The delivery, in November 1971, of the last of the Fischer Collection to the Geology department of the Milwaukee Public Museum represents the finale of a most interesting story. The Fischer collection was donated by me and consists of 296 samples of pigment, dye, minerals, oils and binder used in paint from prehistoric time to the 20th century. The collection also includes a complete Ostwald color wheel in pigment, a post card from Wilhelm Ostwald to Dr. Martin Fischer, Fischer's scrapbook and his notes from lectures on paints delivered all over the United States.

The Fischer Collection has been valued at $4000 by Professor Lawrence Rathsack, art instructor at the University of Wisconsin—Milwaukee. Professor Rathsack, himself an expert on the subject of paint technology, Mr. Joseph Emmuletti and Mr. George Gaenslen of the Geology department, Milwaukee Public Museum, have been most helpful in finding the Fischer Collection a permanent home.

The prime motivation for my writing this article and placing the collection where it is now housed, is to make available to scholars and artists a rich source of information on the history of paint. Mr. Emmuletti, who presides over the collection, has assured me that the items collected by Dr. Fischer, will be made available to any interested party for study, examination and photography.

In August 1968, Mr. Louis Voight, Seminary Librarian at Wittenberg University, Springfield, Ohio, called me and asked if I would like some paint. I was an art instructor at the time in Wittenberg's art department and Louis was a friend and neighbor. Although my specialization is drawing and sculpture, I replied in the affirmative, more from curiosity than any other motive. I met Louis in the Thomas Library basement and he showed me some dirty cardboard boxes which, he said, the library was planning to discard because they lacked sufficient storage space.

I opened one of the boxes of "paint" and observed a carefully labelled collection of jars, capped and sealed with sealing wax. This was, I reflected, most unusual paint! Thus my curiosity was aroused by my first glance at the pigment collection of Dr. Martin Fischer. I was determined to uncover the reason for the collection and facts
about the man who assembled it. Every box marked "Fischer Collection" was moved to my studio where I proceeded carefully to open and catalog each box and each item. The number of boxes totaled fourteen, most containing notes in pencil by Dr. Fischer, describing the contents of each.

Each group was assigned a letter, A to N, and I carefully copied down the contents of every bottle. Copies of the resulting catalog are in Mr. Emmuletti and Professor Rathsack's files. A perusal of the catalog indicates the order of a careful, scientific mind. Box A, for example, contains all of the whites and blacks ever used as pigment. It is interesting to note that of twenty-two specimens of white pigment, many, listed under proprietary names, are chemically identical to other whites with different proprietary names. For example, Chremmitz, Silver, Flake and Lead white are all lead carbonate.

Of the ten samples of blacks, asphalt and asphaltum are the same. Cork black and lamp black are identical, basically sooty carbon. The two samples of blue-black are graphite. Although not true blacks, Fischer included sepia and mummy as examples of warm blacks which were utilized by 19th century artists. Sepia is squid ink and mummy is literally that; ground up Egyptian mummies! The last worth mentioning is bister (bitumin lake), an analine dye co-precipitated on a clay base. Genuine bister is asphalt.

The fact of the matter is that each sample in this group and every other sample in Dr. Fischer's collection are there for a reason. Either the pigment is historically significant because it was a bad pigment or because it was a good pigment.

Box A also contains samples of mineral pigments used by Medieval and Renaissance artists. Box B contains lakes, madders and various oils and varnishes used as binders. Box C contains stearates and phenols, Box D some reds and browns, Box E a series of ochres and yellows and Box F miscellaneous pigments.

Box G included a note by Dr. Fischer: "Color change from yellow to red due to change in size of particles—9 bottles." These pigments demonstrate the fact that, although chemically identical, the cadmium yellow (light, medium, dark), oranges and reds depend upon the size of the grind to determine their value. The coarser particles appear darker.

Box H contains a mixed group of lake (analine dye) colors and assorted types. Box I, is according to Dr. Fischer's note, "Color types—Earths." Box J is labelled "A series of the natural sources of the dye" and includes samples of madder root from which the Egyptians first extracted a red dye called Alizarin Crimson, and Cochineal, dried bodies of an insect which yields a brilliant red,
Carmine, introduced to European artists in the 17th century. There are 16 samples in this group and one of Dr. Fischer's lectures to the Art Student League of New York, on sources of the dye, suggests the reason for the inclusion of these samples. In addition, Box J contains 18 bottles labelled "Color type pigments—blue-green series." Boxes K and L contain a complete Ostwald color wheel, in powdered pigment.

In order to puzzle out the series, I researched Wilhelm Ostwald. Dr. Martin Fischer was a friend of Ostwald and co-authored several books with his son, Wolfgang. I assembled biographical information on Wilhelm Ostwald and obtained the book *Basic Color: an interpretation of the Ostwald color system* by Paul Thebald. A thorough reading of the book gave me the key to Dr. Fischer's series of coded envelopes.

The color sphere is stored in Box K, a multidrawer wooden box. Each compartment contains 24 envelopes and a letter code. It was now obvious what Fischer had done. Each of the compartments contains all of the 24 colors which Wilhelm Ostwald placed around his color wheel. The letters on each package indicate the black and white content and can be assigned a position thusly on one triangle leaf of a three dimensional Ostwald color sphere. Each group of color packs in Dr. Fischer's series are equal white and black circles or horizontal circles from the Ostwald sphere. The white and black content remains equal all around the 360° of the sphere but the hue changes from #1–24 (yellow to green). If one were to add a binder to these coded pigments, one could produce a complete color sphere.

Box M contains "Gums and oils used for making water and oil color" and 20 samples of "Minerals—Natural—Colored."

Box N contains what Dr. Fischer called his O and S system. This consists of four wooden frames, much like test tube racks. The first is marked S and like the others, contains a series of pigments in glass tubes. In a conversation with Henry Levison, founder of Permanent Pigments, Inc., and himself a color chemist, Fischer's O and S concept was discussed. "It was," said Mr. Levison, "correct in theory, but not necessary. The O colors (oxides) supposedly could not be mixed with vermillion, whereas the S (sulfides) could be." This follows one of Dr. Fischer's conditions for permanency of pigment which states that pigments should not interact chemically with each other within a painting.

Vermilion, discovered by the Egyptians, is a brilliant red called Cinnabar by the Renaissance artists and is sulphide of mercury.

Mr. Levison continued, "The breakdown of Vermilion was due more to interactions with foreign substances in the earths (ochres), not the earths themselves. Thorough washing of the earths by the
Permanent Pigments, Inc. has eliminated any bad effects of earths on Vermilion."

The other three racks contain the remaining S and two O series of pigment. Box N also contains panels of oil paint which Dr. Fischer tested for fading with exposure to hydrogen sulfide \((\text{H}_2\text{S})\). These very same panels are reproduced in Dr. Fischer's book "The Permanent Palette" (Plate II p. 12—Effects of air pollutants on some pigments). Incidentally, plate 1, p. 38, "Effects of light exposure on some pigments," which shows the effects of ultraviolet light, was also found in this group of lecture notes. It consists of a series of strokes of water color pigment on paper, some exposed to sunlight, the others not.

With the Fischer collection safely stored in my studio, I spent the remainder of my stay at Wittenberg researching Dr. Fischer. I have included a biographical sketch of Martin Fischer from the Wittenberg University Publication "Alumnus", in the Appendix.

It should be obvious that Martin Fischer was a man of many talents and interests, well traveled and internationally known. He was a prodigious correspondent and the Thomas Library at Wittenberg has, in its archives, virtually every letter Dr. Fischer received and saved during his lifetime. The letters are housed in bound containers by year and contain many insights into Dr. Fischer's personality and interests.

I began sifting through the letters from 1929–1930 because 1930 is the year during which the book "The Permanent Palette" was published. The letters from publishers beginning in January 1929 provided a running commentary on Fischer's efforts to get his book published. A letter dated January 3, 1929 from Bridgeman Publishing Company, a firm that specialized in art books, states "We are reviewing your manuscript." A letter from Bridgeman dated March 23, 1929 rejects the manuscript. A letter dated August 10, 1939 from publisher Charles Thomas, provides some interesting comments on art and artists. Thomas rejects the manuscript because he feels it is too well written for an artist!

Dear Dr. Fischer:

One of my friends has the largest book decorating organization, another is the second largest buyer of colors, in this country. "The Permanent Palette" was read by both with great interest. Both are artists, and employ some of the best artists in the country. Both feel that the manuscript is written with the authority on the chemistry of color, but express the belief that there will be a very limited sale for the book, for the reason that they believe it is too scientific in character to hold painters. They say it is almost impossible to get artists to take time or make the effort to undertake serious study of color. Louis Kreiger, a Baltimore artist, who has worked out with the physics department of the Hopkins, the most superior color Atlas that I have
seen, as well as Priest, of the Bureau of Standards, deplores the lack of attention of artists to scientific fundamentals. They want to be absolute free lances, seek no guidance.

I hate to tackle a crowd that does not desire knowledge as much as I would like to do the MMS for the sake of the subject it represents. So I have taken the liberty of returning the manuscript, not because it is not good, but because of the special difficulties to be encountered.

Faithfully,

Charles C. Thomas

Eventually the book was published by the National Publishing Society (Fischer, 1930), and contributed to a reform of certain questionable practices within the art products industry. From the Thomas Library archives I turned my attention to the Alumni book collection. The library had two copies of "The Permanent Palette", one of which I copied and eventually gave to Professor Lawrence Rathsock.

I read the book and reread it looking for a key to Fischer's pigment collection. The book itself and its basic format are the framework within which the collection made sense. In the Introduction Dr. Martin Fischer states his thesis; modern painting as a craft is declining. Many 19th century painters were seduced by the spectral colors of aniline dye pigments (lakes) and other non-permanent pigments and their work has dulled in a relatively short period. Fischer attributes this to the artists' ignorance of the chemistry of paint, and his book is an attempt to remedy the situation.

Dr. Fischer's medical interests led him to study the colloidal suspension of water in the cell. Thus when he turned his attention to paint, also a colloidal suspension, he approached his subject in a scientific and analytical manner. According to Dr. Fischer, the following factors affect color permanence: (a) light, (b) air, (c) intermixture with other colors, (d) reaction with the binder (medium), (e) reaction with the ground (primer) on the support (canvas, paper, plaster) and (f) cold or warmth. To Fischer's list I would add the use of non-permanent binders and pigment, exposure to atmospheric pollution and shoddy craftsmanship as the greatest destroyers of paintings in the last one hundred years.

PHENOMENA THAT AFFECT PIGMENT

The ultraviolet portion of sunlight is a strong bleaching agent. It tends to break down all but the simplest pigments such as the ochres or cadmium compounds. Obviously, the informed collector will not hang his paintings in direct sunlight. However, even artificial light will cause non-permanent pigments to fade.
Virtually all manufacturers of paint test their products for light fastness. Permanent Pigments, Inc. tests their paints in the following manner: panels covered with pure paint and tints are mounted at a 45° angle. They are exposed for a six month period to outdoor sunlight. Then they are tested for fading with a colorimeter. These paint tests are run at Cincinnati, where the home plant is located and at Miami, Florida where a branch plant is located. Interestingly, the samples at Cincinnati faded more than those at Miami, although subjected to less intense sunlight and fewer hours exposure. The extreme fading at Cincinnati is said to be caused not by sunlight but by pollution in the air. Samples are also tested indoors, subjected to fluorescent light at a distance of six inches. Both pure and tinted hues are tested because, in use, artists seldom use pure colors. Tints tend to fade more quickly than pure colors.

Why this great concern with fading? Did the artists of past centuries experience this difficulty? No, not at any rate until the 1850's, for up until then all commonly used artists' pigments, even the synthetic ones, were permanent. The first organic synthetic pigment was Mauve, created by William Perkins in 1856. This pigment was a dye derived from the destructive distillation of coal tar. The dye is precipitated on a white earth (alumina) also called white clay. The result is the impermanent aniline lake. All lake colors are dyes characterized by their intense spectral hue, a large and complex molecule, and by their impermanence.

All of these aniline lakes with the exception of Alizarin Crimson proved the undoing of the artists who used them, attracted by the brilliance of these lakes. Fischer mentions Charles Duveneck and James Abbott McNeill Whistler as two artists whose paintings experienced fading, to which list I might add many lesser known artists, numbering in the hundreds.

Alizarin Crimson, (surrogate) $C_{14}H_{8}O_{4}$, resembled and replaced traditional Alizarin, which was first used by the ancient Egyptians. Traditional Alizarin is a dye extracted from the root of the madder plant. Its 19th century substitute proved to be the only early aniline dye to be light fast. The other lakes all faded and, even today, many artists consider dye colors suspect.

Dr. Fischer mentions air as potentially destructive to paint. The effect of pollutants in our atmosphere is well known in 1973. The pollutants in question are sulfide, sulphur dioxide, sulfuric acid, carbonic acid, and water. Sulfide will cause lead white to yellow or blacken in the following manner: the hydrogen sulfide produced when coal or gas is burned acts upon lead carbonate and lead hydroxide components of white lead and changes them to lead sulfide which can appear yellow, orange or black.
What then is a safe palette? Dr. Fischer describes the permanent palette on page 33, chapter 7:

Black-Ivory black
Blue-Ultramarine blue
Green-Chromium oxide (Viridian)
White-Zinc white
Yellow-Pale cadmium
Yellow-Middle cadmium
Orange-Cadmium
Red-Cadmium

May also use: Vermilion-Yellowish to orange
Earth
Yellow-ochre-Light
Yellow-ochre-Dark
Gold ochre
Raw and burnt sienna
Raw and burnt umber
Mars yellow (earth)
Mars red
Mars purple

These colors are: light resistant, fairly bright, and incapable of chemical reaction with each other and elements in the air.

If additional colors are needed, these may be added: Blue-Cobalt, Blue-Cerulean, Green-Cobalt, Violet-Cobalt and Green-Terra verde.

Dr. Fischer recommends, as a primer for linen, one part zinc white with one part lead white cut with turpentine. His preferred medium was raw cold pressed linseed oil, bleached by sunlight. He cautions against the use of boiled linseed oil or of driers and siccatives.

The preferred varnish would be pure cold pressed linseed oil or as a second choice, resinous varnishes such as Copal, Damar, Mastic or Amber. The recommended solvent for thinning oil paint is gum spirits of turpentine.

As stated earlier, my purpose in writing this paper is to encourage other scholars and students interested in artists’ paints to pursue the subject, using an extremely valuable tool, the Fischer Collection. Those wishing to examine the specimens should contact Mr. Joseph Emmuletti of the Milwaukee Public Museum. I would also be happy to supply additional information such as the catalog of the collection and related data. In addition, researchers should try to locate copies of Fischer’s “The Permanent Palette” published in 1930; see References.

Let me conclude with a brief aside. In January 1973, I received a letter from Miss Ilo Fischer, Thomas Library, Wittenberg University, stating that the last remaining samples of Dr. Fischer’s collection had recently been uncovered in the library storeroom. “Would I like them sent to me?” Indeed I would was my reply. This mini-collection was then sent to me by Mr. Louis Voight.

I have merely hinted at many possibilities for further study regarding paint and would like nothing better than to see these areas researched in depth by other scholars.
THROUGH HISTORY WITH THE FISCHER COLLECTION

The following list summarizes some of the more important pigments as they were introduced in various Asian and European epochs. Each italicized pigment is found among the specimens in the Fischer collection.

The first group illustrates some of the pigments used by prehistoric artists. Yellow-Limonite or yellow ochre—an iron oxide, Red Ochre—red iron oxide

The next sample was used in the ancient Middle East or Mesopotamia and is Black, Bitumen or asphaltum.

Egyptian artists used the following: Green, Malachite—copper carbonate, Red, Hematite—red iron ore, Blue, Azurite—blue copper carbonate, Red, Alizarin Crimson—a dye from the madder root, Bright red, Vermilion or Cinnabar—mercury compound, Yellow, Orpiment—arsenic compound

During the Middle Ages and up to the Renaissance all of the above were used plus the following: Black Ivory—charred ivory, White Lead—lead carbonate, Indigo Purple—dye from the indigo plant.

The Baroque and Rococo periods saw the introduction of: Cobalt Blue—ground smalt (Venetian glass), Red, Minium—red lead oxide, Naples Yellow—antimoniate of lead, Orange Realgar—disulphide of arsenic, Cambode Yellow—solid resin from Cambodia, Carmine Red—dye from the cochineal insect, Verdigris Green—made by mixing fermented grapes and copper (copper acetate).

The first pigment to be synthesized from raw materials was discovered by accident, Diesbach's blue, in 1704. The color is now called Prussian blue or Berlin blue after the nationality of its discoverer: Prussian Blue—iron ferrocyanide.

Cobalt Blue followed in 1802 and is cobalt oxide plus aluminum oxide.

Ultramarine Blue was synthesized in 1824 and is thought to be colloidal sulphur in a glassy matrix.

Viridian, a dark green, was synthesized by Guignet, a Frenchman, in 1838. It also goes by the name Verte Emeraude, or chromium green, and is hydrous chromic oxide.

Cerulean Blue was created in the 19th century by mixing Cobalt Blue with tin oxide, a white pigment. It is actually a tint of Cobalt Blue.

Zinc White was also developed in the 19th century and is zinc oxide.

As stated before the first organic synthetic pigment was Mauve which is precipitated on alumina, or clay. Mauve and other aniline dye colors, as first produced, proved to lack light fastness.

In the early 1900's, two inorganic pigments were introduced which are light fast. They were: Titanium White—titanium oxide and the Cadmium pigments which are based on chemically pure cadmium sulfo-selenide. They range from Cadmium Yellow to Orange and Red. All are identical except for the particle size of the pigment. The finer sized are lighter.

REFERENCES


RESOURCE PEOPLE

MISS ILO FISCHER, Research Librarian, Thomas Library, Wittenberg University, Springfield, Ohio.

MR. HENRY LEVISON, Permanent Pigments Inc., 2700 Highland Avenue, Cincinnati, Ohio.
MARTIN H. FISCHER

Dr. Martin Fischer, widely-known and versatile man of science, art, and letters who directed the Department of Physiology and taught at the University of Cincinnati College of Medicine for 40 years, died January 19 at his Cincinnati home after a long illness. He was 82.

Dr. Fischer received Wittenberg's honorary Doctor of Science degree in 1932.

Dr. Fischer was one of those rare teachers who sparked interest in medicine and other areas of the mind in generations of students. His wide capacity for friendship made him one of the city's best known and loved persons.

Dr. Stanley E. Dorst, '19, '48H, dean of UC's College of Medicine, called Dr. Fischer "a unique person."

"Not only was Dr. Fischer a physiologist and brilliant lecturer, he was also an artist of considerable ability and a man of literature," Dr. Dorst pointed out.

"His translations of Gracian's 'Truth-telling Manuel' is a classic and his books on the lives of Christian R. Holmes and William B. Wherry are monumental works.

"During Dr. Fischer's term as director of the Department of Physiology, two special units were developed with his aid and encouragement. These are the widely-known Kettering Laboratories in the University of Cincinnati Medical Center and Tanners' Council Research Laboratories on Cincinnati University's main campus. Both were outgrowths of experimental work then going on in the Physiology Department."

In physiology Dr. Fischer was known for his early work in the investigation of the colloidal chemistry of body tissues and for his textbook on physiology of alimentation. Best known of his medical writing was the book "Edema and Nephritis."

Dr. Fischer and his wife were major benefactors of Wittenberg. Mrs. Fischer who preceded him in death, bequeathed the University $127,000. Additional bequests from Dr. Fischer will raise the total to approximately $220,000.
Through the years Dr. Fischer made numerous gifts to Wittenberg including rare books, first editions, maps, and works of art. His total benefactions include about 2,500 volumes, 350 bound periodicals, several hundred monographs on medicine and fine arts, valuable pieces of art and a collection of medals from the Society of Medalists.

He also gave the University a 700 year old Catholic Breviary containing what is believed to be one of the earliest forms of the Rosary. The embossed hand-lettered Breviary, illuminated in color and gold leaf, is the most valuable single item in Wittenberg's rare book collection.

Dr. Fischer's experiments in the pigments of oil paint resulted in the art pigment industry in America. He gave Wittenberg the sequence of pigments that he used for his experiments. His book, "The Permanent Palette," resulted from this research.

Among the paintings given to Wittenberg by Dr. Fischer were some of his own works; paintings representative of the beginnings of Japanese fine art, including prints by the famed Japanese artist Kunisada; oil paintings by Miss Dixie Seldon, landscape and portrait painter of Cincinnati; and John Weis, a portrait painter.

Dr. Fischer had served as director of the Department of Physiology at the University of Cincinnati College of Medicine for 40 years before retiring in 1950. His key contribution in the area of physiology was in the area of colloidal chemistry of body tissue.