysis Carbon 43.83% Silicates 58.32% Iron Oxide and Alumina... 2.29% Lime (CaO) 0.07% Magnesia 0.13% Water and Vol. Matter... 0.10% 99.74%
48	Sept. 15 1914	Inhibitive Red	Patton Paint Co., Milwaukee	Same as Second Coat, Panel No. 11			Same as for First Coat
49	Sept. 15 1914	Red Elastikote	Tropical Oil Co., Cleveland, Ohio	Same as First Coat, Panel No. 1			Same as for First Coat

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CHEMICAL ANALYSES OF PANEL PAINTS

Panel No.	Date Placed to Weather	FIRST COAT.			SECOND COAT		
		Paint	Manufacturer	Analysis	Paint	Manufacturer	Analysis
50	Sept. 15 1914	Dark Green Color "B"	U. S. Graphite Co., Saginaw, Mich.	Pigment 37.5% Vehicle 62.5% Lbs. pigment in 1 gal. Vehicle 47 Iodine No. of Vehicle 134 Pigment Analysis Carbon 62.66% Silica 13.10% Lead Chromate (PbCrO ₄) .. 21.18% Iron Oxide & Alumina 1.10% Lime (CaO)10% Magnesia (MgO) Trace Water & Vol. matter 06% ----- 98.20%			Same as for First Coat
51	Sept. 15 1914	"Dutch Boy" Red Lead Paste	National Lead Co., St. Louis, Mo.	Same as First Coat, Panel No. 40	Graphite No. 1	Iowa Paint Mfg. Co., Ft. Dodge, Iowa	Same as First Coat, Panel No. 38
52	Sept. 15 1914	Elastikote Stone	Tropical Oil Co., Cleveland, Ohio	Same as First Coat, Panel No. 21	Red Elastikote	Tropical Oil Co., Cleveland Ohio.	Same as First Coat, Panel No. 1
53	Sept. 15 1914	Derby Red	Dayton Color Works Co., Day- ton, Ohio	Certified Analysis Ferric Oxide (Fe ₂ O ₃) 6.1% Calcium Sulfate (CaSO ₄) 84.5% Silica and Silicates 5.1% Calcium Carbonate (CaCO ₃) .. 12.0% Linseed Oil 13.8% Resin Oil 11.1% Japan Dryer 14.9% ----- 100.0%			Same as for First Coat
54	Sept. 15 1914	Elastikote Outside White	Tropical Oil Co., Cleveland, Ohio	Same as First Coat, Panel No. 19			Same as for First Coat
55	Sept. 15 1914	Standard Barn Paint	Lowe Bros. Co., Dayton, Ohio	Ferric Oxide (Fe ₂ O ₃) 10.1% Calcium Sulfate (CaCO ₄) 18.8% Silica & Silicates 18.0% Calcium Carbonate 4.8% Linseed Oil 36.3% Japan Dryer 12.0% ----- 100.0%			Same as for First Coat

56	Sept. 15 1914	Red Lead	Alston Lucas Paint Co., Chicago	Red Lead (Pb3O4) 95.14% Lead Oxide (PbO) 3.47% 98.61%	Dixon's Silica Graphite	Same as First Coat, Panel No. 7
57	Sept. 15 1914	No. 060 Red Lead	Patton Paint Co., Milwaukee	Same as First Coat, Panel No. 42		Same as for First Coat
58	Sept. 15 1914	Elastikote Stone	Tropical Oil Co., Cleveland, Ohio	Same as First Coat, Panel No. 21		Same as for First Coat
59	Sept. 15 1914	Sublimed White Lead No. 2	Sherwin Williams Co., Chicago	Pigment 67.0% Vehicle 33.0% Lbs. pigment to 1 gal. Vehicle 24.0 Pigment Analysis Lead Sulfate (PbSO4) 72.8% Lead Oxide (PbO) 19.2% Zinc Oxide (ZnO) 6.7% Insoluble 0.7% Loss on Ignition 1.4% 100.8%		Same as for First Coat
60	Sept. 15 1914	Graphite No. 400	Minn. Linseed Oil Paint Co., Minneapolis, Minn.	Pigment 45.0% Vehicle 55.0% Lbs. pigment per 1 gal. Vehicle 6.3 Iodine No. of Vehicle 151 Pigment Analysis Carbon 79.88% Silica 15.27% Iron Oxide & Alumina 1.16% Lime (CaO) 2.12% Magnesia (MgO) 1.20% Water & Vol. matter06% 100.28%		Same as for First Coat
61	Sept. 15 1914	Sublimed Blue Lead	Otley Mfg. Co., Chicago	Pigment 36.7% Vehicle 63.3% Lbs. pigment to 1 gal. vehicle 4.5 Iodine No. of Vehicle 180 Pigment Analysis Lead Sulfate (PbSO4) 49.4% Lead Sulfide (PbSO3) 11.7% Lead Sulfid (PbS) 1.8% Lead Oxide (PbO) 34.6% Zinc Oxide (ZnO) 2.2% In soluble, carbon, etc. 1.7% 101.4%		Same as for First Coat

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CHEMICAL ANALYSES OF PANEL PAINTS

Panel No.	Date Placed to Weather	FIRST COAT.			SECOND COAT		
		Paint	Manufacturer	Analysis	Paint	Manufacturer	Analysis
62	Sept. 15 1914	Bronz Green Graphite No. 411	Great Western Paint Mfg. Co., Kansas City, Mo.	Pigment Vehicle 35.5% 64.5% Lbs. pigment per 1 gal. Vehicle 4.3 Iodine No. of Vehicle 159 Pigment Analysis Carbon 63.9% Insoluble 24.1% Iron Oxide 1.7% Calcium Carbonate 8.9% Calcium Sulfate 1.7% Lead Chromate small 100.3%	No. 435 Graphite	Great Western Paint Mfg. Co., Kansas City	Pigment Vehicle 44% 56% Lbs. pigment to 1 gal. Vehicle 6.1 Iodine No. of Vehicle 137 Pigment Analysis Carbon 64.44% Silica 21.77% Iron Oxide and Alumina 5.98% Lime (CaO) 6.05% Magnesia (MgO) 0.39% Water and Vol. Matter 0.14% 98.77%
63	Sept. 15 1914	Sublime White Lead	Cheesman & Elliott, New York	Pigment Vehicle 51.2% 48.8% Lbs. pigment to 1 gal. Vehicle 8.2 Iodine No. of Vehicle 161 Water Trace Pigment Analysis Lead Sulfate (PbSO ₄) 38.0% Lead Oxide (PbO) 8.6% Zinc Oxide (ZnO) 2.7% Iron Oxide (Fe ₂ O ₃) 1.3% Lime (CaO) Trace Magnesia (MgO) Trace Sulfur Dioxide (SO ₂)02% Water, Carbon Dioxide, etc. 2.08% Silicates 47.30% 100.00%	Same as for First Coat		Same as for First Coat
64	Sept. 15 1914	No. 435 Graphite	Great Western Paint Mfg. Co., Kansas City, Mo.	Same as Second Coat, Panel No. 62			Same as for First Coat
65	Nov. 13 1914	Transparent Acid Proof Coating	Glidden Varnish Co., Cleveland, Ohio	Iodine No. 96.3	Graphite Acid Proof Coating	Glidden Varnish Co., Cleveland, Ohio	Pigment Vehicle 44% 56% Lbs. pigment to 1 gal. Vehicle 6.1 Iodine No. of Vehicle 95 Pigment Analysis Carbon 47.08% Silica 48.77% Iron Oxide and Alumina... 2.33%

									Lime (CaO) Magnesia (MgO) Water and Vol. matter			
66	Nov. 13 1914	Red Oxide No. 501	Great Western Paint Co., Kansas City	Pigment Vehicle 42% Lbs. pigment per gal. Vehicle 58% 5.7 Iodine No. of Vehicle 138 Pigment Analysis Insoluble 11.0% Calcium Carbonate 62.5% Iron Oxide & Alumina 33.9% Magnesia Trace	Same as First Coat, Panel No. 65.				99.00%	Same as for First Coat		
67	Nov. 13 1914	Transparent Acid Proof Coating	Glidden Varnish Co., Cleveland, Ohio	Same as First Coat, Panel No. 65.						Same as for First Coat		
68	Nov. 13 1914	No. 435 Graphite	Great Western Paint Mfg. Co., Kansas City.	Same as Second Coat, Panel No. 62						Same as for First Coat		
69	Nov. 13 1914	Transparent Acid Proof Coating	Glidden Varnish Co., Cleveland, Ohio	Same as First Coat, Panel No. 65						Same as Second Coat, Panel No. 65		
70	Nov. 13 1914	Bronz Green Graphite No. 411	Great Western Paint Mfg. Co., Kansas City	Same as First Coat, Panel No. 62						Same as Second Coat, Panel No. 62		
71	Nov. 13 1914	French Gray Acid Proof	Glidden Varnish Co., Cleveland, Ohio	Pigment 48% Vehicle 52% Lbs. pigment per gal. Vehicle 7.2 Iodine No. Vehicle 120 Pigment Analysis Lead Sulfate (PbSO ₄) 19.5% Lead Sulfit (PbSO ₃)9% Lead Oxide (PbO) 3.5% Lead Sulfid (PbS) 0.2% Zinc Oxide (ZnO) 49.5% Iron Oxide (Fe ₂ O ₃) 2.5% Lime (CaO) 0.8% Magnesia (MgO) 1.2% Carbon Dioxide (CO ₂) 0.2% Carbon & Vol. matter 1.9% Insol. matter 18.2% 98.5%						Same as for First Coat		
72	Nov. 13 1914	Bronz Green Graphite No. 411	Great Western Paint Mfg. Co., Kansas City	Same as First Coat, Panel No. 62						Red Oxide No. 501	Great Western Paint Mfg. Co., Kansas City	Same as First Coat, Panel No. 66

TABLE I
CHEMICAL ANALYSES OF PANEL PAINTS

Panel No.	Date Placed to Weather	FIRST COAT.			SECOND COAT		
		Paint	Manufacturer	Analysis	Paint	Manufacturer	Analysis
73	Nov. 13 1914	French Gray Acid Proof Coating	Glidden Varnish Co., Cleveland, O.	Same as First Coat, Panel No. 71	Graphite Acid Proof Coating	Glidden Varnish Co., Cleveland, Ohio	Same as Second Coat, Panel No. 65
74	Nov. 13 1914	Red Oxide No. 501	Great Western Paint Mfg. Co., Kansas City	Same as First Coat, Panel No. 66	Bronz Green Graphite No. 411	Great Western Paint Co., Kansas City	Same as First Coat, Panel No. 62
75	Nov. 13 1914	White Guard Rail Paint	Glidden Varnish Co., Cleveland, Ohio	Pigment 60% Vehicle 40% Lbs pigment per gal. vehicle 5.2 Iodine No. of Vehicle 94 Pigment Analysis Lead Sulfate (PbSO ₄) 21.9% Lead Oxide (PbO) 5.1% Zinc Oxide (ZnO) 37.8% Iron Oxide (Fe ₂ O ₃) 0.3% Lime (CaO) 0.5% Magnesia (MgO) Trace Carbon dioxide 0.4% Insol. matter 32.0% 98.0%			Same as for First Coat
76	Nov. 13 1914	No. 435 Graphite	Great Western Paint Mfg. Co., Kansas City	Same as Second Coat, Panel No. 62	Red Oxide No. 501	Great Western Paint Mfg. Co., Kansas City	Same as First Coat, Panel No. 66
77	Nov. 13 1914	Transparent Acid Proof Coating	Glidden Varnish Co., Cleveland, Ohio	Same as First Coat, Panel No. 65			Same as for First Coat
78	Nov. 13 1914	Red Oxide No. 501	Great Western Paint Mfg. Co., Kansas City	Same as First Coat, Panel No. 66	No. 435 Graphite	Great Western Paint Mfg. Co., Kansas City	Same as Second Coat, Panel No. 62
79	Nov. 13 1914	French Gray Acid Proof Coating	Glidden Varnish Co., Cleveland, Ohio	Same as First Coat, Panel No. 71	Graphite Acid Proof Coating	Glidden Varnish Co., Cleveland, Ohio	Same as Second Coat, Panel No. 65
80	Nov. 13 1914	Graphite No. 400	Minn. Linseed Oil Paint Co., Minn.	Same as First Coat, Panel No. 60			Same as for First Coat
81	Dec. 22 1914	Nobrac	Patterson Sargent Co., Chicago, Ill.	Same as First Coat, Panel No. 2			Same as for First Coat

82	Dec. 22 1914	Ti-Ki Metal Coating Spec- ial Sublimed Blue Lead	Acme White Lead & Color Co.	Pigment 58% Vehicle 42% Lbs. pigment per gal. vehicle 10.8 Iodine No. Vehicle 135 Pigment Analysis Lead Sulfate (PbSO ₄) 44.1% Lead Sulfite (PbSO ₃) 2.1% Lead Sulfid (PbS) 0.4% Lead Oxide (PbO) 46.0% Zinc Oxide (ZnO) 1.8% Iron Oxide (Fe ₂ O ₃) 1.1% Lime (CaO) 1.2% Carbon dioxide (CO ₂) 1.5% Magnesia (MgO) Trace 98.2%	Same as for First Coat
83	Dec. 22 1914	Bronz Green Graphite No. 411	Great Western Paint Mfg. Co., Kansas City	Same as First Coat, Panel No. 62	Same as for First Coat
84	Dec. 22 1914	Ti-Ki Metal Coating Spec- ial Red Lead	Acme White Lead & Color Co., De- troit, Mich	Pigment 59% Vehicle 41% Lbs. pigment per gal. Vehicle 11.3 Iodine No. Vehicle 136 Pigment Analysis Red Lead (Pb ₃ O ₄) 46.0% Lead Oxide (PbO) 2.7% Zinc Oxide (ZnO) 1.1% Iron Oxide (Fe ₂ O ₃) 0.5% Lime (CaO) 0.2% Magnesia (MgO) 2.3% Insoluble 45.7% 98.5%	Same as for First Coat
85	Dec. 22 1914	Ti-Ki Metal Coating Spec- ial Sublimed White Lead	Acme White Lead & Color Co., De- troit, Mich.	Pigment 58% Vehicle 42% Lbs. pigment per gal. vehicle 10.8 Iodine No. of Vehicle 143 Pigment Analysis Lead Sulfate (PbSO ₄) 47.0% Lead Basic Carbonate 43.1% Zinc Oxide (ZnO) 8.3% Calcium Carbonate 0.5% Magnesia Trace Iron Oxide 0.3% 99.2%	Same as for First Coat
86	Dec. 22 1914	Graphite No. 400	Minn. Linseed Oil Paint Co., Minn.	Same as First Coat, Panel No. 60	Same as for First Coat

TABLE I
CHEMICAL ANALYSES OF PANEL PAINTS

Panel No.	Date Placed to Weather	FIRST COAT.			SECOND COAT		
		Paint	Manufacturer	Analysis	Paint	Manufacturer	Analysis
87	Dec. 22 1914	Ti-Ki Metal Coating Spec-ial Sublimed Blue Lead	Acme White Lead & Color Co., Detroit, Mich.	Same as First Coat, Panel No. 82	Graphite No. 400	Minn. Linseed Oil Paint Co., Minneapolis	Same as First Coat, Panel No. 60
88	Dec. 22 1914	Ti-Ki Metal Coating Spec-ial Red Lead	Acme White Lead & Color Co., Detroit, Mich.	Same as First Coat, Panel No. 84	Graphite No. 400	Minn. Linseed Oil Paint Co., Minneapolis	Same as First Coat, Panel No. 60
89	Dec. 22 1914	Ti-Ki Metal Coating Spec-ial Sublimed White Lead	Acme White Lead & Color Co., Detroit, Mich.	Same as First Coat, Panel No. 85	Graphite No. 400	Minn. Linseed Oil Paint Co., Minneapolis	Same as First Coat, Panel No. 60
90	Dec. 22 1914	Ti-Ki Metal Coating Spec-ial Sublimed Blue Lead	Acme White Lead & Color Co., Detroit, Mich.	Same as First Coat, Panel No. 82	No. 435 Graphite	Great Western Paint Mfg. Co., Kansas City	Same as Second Coat, Panel No. 62
91	Dec. 22 1914	Arctum-Maron	Atlantic Refining Co., Cleveland, Ohio	Pigment 12.0% Vehicle 88.0% Lbs. pigment per gal. vehicle 1.1 Iodine No. of heavy oil and linseed 89 Pigment Analysis Insoluble Matter 26.75% Iron Oxide and Alumina 55.01% Calcium Carbonate 17.00% 98.76%			Same as for First Coat
92	Dec. 22 1914	Iron Primer	C. R. Cook Paint Co., Kansas City	Same as First Coat, Panel No. 9	Arctum-Maron	Atlantic Refining Co., Cleveland, O	Same as First Coat, Panel No. 91
93	Dec. 22 1914	Red Paint	Glen Refining Co., Cleveland, Ohio	Pigment 52% Vehicle 48% Pigment Analysis Insoluble 8.68% Ferric Oxide (Fe ₂ O ₃) 10.72% Lime (CaO) 38.50% Magnesia (MgO) 0.95% Sulfur Trioxide (SO ₃) 18.10% Vol. matter 23.05% 100.00%			Same as for First Coat

94	Dec. 22 1914	Graphite	Otley Paint Mfg. Co., Chicago	Pigment Vehicle	19% 81%				Same as for First Coat
				Pigment Analysis Carbon 33.9% Lime (CaO) 2.1% Sulfur trioxide (SO ₃)3% Insoluble (Silica) 62.4% 98.7%					
95	Dec. 22 1914	Iron Primer	C. R. Cook Paint Co., Kansas City	Same as First Coat, Panel No. 9					Same as for First Coat
96	Dec. 22 1914	Gray No. 4690	Patton Paint Co., Milwaukee	Pigment Vehicle	22% 78%				
				Lbs. pigment per gal. vehicle 2.2 Pigment Analysis Lead Sulfate (PbSO ₄) 49.2% Lead Sulfite (PbSO ₃) 0.5% Lead Oxide (PbO) 9.8% Zinc Oxide (ZnO) 3.8% Ferric Oxide (Fe ₂ O ₃) 22.4% Alumina (Al ₂ O ₃) 1.9% Insoluble 8.5% Vol. and combustible matter.. 1.4% 97.5%					Same as for First Coat
97	Dec. 22 1914	Elastikote Outside White	Tropical Oil Co., Cleveland, Ohio.	Same as First Coat, Panel No. 19					Same as for First Coat
98	Dec. 22 1914	Elastikote Stone	Tropical Oil Co., Cleveland, Ohio.	Same as First Coat, Panel No. 21	Red Elastikote			Tropical Oil Co., Cleveland Ohio	Same as First Coat, Panel No. 1
99	Dec. 22 1914	Venetian Red		Same as First Coat, Panel No. 35					Same as for First Coat
100	Dec. 22 1914	Dutch Boy Red Lead Paste	National Lead Co., St. Louis, Mo.	Same as First Coat, Panel No. 51					Same as for First Coat
101	Dec. 22 1914	No. 2 Sublime Blue Lead	Platt & Thornburg	Same as First Coat, Panel No. 41	Standard Red Oxide			Patton Paint Co., Milwau- kee.	Same as First Coat, Panel No. 29
102	Dec. 22 1914	Arcoctum-Ma- roon	Atlantic Refining Co., Cleveland, O.	Same as First Coat, Panel No. 91					Same as for First Coat
103	Dec. 22 1914	Graphite No. 400	Minn. Linseed Oil Paint Co., Minn.	Same as First Coat, Panel No. 60					Same as for First Coat
104	Dec. 22 1914	Red Elastico	Tropical Oil Co., Cleveland, Ohio	Same as First Coat, Panel No. 1	Black Elastikote			Tropical Oil Co., Cleveland Ohio	Same as Second Coat, Panel No. 1
105	Dec. 22 1914	Iron Primer	C. R. Cook Paint Co., Kansas City	Same as First Coat, Panel No. 9	Special Graphite			C. R. Cook Paint Co., Kansas City	Same as Second Coat, Panel No. 3

TABLE I
CHEMICAL ANALYSES OF PANEL PAINTS

Panel No.	Date Placed to Weather	FIRST COAT.			SECOND COAT		
		Paint	Manufacturer	Analysis	Paint	Manufacturer	Analysis
106	Dec. 22 1914	Dixon's Silica Graphite		Same as First Coat, Panel No. 7		Same as for First Coat	
107	Dec. 22 1914	Ercnze Green No. 320	Lowe Bros. Co., Dayton, Ohio.	Same as Second Coat, Panel No. 10		Same as for First Coat	
108	Dec. 22 1914	Metalcoate	Lowe Bros. Co., Dayton, Ohio.	Same as First Coat, Panel No. 14		Same as for First Coat	
109	Dec. 22 1914	Elasticoate Stone	Tropical Oil Co., Cleveland, Ohio.	Same as First Coat, Panel No. 21	Red Elastikote	Same as First Coat, Panel No. 1	
110	Dec. 22 1914	No. 300 Red Lead	Atlas Oil Co., Omaha, Nebr.	Pigment Analysis Red Lead (Pb3O4) 35.10% Lead Oxide (PbO) 7.32% Lime (CaO) 28.34% Carbon dioxide 22.22% Insoluble matter 0.69% Organic Coloring matter 6.33% 100.00%			
111	Dec. 22 1914	Pure Blue Lead No. 1	Sherwin Williams Co., Chicago	Same as First Coat, Panel No. 45		Same as for First Coat	
112	Dec. 22 1914	Inhibitive Red	Fatton Paint Co., Milwaukee	Same as Second Coat, Panel No. 11		Same as for First Coat	
113	Dec. 22 1914	Transparent Acid Proof Coating	Glidden Varnish Co., Cleveland, Ohio	Same as First Coat, Panel No. 65		No Second Coat Applied	
114	Dec. 22 1914	Transparent Acid Proof Coating	Glidden Varnish Co., Cleveland, Ohio	Same as First Coat, Panel No. 65		Same as for First Coat	
115	Dec. 22 1914	"Dutch Boy" Red Lead Paste	National Lead Co., St. Louis	Same as First Coat, Panel No. 51	Transparent Acid Proof Coating	Same as First Coat, Panel No. 65	
116	Dec. 22 1914	"Dutch Boy" Red Lead Paste	National Lead Co., St. Louis	Same as First Coat, Panel No. 51	Transparent Acid Proof Coating	Same as First Coat, Panel No. 65	
117	Dec. 22 1914	Pure Raw Linseed Oil	E. H. Sargent & Co., Chicago	Specific Gravity @ 7029342 Iodine No. Jan. 1915 198 Iodine No. July, 1914 198		Same as for First Coat	
118	Dec. 22 1914	Pure Raw Linseed Oil	E. H. Sargent & Co., Chicago	Same as First Coat, Panel No. 117		Same as for First Coat	

119	Dec. 22 1914	Single Boiled Linsseed Oil	E. H. Sargent & Co., Chicago	Same as First Coat, Panel No. 117	Linsseed Oil Special Boiled	Same as for First Coat
120	Dec. 22 1914	Pure Raw Lin- seed Oil		Iodine No. 160 Manganese002%		No Second Coat Applied
121	Dec. 22 1914	Linsseed Oil Special Boiled		Same as Second Coat, Panel No. 120		No Second Coat Applied
122	Dec. 22 1914	Linsseed Oil Special Boiled		Same as Second Coat, Panel No. 120		No Second Coat Applied
123	Apr. 13 1915	Iron Primer	C. R. Cook Paint Co., Kansas City	Same as First Coat, Panel No. 9	Black Gilsomite	Pigment none Vehicle 100% Vol. hydrocarbons 49% Heavy hydrocarbons 51% Iodine No. of whole 57 Water none
124	Apr. 13 1915	Black Gilsomite	Standard Paint & Lead Works, Cleveland, Ohio	Same as Second Coat, Panel No. 123		Same as for First Coat
125	Apr. 13 1915	Gray Gilsomite	Standard Paint & Lead Works, Cleveland, Ohio	Pigment 37% Vehicle 63% Lbs. pigment per gal. Vehicle 4.6 Iodine No. of vehicle 169 Pigment Analysis Barium Carbonate (BaCO ₃) 2.2% Barium Sulfate (BaSO ₄) 6.4% Zinc Sulfid (ZnO) 7% Iron Oxide (FeO ₃) 0.9% Zinc Oxide (ZnO) 77.4% Calcium Carbonate (CaCO ₃) 0.7% Asphaltum Gum 11.6% 99.9%		Same as for First Coat
126	Apr. 13 1915	Red Gilsomite	Standard Paint & Lead Works Cleveland, Ohio	Pigment 49% Vehicle 51% Lbs. pigment per gal. vehicle 7.6 Iodine No. of vehicle 140 Pigment Analysis Insoluble 7.0% Iron Oxide 22.2% Calcium Sulfate 27.0% Calcium Carberate 42.6% 99.5%		Same as for First Coat

TABLE I
CHEMICAL ANALYSES OF PANEL PAINTS

No.	Weather Placed to Weather	FIRST COAT.			SECOND COAT.		
		Paint	Manufacturer	Analysis	Paint	Manufacturer	Analysis
127	Apr. 13 1915	White Bridge Paint	Standard Paint & Lead Works, Cleveland, Ohio	Pigment Vehicle Lbs. pigment per gal. vehicle Iodine No. of Vehicle Pigment Analysis Barium Sulfate (BaSO ₄) Zinc Sulfid (ZnS) Zinc Oxide (ZnO) Lead Sulfate (PbSO ₄) Iron Oxide (Fe ₂ O ₃) Calcium Carbonate (CaCO ₃)	57% 43% 10.5 134 28.0% 8.7% 3.5% 19.2% 0.8% 38.0%		Same as for First Coat
128	Apr. 13 1915	Tockolith (Gray)		99.2%			
129	June 24 1915	Structural Iron Coating		No Analysis (A coal tar paint)			Same as for First Coat
130	June 24 1915	Jap. Asphalt		A coal tar product.			Same as for First Coat
131	June 24 1915	Iron Primer	C. R. Cook Paint Co., Kansas City	Same as First Coat, Panel No. 9			Same as for First Coat
132	June 24 1915	Ebony Black		Asphaltic base			Same as for First Coat
133	June 24 1915	Sticketite		Coal tar paint			Same as for First Coat
134	June 24 1915		Hawkeye Oil Co., Waterloo & Mason City, Ia.	Pigment Vehicle Lbs. pigment to 1 gal. vehicle Iodine No. of vehicle Pigment Analysis Carbon Silicates Iron Oxide Lime Basic Lead Carbonate	11.8% 88.2% 1.0 92 73.8% 14.3% .8% .9% 10.3% 100.1%	Same as for First Coat	
135	June 24 1915	Silver Metallic	Atlas Oil Co., Omaha, Nebr.	Aluminum pigment			Same as for First Coat

136 A June 24 1915	Outside White O. W.	Uhlmann & Phil- pott Co., Cleveland, Ohio	Pigment Vehicle	70% 30%	Same as for First Coat	
			Lbs. pigment per gal. vehicle	18.2		
			Iodine No. of Vehicle	158		
			Pigment Analysis			
			Barium Sulfate (BaSO4)	34.0%		
			Basic Lead Carbonate	20.3%		
			Zinc Oxide (ZnO)	15.3%		
			Zinc Sulfid	12.8%		
			Ferric Oxide	12.5%		
			Calcium Carbonate	14.4%		
				97.3%		
136 B June 24 1915	O. W. C. Out- side White	Uhlmann & Phil- pott Co., Cleveland, Ohio	Pigment Vehicle	63% 37%	Same as for First Coat	
			Lbs. pigment to 1 gal. vehicle	13.3		
			Iodine No. of vehicle	120		
			Pigment Analysis			
			Barium Sulfate	40.0%		
			Zinc Oxide	17.8%		
			Calcium Carbonate	34.4%		
			Zinc Sulfid	4.6%		
			Ferric Oxide	0.6%		
				97.4%		

TABLE II
INSPECTION REPORT OF PAINT PANELS. MAY 25, 1917

Panel Number	Condition of Paint Film										Rating—Scale 10	Condition for Repainting	Remarks
	Discoloring	Spotting	Checking	Chalking	Peeling or Scaling	Alligatoring	Washing	Dirty	Rusting	Pitting			
1	yes	no	yes	yes	no	no	no	no	no	no	6	good	Should be repainted for appearance
2	no	no	yes	yes	no	no	no	no	no	no	10	good	Giving excellent protection
3	yes	no	yes	yes	no	no	yes	no	no	no	10	good	Undercoat showing
4	no	yes	no	no	no	no	no	no	no	yes	10	good	Should be watched for rusting underneath film
5	no	no	yes	no	no	no	no	no	no	no	9	good	In good general condition
6	no	no	no	no	no	no	no	no	no	no	10	good	Giving excellent protection
7	no	no	no	no	no	no	no	no	no	no	10	good	In excellent condition
8	yes	yes	yes	yes	no	no	no	no	no	no	10	good	Giving excellent protection
9	no	no	no	no	no	no	no	no	no	no	10	good	In excellent condition
10	yes	no	yes	no	no	no	no	no	no	no	10	good	Giving excellent protection
11	yes	yes	yes	yes	no	no	no	no	no	no	9	bad	Evidence of rusting underneath film
12	yes	yes	yes	no	no	no	no	no	no	no	8	good	Should be repainted at once
13	yes	no	yes	no	no	no	no	no	no	no	7	good	In fair general condition
14	yes	yes	no	yes	no	no	no	yes	no	no	8	good	Should be repainted at once
15	no	no	no	no	no	no	no	no	no	no	7	good	In excellent condition
16	yes	yes	yes	yes	no	no	no	no	no	no	10	good	Giving excellent protection
17	no	no	no	no	no	no	no	no	no	no	10	good	In excellent condition
18	yes	yes	yes	yes	no	no	no	yes	no	no	8	good	Should be repainted
19	yes	yes	yes	yes	no	no	no	yes	no	no	4	fair	Should be repainted at once
20	no	no	no	no	no	no	no	no	yes	yes	8	good	Should be repainted
21	no	no	no	no	no	no	no	no	yes	no	7	good	Undercoat showing. Should be painted
22	yes	yes	no	no	no	no	no	no	yes	yes	9	good	Should be repainted
23	yes	yes	yes	yes	no	no	no	no	yes	yes	0	bad	Must be scraped and repainted
24	yes	yes	yes	yes	no	no	no	no	yes	no	9	good	Should be repainted
25	yes	no	yes	yes	no	no	no	yes	no	no	10	good	Still giving good protection
26	yes	yes	no	no	no	no	no	no	yes	no	7	good	Should be repainted at once
27	yes	yes	yes	yes	yes	no	yes	yes	no	yes	3	fair	Should be repainted at once
28	yes	yes	yes	yes	yes	no	no	yes	no	yes	0	bad	Evidence of rust underneath film
29	yes	no	yes	no	no	no	no	yes	yes	no	2	poor	Evidence of rust underneath film
30	no	no	no	no	no	no	no	no	yes	no	10	good	Giving excellent protection
31	yes	yes	yes	yes	yes	no	yes	no	yes	yes	0	poor	Should be scraped and repainted
32	no	no	no	no	yes	no	yes	no	no	no	10	good	Giving poor protection
33	yes	yes	yes	yes	yes	yes	no	no	yes	yes	5	good	Should be repainted at once
34	yes	yes	yes	no	no	yes	no	no	yes	yes	0	bad	Failed in 6 mo. Must be burned, scraped and repainted
35	yes	yes	yes	no	no	no	no	no	no	no	7	fair	Evidence of rusting underneath film; must be closely watched
36	yes	yes	no	yes	no	no	no	no	yes	yes	5	fair	Should be watched for scraping and repainting

87	yes	yes	yes	yes	no	no	no	no	no	no	yes	no	8	good	Should be repainted
88	yes	no	no	no	no	no	no	no	no	no	yes	no	3	poor	Should be watched for scraping and repainting
89	yes	yes	yes	yes	no	no	no	no	no	no	no	no	10	good	In excellent condition
90	yes	yes	yes	yes	no	no	no	no	no	no	no	yes	6	good	Giving excellent protection
91	yes	yes	yes	yes	no	no	no	no	no	no	no	yes	10	good	Giving excellent protection
92	yes	yes	yes	yes	no	no	no	no	no	no	no	yes	6	good	Should be watched for rusting underneath film
93	yes	yes	yes	yes	no	no	no	no	no	no	no	yes	7	good	Should be scraped and repainted
94	yes	no	yes	yes	no	no	no	no	no	no	no	yes	0	bad	Still giving protection
95	no	no	yes	yes	no	no	no	no	no	no	no	yes	8	good	Should be watched for scraping and repainting
96	yes	yes	yes	yes	no	no	no	no	no	no	no	yes	10	good	Giving good protection
97	no	no	no	yes	no	no	no	no	no	no	no	no	10	good	Should be watched for rusting underneath film
98	yes	no	yes	no	no	no	no	no	no	no	no	no	10	good	Giving excellent protection
99	yes	yes	yes	yes	no	no	no	no	no	no	no	yes	7	fair	Should be repainted
50	no	no	no	no	no	no	no	no	no	no	no	no	10	good	Giving excellent protection
51	no	no	no	no	no	no	no	no	no	no	no	no	10	good	Undercoat showing; should be repainted
52	no	no	no	yes	no	yes	yes	yes	yes	yes	yes	yes	0	bad	Should have been scraped and repainted after one year of service
53	yes	yes	yes	yes	no	no	no	no	no	no	no	yes	7	fair	Should have been repainted after two years of service
54	yes	yes	yes	yes	no	no	no	no	no	no	no	yes	0	bad	Rusting underneath film; should be scraped and repainted
55	yes	yes	no	no	no	no	no	yes	no	no	no	yes	8	good	Should be watched for repainting
56	no	no	yes	no	yes	no	no	no	no	no	no	yes	8	good	Should be watched for repainting
57	yes	yes	yes	yes	no	no	no	no	no	no	no	yes	10	good	Giving good protection
58	yes	yes	yes	yes	yes	no	no	no	no	no	no	yes	7	good	Should be repainted
59	yes	yes	yes	yes	yes	no	no	no	no	no	no	yes	8	good	Should be repainted
60	yes	yes	no	no	no	no	no	no	no	no	no	yes	10	good	Giving good protection
61	yes	yes	yes	no	no	no	no	no	no	no	no	yes	3	bad	Rusting underneath film; should be scraped and repainted
62	no	no	yes	no	no	no	no	no	no	no	no	yes	10	good	Giving good protection
63	yes	no	yes	no	no	no	no	no	no	no	no	no	10	good	Giving excellent protection
64	no	no	yes	no	no	no	no	no	no	no	no	no	10	good	Giving good protection
65	no	no	yes	yes	no	no	no	no	no	no	no	no	10	good	Giving excellent protection
66	yes	yes	yes	yes	no	no	no	no	no	no	no	yes	2	bad	Must be scraped and repainted
67	yes	yes	yes	yes	no	no	no	no	no	no	no	yes	2	poor	Should have been repainted after two years' service
68	no	no	no	no	no	no	no	no	no	no	no	no	10	good	Giving excellent protection
69	no	no	yes	yes	no	no	no	no	no	no	no	no	10	good	Giving excellent protection
70	no	no	no	no	no	no	no	no	no	no	no	no	10	good	Giving excellent protection
71	yes	yes	yes	yes	no	no	no	no	no	no	no	yes	0	poor	Should be scraped and repainted; rusting underneath film
72	no	no	yes	no	no	no	no	no	no	no	no	yes	6	fair	Will soon require scraping and repainting
73	no	no	no	no	no	no	no	no	no	no	no	no	10	good	Giving excellent protection
74	yes	yes	yes	yes	no	no	no	no	no	no	no	yes	6	fair	Will soon require scraping and repainting
75	yes	yes	yes	yes	no	no	no	no	no	no	no	yes	6	fair	Should have been repainted after two years of service
76	yes	yes	yes	yes	no	no	no	no	no	no	no	yes	4	poor	Must be scraped and repainted
77	yes	yes	yes	yes	no	yes	no	no	no	no	no	yes	0	bad	Failed entirely
78	yes	no	yes	no	yes	no	no	no	no	no	no	yes	10	good	Giving excellent protection
79	no	no	no	yes	no	no	no	no	no	no	no	no	10	good	Giving excellent protection
80	no	no	yes	yes	no	no	yes	no	no	no	no	no	10	good	Wrinkled film makes a smooth job of repainting difficult
81	no	no	no	no	no	no	no	no	no	no	no	no	10	good	Giving excellent protection
82	yes	yes	no	no	no	no	no	no	no	yes	yes	yes	9	good	Giving excellent protection
83	yes	yes	yes	yes	no	no	no	no	no	yes	no	yes	2	bad	Difficult to repaint; must be scraped
84	yes	no	yes	yes	no	no	no	no	no	no	no	no	10	good	Giving excellent protection
85	yes	yes	yes	yes	no	no	no	no	no	no	no	yes	7	good	Should be repainted at once
86	no	no	no	no	no	no	no	no	no	no	no	no	10	good	Giving excellent protection
87	no	no	no	no	no	yes	no	no	no	no	no	no	10	good	Should be repainted for appearance only. Giving good protection.

TABLE II
INSPECTION REPORT OF PAINT PANELS. MAY 25, 1917

Panel Number	Condition of Paint Film										Condition of metal	Rating—Scale 10	Condition for Re-painting	Remarks
	Discoloring	Spotting	Checking	Chalking	Peeling or Sealing	Alligatoring	Washings	Dirty	Rusting	Pitting				
88	no	no	yes	yes	no	no	no	no	no	no	10	good	Giving excellent protection	
89	no	no	yes	no	no	no	no	no	no	no	10	good	Giving excellent protection	
90	no	no	es	no	no	no	no	no	no	no	10	good	Giving excellent protection	
91	yes	yes	yes	no	no	no	no	yes	no	no	3	bad	Must be scraped for repainting	
92	no	no	yes	no	no	yes	no	no	no	no	10	good	Giving excellent protection	
93	yes	no	yes	no	no	no	no	no	no	no	0	bad	Must be scraped for repainting	
94	no	no	yes	no	no	no	no	no	no	no	10	good	Giving excellent protection	
95	no	no	yes	no	no	no	no	no	no	no	10	good	Giving excellent protection	
96	es	yes	yes	no	no	no	no	no	no	no	10	good	Giving excellent protection	
97	es	yes	yes	no	no	no	no	no	no	no	7	good	Should be repainted	
98	no	no	no	no	no	no	no	no	no	no	10	good	Giving excellent protection	
99	yes	yes	yes	no	no	no	no	no	no	no	8	good	Should be watched for rusting underneath film	
100	yes	yes	yes	no	no	no	no	no	no	no	9	good	Giving good protection	
101	no	yes	no	yes	no	no	no	no	no	no	8	good	Should be watched for rusting underneath film	
102	es	yes	yes	no	no	no	no	no	no	no	7	poor	Must be scraped for repainting	
103	no	no	no	no	no	es	no	no	no	no	10	good	Giving excellent protection	
104	yes	yes	yes	no	no	no	no	no	no	no	8	good	Should be repainted for appearance only; giving good protection	
105	no	yes	no	no	no	no	no	no	no	no	10	good	Should be watched for rusting underneath film	
106	no	no	no	yes	no	no	no	no	no	no	10	good	Giving excellent protection	
107	no	no	no	yes	no	no	no	no	no	no	10	good	Giving excellent protection	
108	yes	yes	no	yes	no	no	no	no	no	yes	5	poor	Will soon require scraping and repainting	
109	no	no	no	yes	no	no	yes	no	no	no	10	good	Should be watched for repainting	
110	no	no	yes	yes	no	no	no	no	no	no	10	good	Giving excellent protection	
111	yes	yes	yes	no	no	no	yes	no	no	no	10	good	Should be repainted for appearance only; giving good protection	
112	yes	yes	yes	no	no	no	no	no	no	no	3	bad	Must be scraped and repainted	
113	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	0	bad	Failed entirely	
114	es	yes	yes	yes	yes	yes	yes	yes	yes	yes	0	bad	Failed entirely	
115	yes	no	yes	no	no	no	no	no	no	no	10	good	Giving excellent protection	
116	yes	no	yes	no	no	no	no	no	no	no	10	good	Giving excellent protection	
117	es	yes	yes	yes	no	no	no	no	no	no	10	good	Giving excellent protection	
118	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	0	bad	Failed completely	
119	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	0	bad	Failed completely	
120	yes	yes	no	yes	yes	yes	no	no	no	no	7	good	Giving good protection	
121	yes	yes	no	yes	no	no	no	no	no	yes	0	bad	Failed completely	

122	yes	no	no	no	no	no	no	no	no	yes	yes	2	bad	Must be scraped and repainted
123	no	yes	yes	no	no	no	no	no	no	no	good	9	good	Should be repainted
124	yes	yes	yes	no	no	no	no	no	no	yes	yes	0	bad	Must be scraped and repainted
125	yes	yes	no	no	yes	no	no	no	no	yes	no	0	bad	Must be scraped and repainted
126	yes	no	yes	no	no	no	no	no	no	yes	no	8	good	Should be watched for rusting underneath film
127	yes	yes	yes	no	no	no	no	no	no	yes	no	5	fair	Panel injured; not a fair test
128a	no	no	yes	no	no	no	no	no	no	no	no	10	good	Giving excellent protection
128b	yes	no	yes	no	no	no	no	no	no	no	no	10	good	Giving excellent protection
129	yes	yes	no	yes	yes	no	no	no	no	yes	yes	0	bad	Must be burned and scraped for painting
130	no	yes	no	yes	yes	no	no	no	no	yes	yes	0	bad	Must be burned and scraped for painting
131	yes	no	yes	no	yes	no	no	no	no	yes	yes	8	good	Should be repainted at once
132	no	yes	no	yes	yes	no	no	no	no	yes	yes	0	bad	Must be thoroughly scraped for repainting
133	yes	yes	no	yes	yes	no	no	no	no	yes	yes	0	bad	Must be burned and scraped for repainting
134	no	no	yes	no	yes	yes	no	no	no	yes	yes	6	fair	Must be watched for scraping and repainting
135	yes	no	yes	no	no	no	no	no	no	yes	yes	0	bad	Must be scraped and repainted
136a	yes	yes	yes	no	no	no	no	no	no	yes	no	8	good	Should be repainted at once
136b	yes	yes	yes	yes	no	no	no	no	no	yes	no	4	poor	Should have been repainted after two years of service

TABLE III
INSPECTION REPORT OF PAINT PANELS. MAY, 1918

Panel Number	Condition of Paint Film										Condition of metal	Rating—Scale 10	Condition for Re-painting	Remarks
	Discoloring	Spotting	Checking	Chalking	Peeling or Scaling	Alligatoring	Washing	Dirty	Rusting	Pitting				
1	yes	yes	yes	yes	no	no	no	no	no	no	no	8	good	Still giving protection
2	no	no	no	no	no	no	no	no	no	no	no	7	poor	Beginning to rust underneath film
3	no	no	no	no	no	no	no	no	no	no	no	10	good	Still giving good protection
4	no	no	no	no	no	no	no	no	no	no	no	7	poor	Beginning to rust underneath film
5	no	no	no	no	no	no	no	no	no	no	no	10	good	Still giving good protection
6	no	no	no	no	no	no	no	no	no	no	no	8	good	Still giving good protection, but three small rust spots showing
7	no	no	no	no	no	no	no	no	no	no	no	9	poor	Rust developing rapidly underneath film where panel has been slightly scratched
8	yes	yes	yes	yes	no	no	no	no	no	no	no	10	good	Still giving good protection
9	no	no	no	no	no	no	no	no	no	no	no	9	poor	Rust just beginning to develop underneath film
10	no	no	no	no	no	no	no	no	no	no	no	10	good	Giving excellent protection. Undercoat showing some
11	no	no	yes	no	no	no	no	no	no	no	no	6	poor	Beginning to rust badly
12	yes	yes	no	yes	no	no	no	no	no	no	no	6	poor	Rusting underneath film
13	no	no	no	yes	no	no	no	no	no	no	no	7	fair	Indication of rusting underneath film
14	yes	no	no	yes	no	no	no	no	no	no	no	4	bad	Rusting underneath film. Must be scraped for repainting
15	no	no	no	yes	no	no	no	no	no	no	no	10	good	Giving good protection
16	yes	no	yes	yes	no	no	no	no	no	no	no	10	good	Giving good protection
17	no	no	no	yes	no	no	no	no	no	no	no	10	good	Giving good protection
18	no	yes	yes	yes	no	no	no	no	no	no	no	8	good	Should be repainted
19	yes	yes	yes	yes	no	no	no	no	no	no	no	6	fair	Should be repainted
20	yes	yes	no	yes	no	no	no	no	no	no	no	6	fair	Should be repainted
21	yes	no	no	yes	no	no	no	no	no	no	no	6	fair	Should be repainted
22	yes	no	no	no	no	no	no	no	no	no	no	7	good	Should be repainted
23	yes	yes	no	yes	no	no	no	no	no	no	no	3	bad	Must be scraped for repainting
24	yes	yes	yes	yes	no	no	no	no	no	no	no	7	good	Must be repainted
25	yes	yes	yes	yes	no	no	no	no	no	no	no	9	good	Giving good protection
26	yes	yes	yes	yes	no	no	no	no	no	no	yes	5	poor	Rusting underneath film—must be scraped for repainting
27	yes	yes	yes	yes	no	no	no	no	no	no	no	3	bad	Should have been repainted after two years' service
28	yes	yes	yes	yes	yes	no	no	no	no	no	no	0	bad	Failed entirely
29	yes	yes	no	yes	no	no	no	no	no	no	no	10	good	Still giving good protection
30	no	no	no	no	no	no	no	no	no	no	no	10	good	Still giving good protection
31	yes	yes	no	yes	no	no	no	no	no	no	yes	4	bad	Must be scraped for repainting
32	yes	yes	yes	yes	no	no	no	no	no	no	no	6	fair	Must be repainted
33	yes	yes	yes	yes	no	no	no	no	no	no	no	7	good	Must be repainted
34	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	0	bad	Failed entirely in six months
35	yes	yes	no	no	no	no	no	no	no	no	no	10	good	Giving good protection, but should be watched for rusting underneath film
36	yes	yes	no	yes	no	no	no	no	no	no	no	6	poor	Rusting underneath film. Must be scraped for repainting

TABLE III
INSPECTION REPORT OF PAINT PANELS, MAY, 1918

Panel Number	Condition of Paint Film										Condition for Re-painting	Remarks
	Discoloring	Spotting	Checking	Chalking	Peeling or Scaling	Alligatoring	Washing	Dirty	Rusting	Pitting		
88	no	no	no	no	no	no	no	no	no	no	10	Still giving good protection
89	no	no	no	no	no	no	no	no	no	no	10	Still giving good protection
90	no	no	no	no	no	no	no	no	no	no	10	Still giving good protection
91	yes	no	yes	yes	no	no	no	no	yes	no	9	Should be repainted
92	yes	no	yes	yes	no	no	no	no	no	no	10	Still giving good protection
93	yes	yes	no	yes	no	no	yes	no	yes	no	4	Repainting might save it
94	no	no	no	yes	no	no	no	no	no	no	10	Still giving good protection
95	yes	no	no	no	no	no	no	no	no	no	10	Still giving good protection
96	yes	no	no	yes	no	no	no	no	yes	no	9	Should be repainted
97	yes	yes	yes	yes	no	no	no	no	yes	no	7	Should be repainted
98	yes	no	no	yes	no	no	no	no	yes	no	9	Should be repainted
99	yes	no	yes	yes	no	no	no	no	yes	no	9	Rusting underneath film
100	yes	no	yes	yes	no	no	no	no	yes	no	poor	Still giving good protection
101	yes	yes	yes	yes	no	no	no	no	no	no	10	Indication of rusting underneath film
102	yes	yes	yes	yes	no	no	no	no	no	no	9	Very brittle film. Must be scraped for repainting
103	no	no	yes	yes	no	no	no	no	yes	no	8	Must be repainted
104	yes	no	yes	yes	no	no	no	no	no	no	8	Brittle film. Still protecting.
105	no	no	no	no	no	no	no	no	no	no	10	Still giving good protection
106	no	no	no	no	no	no	no	no	no	no	9	Still giving good protection
107	yes	no	no	no	no	no	no	no	yes	no	7	Should be repainted
108	no	yes	yes	yes	no	no	no	no	yes	no	6	Should be repainted
109	yes	no	yes	yes	no	no	no	no	yes	no	8	Should be repainted
110	yes	yes	yes	yes	no	no	no	no	yes	no	8	Should be repainted
111	yes	yes	yes	yes	no	no	no	no	yes	no	8	Should be repainted
112	yes	yes	yes	yes	no	no	no	no	yes	no	8	Should be repainted
113	yes	yes	no	no	no	no	no	no	yes	no	5	Must be scraped for repainting
114											0	Failed completely
115											0	Failed completely
116											0	Failed completely
117											0	Failed completely
118											0	Failed completely
119											0	Failed completely
120	yes	yes	yes	no	yes	no	no	no	yes	no	5	Must be repainted
121											5	Failed completely
122											0	Failed completely
123	no	no	yes	no	no	no	no	no	no	no	0	Failed completely
124	no	yes	yes	no	yes	no	no	no	yes	no	10	Brittle film. Should be repainted
125	yes	yes	yes	no	no	yes	no	yes	yes	no	0	Must be scraped for repainting
											3	Brittle film. Must be repainted

126	no	yes	no	yes	no	no	yes	yes	no	5	fair	Must be repainted
127	Panel	injured	omitted	from test	no	no	no	no	no	10	good	Still giving good protection
128a	no	no	no	no	no	no	yes	no	no	10	good	Still giving good protection
128b	no	no	yes	no	yes	yes	yes	yes	no	0	bad	Failed completely
129	no	no	yes	yes	yes	yes	yes	yes	0	bad	Failed completely	
130	no	yes	no	no	no	no	no	yes	5	fair	Must be repainted	
131	no	yes	yes	no	no	no	no	yes	0	bad	Failed completely	
132								yes	0	bad	Failed completely	
133						yes		yes	9	good	Must be watched for repainting	
134	no	no	no	no	no	no	no	yes	0	bad	Must be scraped and repainted	
135	no	yes	yes	no	yes	no	no	yes	0	bad	Should be repainted	
136a	yes	yes	yes	no	no	no	no	yes	8	good		
136b	yes	yes	yes	yes	no	no	no	yes	4	fair	Should have been repainted after one year's service	

TABLE IV
INSPECTION REPORT OF PAINT PANELS. MAY 22, 1919

Panel Number	Condition of Paint Film							Condition of Metal	Ratings—Scale 10	Condition for Re-painting	Remarks
	Discoloring	Spotting	Checking	Chalking	Peeling or Scaling	Alligatoring	Washing				
1	yes	no	no	no	no	no	no	no	10	good	Giving good protection
2	no	no	no	no	no	no	no	no	7	poor	Rusting under film
3	no	no	no	no	no	no	no	no	9	good	Few rust spots showing
4	no	no	no	no	no	no	no	no	8	poor	Rusting slightly
5	yes	yes	no	no	no	no	no	yes	8	fair	Rusting slightly
6	no	no	no	no	no	no	no	yes	7	poor	Several rust spots showing
7	no	no	no	no	no	no	no	yes	7	poor	Rusting where scratched
8	yes	yes	no	yes	yes	no	no	yes	8	poor	Second coat must be removed
9	no	no	no	no	no	no	no	no	10	good	Giving good protection
10	no	no	no	no	no	no	no	no	6	good	Should be repainted
11	yes	yes	yes	no	no	no	no	no	6	good	Poor appearance
12	no	yes	no	yes	no	no	no	yes	5	poor	Must be scraped before repainting
13	no	no	no	no	no	no	no	yes	8	good	Should be repainted
14	yes	yes	no	yes	no	no	no	no	4	poor	Must be scraped
15	no	no	no	no	no	no	no	no	10	good	In good condition
16	yes	no	yes	yes	no	no	no	no	8	good	Must be repainted
17	no	no	no	no	no	no	no	yes	8	good	Beginning to rust under film
18	yes	yes	yes	yes	yes	no	no	yes	3	poor	Must be scraped
19	yes	yes	yes	yes	yes	no	no	yes	4	fair	Should be painted
20	no	no	no	no	no	no	no	yes	6	fair	Should be repainted
21	no	no	no	no	no	no	no	yes	7	good	Should be repainted
22	yes	yes	yes	yes	no	no	no	yes	8	good	Should be repainted
23	yes	yes	yes	yes	no	no	no	no	0	bad	Must be scraped
24	yes	yes	yes	yes	no	no	no	yes	5	fair	Should be repainted
25	yes	yes	yes	yes	no	no	no	yes	7	good	Should be repainted
26	yes	yes	yes	yes	no	no	no	no	5	poor	Must be scraped before repainting
27	yes	yes	yes	yes	no	no	no	yes	3	poor	Must be scraped before repainting
28	yes	yes	yes	yes	yes	no	no	yes	2	poor	No paint remaining
29	yes	yes	no	no	no	no	no	yes	2	poor	Rusting beneath film
30	no	no	no	no	no	no	no	no	10	good	Giving good protection
31	yes	no	no	no	no	no	no	no	0	poor	Must be scraped
32	no	no	yes	no	yes	no	no	yes	9	good	Beginning to rust
33	yes	yes	yes	yes	no	no	no	yes	2	poor	Must be scraped and repainted
34	yes	yes	yes	yes	no	no	no	yes	0	poor	Failed entirely
35	yes	yes	no	no	no	no	no	no	7	fair	Rusting in spots

36	no	yes	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	6	poor	Rusting beneath film
37	yes	yes	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	0	bad	Should be scraped
38	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	8	fair	Rusting in spots
39	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	9	good	Giving good protection
40	yes	yes	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	9	good	Should be repainted
41	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	3	poor	Rusting in spots
42	yes	yes	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	9	good	Should be repainted
43	no	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	8	good	Giving fair protection
44	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	4	bad	Must be scraped before repainting
45	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	4	poor	Must be scraped before repainting
46	yes	yes	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	4	poor	Must be repainted
47	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	7	fair	Must be repainted
48	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	10	good	Giving good protection
49	yes	yes	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	7	good	Should be repainted
50	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	5	poor	Must be repainted
51	no	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	9	good	Giving good protection
52	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	9	good	Rusting in a few spots
53	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	0	bad	Failed
54	yes	yes	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	3	bad	Must be scraped
55	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	0	bad	Rusting under film
56	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	9	good	Rusting where scratched
57	yes	yes	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	10	good	Giving good protection
58	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	4	poor	Must be scraped
59	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	1	poor	Must be scraped
60	no	no	yes	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	7	fair	Rusting between films
61	yes	no	yes	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	0	bad	Failed
62	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	7	fair	Should be repainted
63	no	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	3	poor	Should be scraped and repainted
64	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	7	fair	Rusting in spots
65	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	0	bad	Rusting beneath film
66	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	9	good	Still giving protection
67	yes	no	yes	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	4	bad	Must be scraped
68	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	9	good	Giving protection
69	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	5	poor	Must be scraped
70	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	9	good	Giving good protection
71	yes	yes	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	0	poor	Must be scraped
72	yes	yes	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	8	good	Should be repainted
73	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	10	good	Giving good protection
74	yes	yes	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	4	poor	Should be scraped
75	yes	yes	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	3	poor	Must be scraped
76	yes	yes	no	no	no	no	no	no	no	no	no	yes	yes	yes	yes	yes	no	1	poor	Should be scraped
77	yes	yes	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	0	bad	Must be scraped
78	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	3	poor	Rusting Beneath film
79	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	10	good	Giving excellent protection
80	yes	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	2	poor	Must be scraped
81	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	9	good	Giving good protection
82	yes	yes	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	0	good	Rusting slightly
83	yes	yes	yes	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	0	bad	Must be scraped
84	yes	yes	yes	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	7	fair	Beginning to rust
85	yes	yes	yes	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	3	poor	Rusting badly
86	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	7	fair	Rusting in spots

TABLE IV
INSPECTION REPORT OF PAINT PANELS. MAY 22, 1919

Panel Number	Condition of Paint Film										Condition of metal	Rating—Scale 10	Condition for Re-painting	Remarks
	Discoloring	Spotting	Checking	Chalking	Peeling or Scaling	Alligatoring	Washing	Dirty	Rusting	Pitting				
87	no	no	no	no	no	no	no	no	no	no	no	6	good	Beginning to rust
88	no	no	no	no	no	no	no	no	no	no	no	10	good	Giving fine protection
89	no	no	no	no	no	no	no	no	no	no	no	9	good	Beginning to rust
90	no	no	no	no	no	no	no	no	no	no	no	10	good	Giving fine protection
91	yes	yes	no	no	no	no	no	no	no	no	no	1	bad	Rusting beneath film
92	yes	no	no	yes	no	no	no	no	no	no	no	10	good	Giving good protection
93	yes	yes	no	no	no	no	no	no	no	no	no	0	bad	Must be scraped
94	no	no	no	no	no	no	no	no	no	no	no	9	good	Beginning to rust in spots
95	no	no	no	no	no	no	no	no	no	no	no	10	good	Giving good protection
96	yes	yes	yes	yes	no	no	no	no	no	no	no	9	good	Should be repainted
97	yes	yes	yes	yes	no	no	no	no	no	no	no	4	fair	Should be repainted
98	no	no	no	no	no	no	no	no	no	no	no	10	good	Still giving good protection
99	no	no	no	no	no	no	no	no	no	no	no	8	good	Still giving good protection
100	yes	no	yes	no	no	no	no	no	no	no	no	10	good	Still giving protection
101	no	no	no	no	no	no	no	no	no	no	no	8	good	Still giving protection
102	yes	yes	yes	no	no	no	no	no	no	no	yes	4	poor	Must be scraped
103	no	no	no	no	no	no	no	no	no	no	no	8	fair	Giving fair protection
104	yes	yes	yes	no	no	no	no	no	no	no	no	8	fair	Still protecting
105	no	no	no	no	no	no	no	no	no	no	no	10	good	Giving fine protection
106	no	no	no	no	no	no	no	no	no	no	no	9	good	Rusting in a few spots
107	no	no	no	no	no	no	no	no	no	no	no	10	good	Giving fine protection
108	no	no	no	no	no	no	no	no	no	no	no	9	good	Giving good protection
109	no	no	no	no	no	no	no	no	no	no	no	9	good	Giving good protection
110	yes	yes	yes	yes	no	no	no	no	no	no	no	3	poor	Beginning to rust
111	yes	yes	yes	yes	no	no	no	no	no	no	no	3	poor	Must be scraped
112	yes	yes	no	no	no	no	no	no	no	no	no	2	poor	Must be scraped
113												0		Failed entirely
114														
115														
116														
116x														Panel lost
117												0		Failed completely
118												0		Failed completely
119												0		Failed completely
120												0		Failed completely

121	no	yes	yes	no	yes	no	no	no	no	no	0	Failed completely
122	yes	yes	yes	no	no	no	no	no	no	8	good	Failed completely
123	no	no	no	no	no	no	no	no	no	0		Should be repainted
124	yes	yes	yes	no	no	no	no	no	no	0		Failed completely
125	no	no	no	no	no	no	no	no	no	0	poor	Should be scraped and repainted
126	no	no	no	no	no	no	no	no	no	4		Rusting under film
127	yes	yes	yes	no	yes	no	no	no	no	0	bad	Should be repainted at once
128a	no	yes	no	no	no	no	no	no	no	10	good	Giving good protection
128b	yes	no	no	no	no	no	no	no	no	10	good	Giving good protection
129	yes	yes	yes	no	yes	yes	no	no	yes	0	bad	Failed completely
130	yes	yes	yes	yes	yes	yes	yes	yes	yes	0	bad	Failed
131	yes	yes	yes	yes	yes	yes	yes	yes	yes	0	bad	Must be scraped
132	yes	yes	yes	no	yes	no	no	no	yes	0	bad	Failed completely
133	yes	yes	yes	no	yes	no	no	no	yes	0	bad	Failed completely
134	no	yes	no	no	no	no	no	no	yes	3	poor	Rusting under film
135	yes	yes	yes	yes	yes	no	yes	yes	yes	0	bad	Failed
136a	yes	yes	yes	yes	no	no	no	no	no	2	poor	Must be scraped
136b	yes	yes	yes	yes	no	no	yes	no	yes	0	bad	Must be scraped

APPENDIX I

Standard Paints for Highway Bridges

(Revised to July 1, 1918)

The following paints have been analyzed in the laboratories of the Iowa State Highway Commission and found to conform to the revised paint specifications for 1917. This list is given only as a guide to buyers and the Highway Commission reserves the right to reject any of these paints which are found, at any time, to fail to fulfill the requirements of the specifications.

FIELD COATS

- Acme White Lead and Color Co., Detroit, Mich.
 "Ti Ki Metal Coating" Special Sublimed White Lead.
 "Ti Ki Metal Coating" Special Sublimed Blue Lead.
- Akron Milling, Mining & Manufacturing Co. Akron, Ohio
 "Sublimed Blue Lead."
- The Arco Company.....Cleveland, Ohio
 "White," (Lead Sulfate.)
- C. R. Cook Paint Company..Kansas City, Mo.
 "Graphite Field Coat,"
 "Carbon Black Field Coat,"
 "Graphite Primer,"
 "Lead Sulfate Primer,"
 "Pure Sublimed Lead Blue Primer,"
 "Iron Oxide Primer,"
 "Iron Oxide Field Coat,"
 "White Sublimed Lead,"
 "White Sublimed Lead,"
 "Red Lead."
- The Colorcraft Co.....Columbus, Ohio
 "Red Specification Bridge Paint."
- Detroit White Lead Works....Detroit, Mich.
 "Outside White," (Lead Sulfate.)
 "No. 7, Natural Graphite"
- Foreman Ford Co.....Minneapolis, Minn.
 "Pure Graphite in Liquid Form."
- The Glidden Varnish Co.....Cleveland, Ohio
 "French Gray Acid Proof Coating."
- The Goheen Manufacturing Co..Canton, Ohio
 "Carbonizing Coating."
- The Hawkeye Oil Co.....
 Waterloo and Mason City, Ia.
 "Faultless Graphite No. 26."
- Heath & Milligan Manufacturing Co.....
 Chicago, Ill.
 "Blue Sublimed Lead,"
 "Sublimed White Lead."
- Lowe Bros. Co.....Dayton, Ohio
 "White No. 328," (For wood work only.)
 "Standard Metallic Red No. 6365,"
 "Metalcote,"
 "Bronze Green No. 320."
- Leader Oil Co.....Dubuque, Iowa
 "Structural White No. 801,"
 "Oxide Bridge No. 800."
- Minneapolis Linseed Oil Paint Co.....
 Minneapolis, Minn.
 "Graphite No. 400,"
 "Sublimed White Lead."
- National Lead Co.St. Louis, Mo.
 "Dutch Boy," Red Lead Paste.
- Nubian Paint & Varnish Co....Chicago, Ill.
 "Graphite No. 26."
- Otley Paint Manufacturing Co..Chicago, Ill.
 "No. 511 Sublimed Blue Lead,"
 "No. 512 Sublimed Lead."
- Patterson Sargent Co.....Chicago, Ill.
 "B. P. S. Red Lead Compound,"
 "Nobrac,"
 "B. P. S. Bridge White No. 218," (For wood work only.)
- Patton Paint Co.....Milwaukee, Wis.
 "No. 060 Red Lead,"
 "Sublimed Blue Lead Paint No. 5085,"
 "Standard Red Oxide,"
 "Inhibitive Red,"
 "Grey Inhibitive No. 4690."
- Sherwin Williams Co.....Chicago, Ill.
 "Pure Blue Lead No. 1,"
 "White Lead Sulfate,"
 "Red Lead No. 3,"
 "Sublimed White Lead No. 2,"
 "Gloss White," (For outside use.)
- Standard Glass & Paint Co..Des Moines, Ia.
 "Graphite and Basic Lead Chromate,"
 "Pure Graphite Field Coat."
- Tropical Oil Co.....Cleveland, Ohio
 "Graphite No. 68,"
 "Elastikote Outside White,"
 "Iron Oxide,"
 "Graphite."
- U. S. Graphite Co.....Saginaw, Mich.
 "Dark Green Color B,"
 "Natural Graphite Color A,"
 "Mexican Graphite Color E," (Liquid.)
- Vaughn Paint Co.....Cleveland, Ohio
 "Pilgrim Electrolytic Graphite,"
 "Blue Lead,"
 "Sublimed Blue Lead No. 57."
- Detroit Graphite Co.....Chicago, Ill.
 "Sublimed White Lead,"
 "Sublimed Blue Lead,"
 "Iron Oxide,"
 "Graphite,"
 "Red Lead."
- Diamond Red Paint Co.....Chicago, Ill.
 "No. 1024 Graphite,"
 "No. 1023 Graphite,"
 "No. 1022 Sublimed Blue Lead,"
 "No. 1021 Sublimed Blue,"
 "No. 1020 Lead Sulphate and Zinc Oxide,"
 "No. 1019 Iron Oxide."
- Elberson Paint Co.
 "Sublimed Blue Lead."

SHOP COATS

- Acme White Lead and Color Co..Detroit, Mich.
 "Ti Ki Metal Coating," Special Sublimed White Lead.
- "Ti Ki Metal Coating," Special Sublimed Blue Lead.

Alston Lucas Paint Co.....Chicago, Ill.	National Lead Co.....St. Louis, Mo.
"Red Lead."	"Dutch Boy," Red Lead Paste.
Akron Milling, Mining & Manufacturing Co.	Sherwin Williams Co.....Chicago, Ill.
"Sublimed Blue Lead." Akron, Ohio	"Sublimed White Lead No. 2,"
C. R. Cook Paint Co.....Kansas City, Mo.	"Pure Blue Lead No. 1,"
"Red Lead Primer,"	"White Lead Sulfate,"
"Iron Oxide Primer,"	"No. 202 Dry Red Lead,"
"Pure Sublimed Lead Blue Primer,"	"Lastico Red Lead"
"Graphite Primer,"	"Sublimed White Lead No. 2."
"Lead Sulfate Primer,"	Standard Glass & Paint Co..Des Moines Ia.
"Iron Oxide,"	"Graphite and Basic Lead Chromate."
"Graphite,"	U. S. Graphite Co.....Saginaw Mich.
"Pure Sublimed Blue Lead,"	"Dark Green Color B."
"Pure Sublimed White Lead,"	Detroit Graphite Co.....Chicago, Ill.
"Pure Red Lead."	"Sublimed Blue Lead,"
Detroit White Lead Works....Detroit, Mich.	"Sublimed White Lead."
"New Process Red Lead."	Lowe Bros Co.....Dayton, Ohio
Heath & Milligan Manufacturing Co.....	"Bronze Green No. 320."
Chicago, Ill.	The Tropical Paint & Oil Co.....
"Red Lead."	Cleveland, Ohio
"Blue Sublimed Lead."	"Iron Oxide No. 5,"
"Sublimed White Lead."	"Graphite No. 6."
Minnesota Linseed Oil Paint Co.	Diamond Red Paint Co.....Chicago, Ill.
Minneapolis, Minn.	"No. 1023 Graphite,"
"Sublimed White Lead."	"No. 1022 Sublimed Blue Lead."

APPENDIX II

Standard Specifications for Highway Bridge Paints

IOWA STATE HIGHWAY COMMISSION

Two classes of paint are considered in these specifications; Shop Coat and Field Coat. One shop or prime coat and one field coat of paint shall be applied in conformity with the following requirements:

Metal Must Be Clean Before Shop Coat is Put On.—All metal work (including railings) shall be cleaned from all rust, scale, dirt or grease before the shop coat of paint is applied. If rust, which in the opinion of the inspector cannot be removed is found on any piece, that piece shall be rejected. All parts which come in contact shall be painted before they are riveted together. After assembling and riveting, the metal work thoroughly clean and dry, and before leaving the shop, shall be painted carefully with one coat of one of the hereinafter specified prime coat paints. Parts not accessible after erection shall be painted two coats. While metal work is being erected in place all abraisions of the original paint and all rivet and bolt heads and location marks must be cleaned and painted, preparatory to the second coat.

Protecting Machined Surfaces.—Machined surfaces shall be coated with white lead and tallow before shipment or before being placed in the open.

Paint for Shop Coat.—The pigment of the paint to be used as the shop or prime coat shall be one of the following according to the final tint or color required by the engineer.

1. Pure Red Lead.
2. Pure Sublimed Blue Lead.
3. Pure Sublimated Sulfate of Lead.
4. Basic Lead or Zinc Chromate.
5. Pure Iron Oxide mixed with not less than 10% Basic Lead or Zinc Chromate.
6. Pure Natural Graphite mixed with not less than 20% Basic Lead or Zinc Chromate.

The word "pure" in the above shall be interpreted as meaning without the addition of any substances foreign to the various pigments such as silica, silicates, and other inert materials or impurities.

No shop painting shall be done in wet or freezing weather unless such painting is done under cover where the conditions are such that no moisture will condense on the surface of the steel and where the temperature of the atmosphere will be above 45 degrees for at least 10 hours per day.

One Coat of Field Paint After Erection.—After the structure is complete in place, touched up as described above and cleaned of dirt, grease, or oil that may have accumulated during erection, one coat of one of the hereinafter specified field coat paints shall be applied to all accessible parts.

No field painting shall be done in wet weather or when the temperature of the atmosphere is not above 45 degrees F. for at least 10 hours per day.

Paints for Field Coat.—The paints for field coats shall contain any of the following pigments:

1. Red Lead.
2. Sublimed Blue Lead.
3. Sublimed Sulfate of Lead.
4. Iron Oxide.
5. Pure Graphite (natural).
6. Pure Carbon.

Pigments other than graphite or carbon may contain not more than 25% of inert material such as silica, china clay, or asbestos.

Lampblack, Prussian Blue and Chrome Yellow shall be used for obtaining the proper tints.

The pigment of graphite or carbon paints shall not contain less than 70% total graphitic carbon or carbon.

No paint pigment shall contain more than 5% of either Calcium Carbonate or Calcium Sulfate.

No red lead paint shall be used as a field coat without the addition of some tinting pigment in sufficient quantity to eliminate the fading effect of a straight red lead paint.

Paint Vehicle.—The paint vehicle in every case shall be pure boiled linseed oil or China wood oil with the necessary amount of Japan dryer to produce a good drying coefficient and shall in no case contain moisture to exceed 0.5%. The amount of volatile vehicle shall not exceed 10% of the vehicle.

A paint containing coal tar or asphaltic products shall not be used.

Percentage of Pigment in Shop Coat.—The percentage of pigment in the different shop or prime coat paints shall approximate the following:

- Red Lead Paints—not less than 65%.
- Sublimed Blue Lead Paints—not less than 60%.
- Sublimed Lead Sulfate—not less than 60%.
- Basic Lead and Zinc Chromate Paint—not less than 60%.
- Iron Oxide Paints—not less than 55%.
- Graphite Paints—not less than 35%.

Percentage of Pigment in Field Coat.—The percentage of pigments in the various field coat paints shall approximate the following:

- Red Lead Paints—not less than 55%.
- Sublimed Blue Lead Paints—not less than 50%.
- Sublimed Lead Sulfate Paints—not less than 55%.
- Iron Oxide—not less than 50%.
- Pure Graphite—not less than 25%.
- Pure Carbon—not less than 25%.

The Red Lead of any pigment shall not contain more than 10% of Litharge (PbO) nor more than 1.0% of materials other than oxide or Carbonate of Lead.

The Sublimed Blue Lead of any pigment shall be a mixture of Lead Sulfate, Sulfite and Sulfid and Lead Oxide and Zinc Oxide and shall contain not less than 30% of uncombined Lead Oxide (PbO).

The Sublimed Lead Sulfate of any pigment shall be a mixture of Lead Sulfate, Basic Lead Carbonate, or Lead Oxide and Zinc Oxide and shall not contain less than 15% of uncombined Lead Oxide (PbO) or the equivalent of basic lead carbonate.

Samples for Testing.—Before ordering the paint, a sample of at least one quart shall be furnished the engineer, which sample, if approved, will be used in determining the merits of the paint furnished on the work. All paint used must equal the sample in quality.

Samples of the paint delivered at the shop and in the field shall be furnished the engineer by the contractor. These samples shall be tested at the laboratory of the Iowa Highway Commission before any point is applied.

Manufacturers' Guarantee.—The contractor should therefore secure the necessary paint in ample time so that no delay to the work will be caused by the time necessarily used in testing for which ten days should be allowed from the time the sample is collected by the inspector.

In order to facilitate contracting and prevent the necessary delays in collecting and testing samples, the contractor may submit to the Highway Commission a certificate of guarantee from the paint manufacturer stating that the paint which said manufacturer intends to supply for a particular job has been tested and accepted by the Highway Commission and that the paint to be furnished is guaranteed to conform in every respect to the sample submitted to the Highway Commission for testing. The following form shall be used by the paint manufacturers:

Form of Guarantee.—We do hereby represent and guarantee that the.....
 paint which we have furnished.....for painting.....
or other steel structures conforms in every respect to
 the sample submitted to the Iowa State Highway Commission for the purpose of testing and
 accepted by them under Laboratory No.....

Signed.....

Note: The attention of manufacturers is directed to the requirements of Chapters 11A and 11B, Title 12, Supplement to the Code, 1913, relative to the manufacture and sale of paint and linseed oil.

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