R. F. E. Percy,[1] *Chem. Tech. (Hons.) and R. J. Audette,*[2] *Ph.D.*

Automotive Repaints: Just a New Look?

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ABSTRACT: The variety and complexity of primers and paints now used to refinish automobiles assist the forensic chemist in making more specific comparisons of paint samples. Infrared spectroscopy was used to determine the chemical composition of 254 samples of refinishing topcoat products and to establish a data base for comparisons of spectra of unknown samples. Spectra representative of six major types of refinishing products are presented.

KEY WORDS: criminalistics, paints, automobiles, spectroscopic analysis

Perhaps never in the history of automotive refinishing has there been a greater uncertainty concerning the future types of repaint finishing systems. In the mid-1960s, automotive manufacturers introduced "glamorous" colors for the enhancement of the appearance of their vehicles with a three-dimensional appearance of the paint. This introduced a new and more complex problem for the automotive refinisher, but it has assisted in making forensic science comparisons of repainted vehicles more specific.

The examination of automotive paint for identification or comparison constitutes a major portion of the cases handled by the chemistry section of this forensic laboratory. Original automotive topcoat and primer systems are being used to identify manufacturer, vehicle line/series, model year, and assembly plant [*1*] of offending hit-and-run vehicles. Repainted automotive finishes, while lending themselves well to comparison, have not in the past afforded a reliable identification tool. The number and type of repaint primer coats employed are left to the discretion of the body shop repainter while the topcoat color is matched either to the original color or to the color whim of the vehicle owner.

Over the past years many anomalous occurrences with respect to the chemical composition and physical appearances of repainted automotive topcoat finishes have been encountered in our laboratory. For instance, melamine formaldehyde, which is normally associated with original finishes, has been observed within the chemistry of repaint resin systems and the size, shape, and distribution of the metallic flakes within the topcoats have varied considerably. The possibility therefore exists that the forensic scientist, armed with certain information, may be able to identify a probable source of certain repaint automotive finishes. Unfortunately, very little forensic science literature deals with repainted automotive products. As a consequence, local body shops and paint suppliers were asked

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[1]Technologist in charge, Instrumentation Section, Royal Canadian Mounted Police, Crime Detection Laboratory, Edmonton, Alberta, Canada.

[2]Assistant director, Provincial Analyst Laboratory, Alberta Agriculture, Edmonton, Alberta, Canada.

about these anomalies in an attempt to attach some significance to the occurrences being observed.

With the introduction of the "glamorous" colors and the varied application techniques necessary for them, body refinishers are often left in a quandary as to what materials may be employed to duplicate a damaged vehicle's original finish. The anomalies we were observing appeared directly related to the refinisher's problems. In turn, they were directly related to the manufacturer's use of three-dimensional color characteristics to accentuate body styles and lines [*2*].

The refinishers' problems and techniques for duplicating the original factory topcoat finishes are described in detail by Beckwith [*3*]. All the refinishers in our area are using the manufacturers' intermixing systems consisting of numerous tinted base stocks to obtain a proper color match as defined by the paint manufacturer. However, a great deal of innovation and perhaps just a touch of the old "eyeball" technique are still required to attain the desirable geometric attributes [*4*] found on today's motor vehicles. The refinisher's problems become even more complex when he must duplicate the factory colors using materials chemically compatible with the varied resin systems used on the vehicles' original bodies, moldings, fenders, and extensions [*5,6*]. Thus, the repainting of a motor vehicle does not simply represent a new look for that damaged car. The repainter has to concern himself with the chemistry and physical appearance of the paint he is going to use.

In an attempt to assist the refinisher in overcoming the problem of repairing special finishes (such as the clear topcoats found on Mercedes, Volkswagen, Volvo, Ford Versailles, and others), the North American paint manufacturers have in some instances supplied refinishing shops with "factory packaged" paint. In addition, they market specially formulated paints to repair the topcoats for such imported vehicles as the Saab. In other instances, European or Japanese paint manufacturers export their own factory-packaged or touch-up paint to repair their vehicles (for example, Toyota, Jaguar, BMW, Mercedes, and Volvo).

While conducting our inquiries, we collected several samples of every product line made by each manufacturer. A total of 254 samples representing as completely as possible all the chemical types of refinishing topcoat products used in our area were collected.

Instrumentation

A Perkin-Elmer 283 double beam optical null filter-grating infrared (IR) spectrophotometer was equipped with a ×4 all-reflective beam condenser and a reference beam attenuator. The spectrophotometer was employed over the scanning range of 4000 to 200 cm^{-1} in the percentage of transmittance ordinate mode with a scanning time of 6 min, a response time of 1 s, and a slit program of 7. Both the ordinate and abscissa expansion modes were in the normal positions (×1 expansion).

Experimental Procedure

The paint samples were dried according to the manufacturer's application specifications. A 10- to 15-μg sample of each dried sample was intimately ground with spectroscopic-grade KBr powder (International Crystal Laboratory). The ground mixtures were pressed into a 1.5-mm-diameter opening centered in a 13-mm-diameter stainless steel disk held within a Perkin-Elmer Ultra micro KBr die apparatus. The resulting pellets were pressed by employing a Carver hydraulic laboratory press. An IR spectrum was obtained by placing the resulting disk in the ×4 beam condenser and recording the complete IR spectrum by employing normal techniques.

Results and Discussion

All 254 collected samples were analyzed by IR spectroscopy. The resulting IR spectra were sorted into specific product lines and the corresponding spectra were compared one to another. Because a single color of known pigmentation could not be collected, pigment interferences within the spectra were minimized by choosing the IR spectra that best displayed the resin system for the product line. Thus, the IR spectra in Figs. 1 through 6 can be employed as an IR data base to which an unknown spectrum can be compared to identify a specific repaint topcoat product line. The spectra are arranged according to the manufacturer's designations of his own products (acrylic enamel, acrylic lacquer, and so forth) and whether the paint was a North American or imported product. The labels on each spectrum represent the manufacturer and his trade name for that particular product line (for example, Dynalite® and Dynacryl® are CIL's trade names for their acrylic lacquers and acrylic enamel products, respectively).

All the spectra in each figure have variances within the resin systems either in the absence of or in the relative intensities of certain absorption bands. By comparing these spectra it is evident that the absorption differences aid in the identification of individual manufacturer's products. It is interesting to note from the spectra in Fig. 2 that the manufacturers' designations of chemical type did not, in all cases, correspond to the resin system observed from the IR analysis [*7,8*]. For instance, CIL's "Dynacryl" alkyd resin system is designated as an "acrylic enamel" (Fig. 2). In addition, Figs. 2, 5, and 6 clearly indicate that some repaints contain melamine formaldehyde [*8*] (for example, BMW's "Grundlack 80°C" in Fig. 6), which normally is associated only with original factory paint systems.

From the forensic chemist's standpoint, the common industrial terminology for the major resin systems has a tendency to be a bit misleading. Historically, the term "enamel" or "baking enamel" was employed by the industry to designate alkyd or acrylic-type paints that had to be baked on at the repair shop. However, these terms were also used when the only curing process was at room temperature in air-drying rooms. To eliminate this confusion, we have adopted the nomenclature [*1*] of alkyd or acrylic to designate repaint topcoat finishes and alkyd melamine or acrylic melamine to designate original factory topcoat finishes.

Each sample collected was subjected to solvent tests to determine if suitable screening procedures could be developed for the discrimination of a particular product [*9*]. None of the resin systems dissolved in toluene or benzene. All of the acrylics and alkyds, with the exception of the Sherwin Williams' Acrylic® (Fig. 1), softened but did not dissolve in methylene chloride, acetone, and ethyl acetate. The Sherwin Williams' Acrylic did dissolve in methylene chloride. In contrast, every acrylic lacquer dissolved in these three solvents.

In an attempt to match the new factory clear coats used on North American vehicles, most of the repair shops within our area were employing the unpigmented clear coat products of DuPont's Lucite®, CPI's Duracryl®/Delstar®, or Sherwin Williams' Acrylyd®. These were applied on top of a thin layer of the appropriate pigmented resin. For the European vehicles having clear coat systems, we found that either the Herberts Standox Standocryl Auto Lacq® or the Volvo and Volkswagen factory-packaged clear coats were applied.

In general, it was found that the repair shops in our area normally employed the imported factory package systems (Figs. 5 and 6) to repair small areas on damaged panels for European imports and some Japanese vehicles. Where the factory package was not available, Herberts Standox products were normally used on the continental European cars. In addition, North American paint manufacturers were also making specially designed factory packages for certain European manufacturers. For instance, it was our

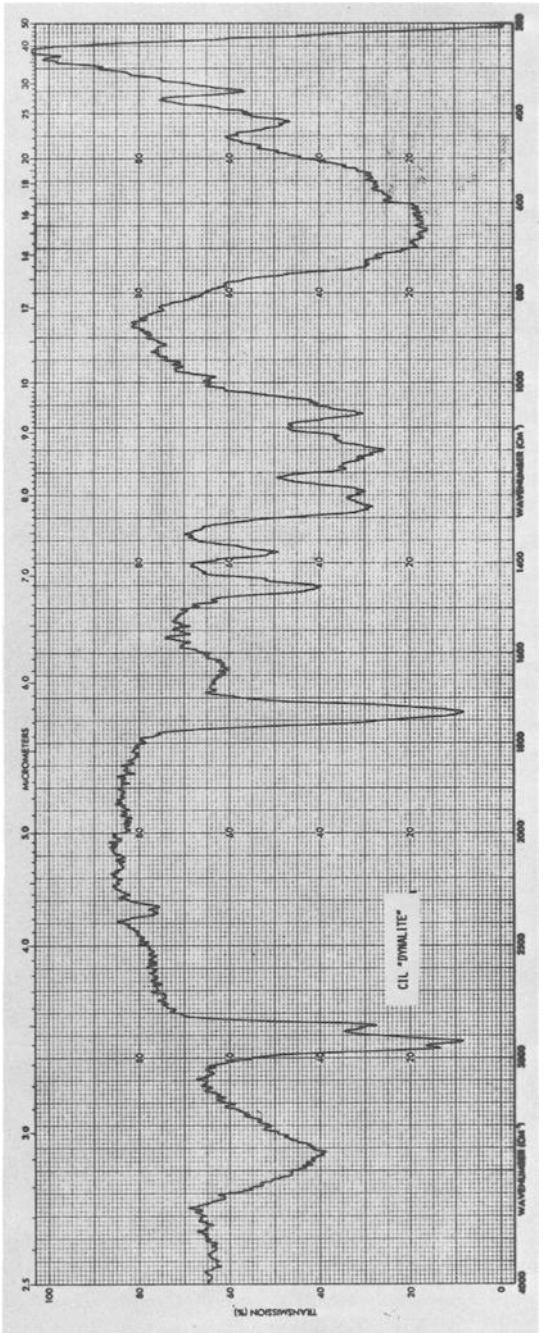
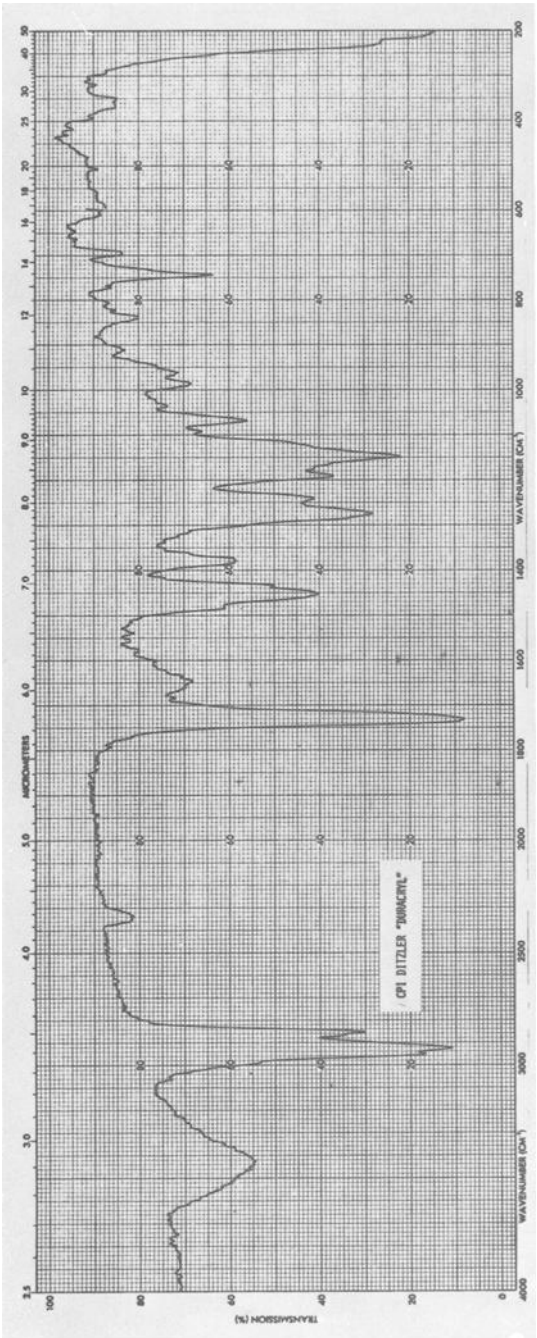


FIG. 1—*North American paint vendors' "acrylic lacquer."*



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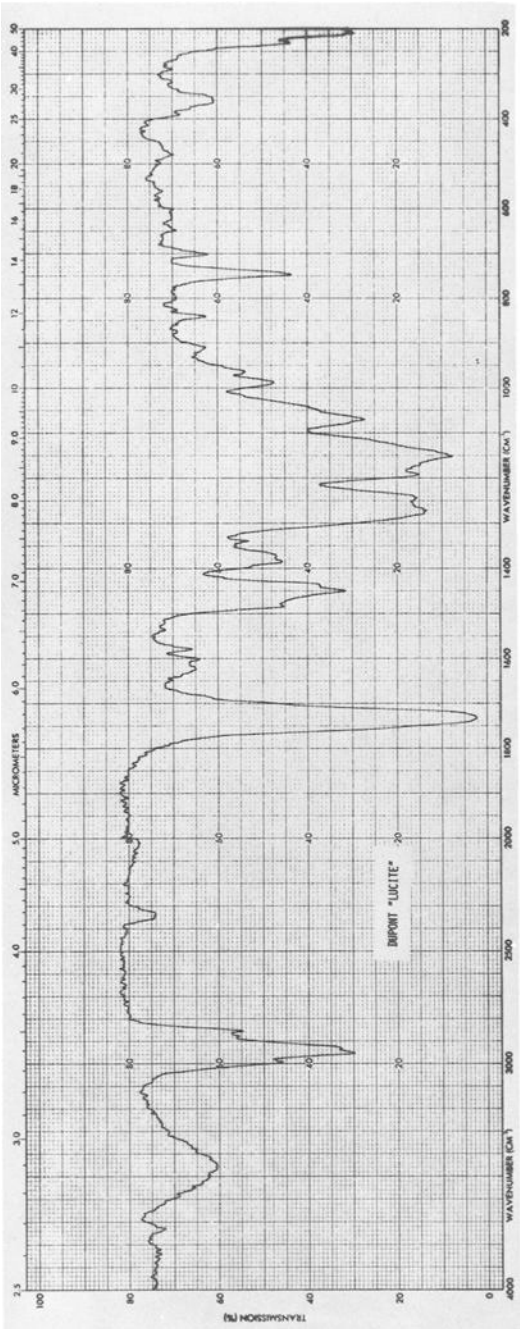

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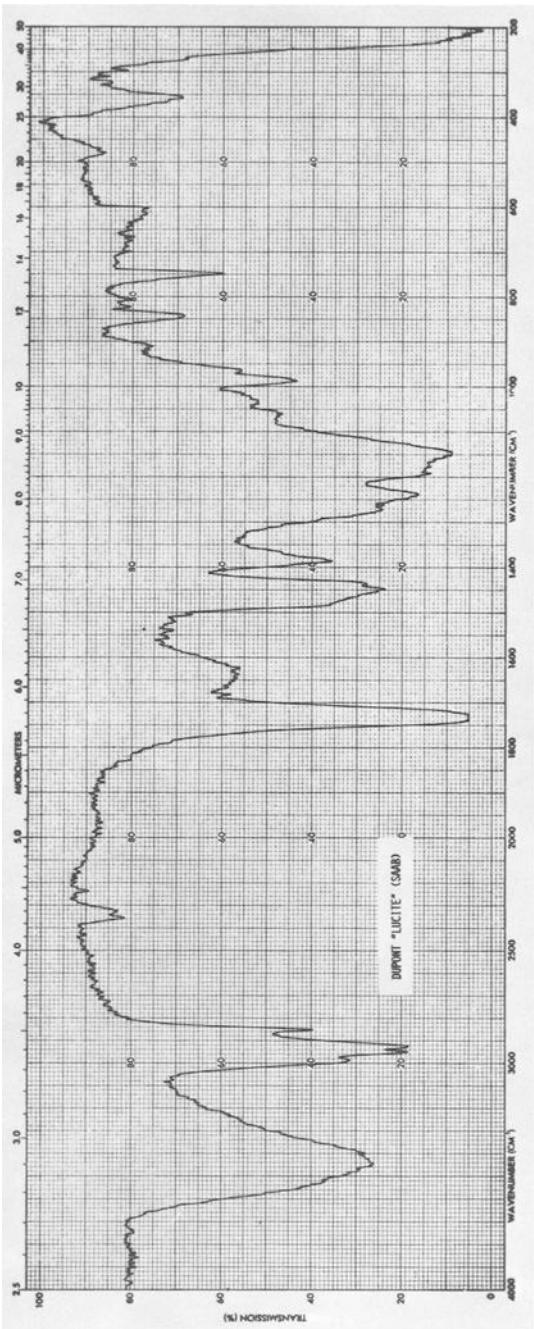

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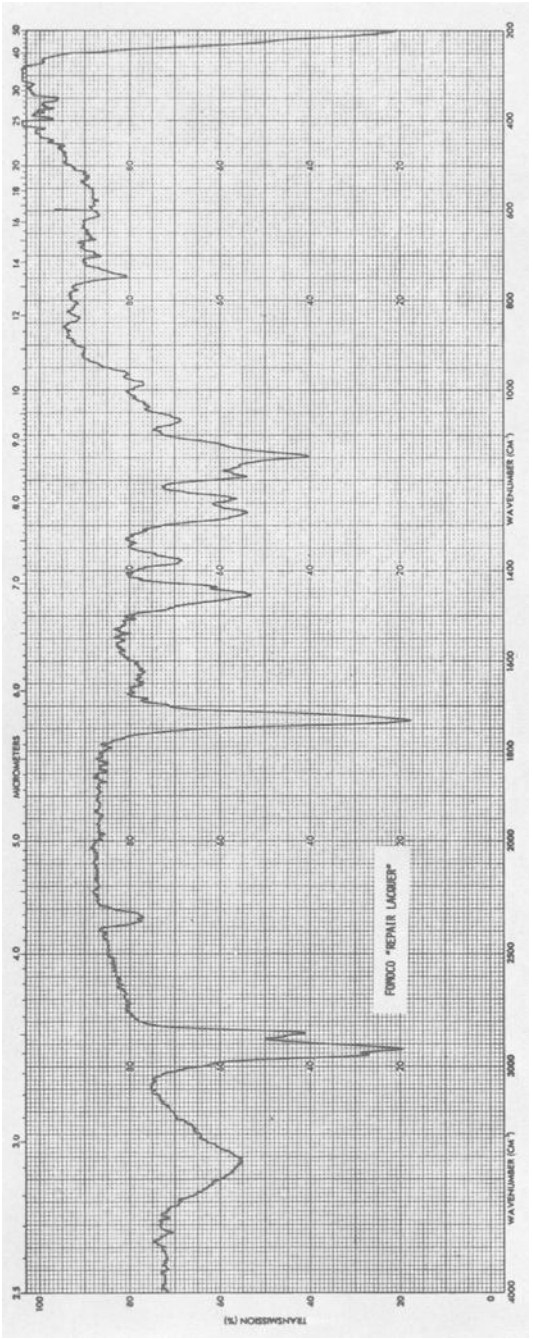

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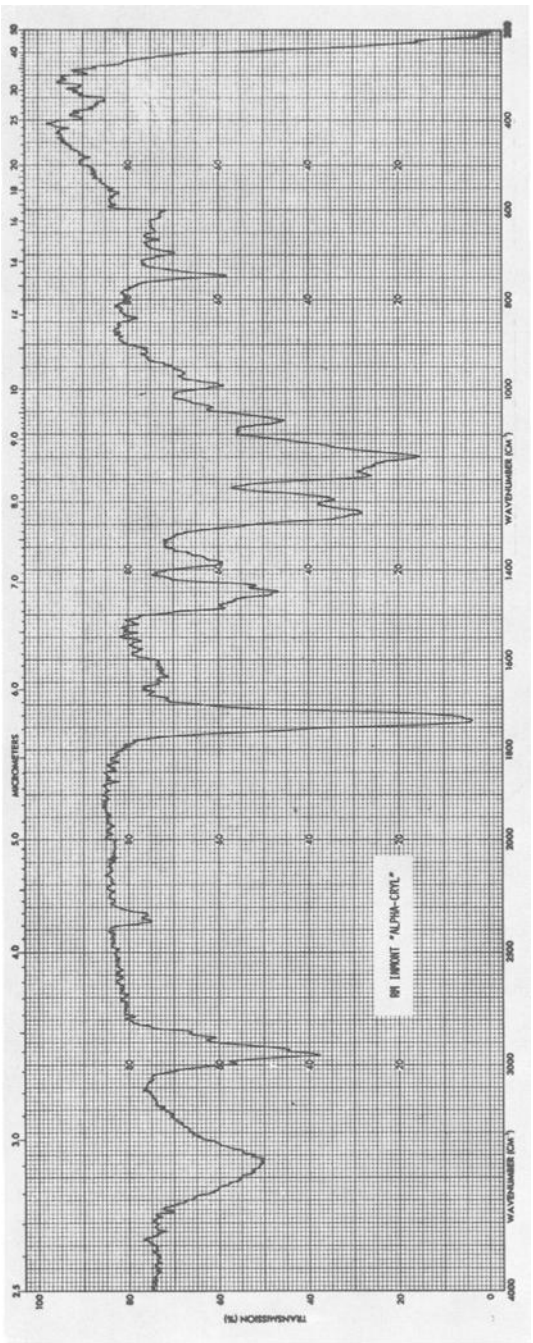

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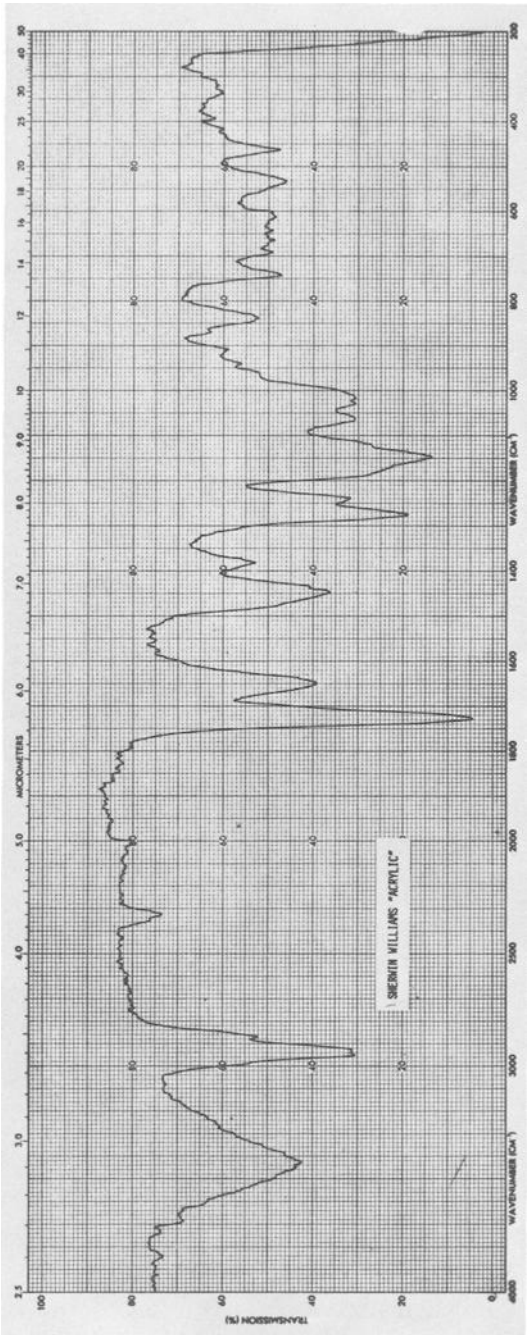

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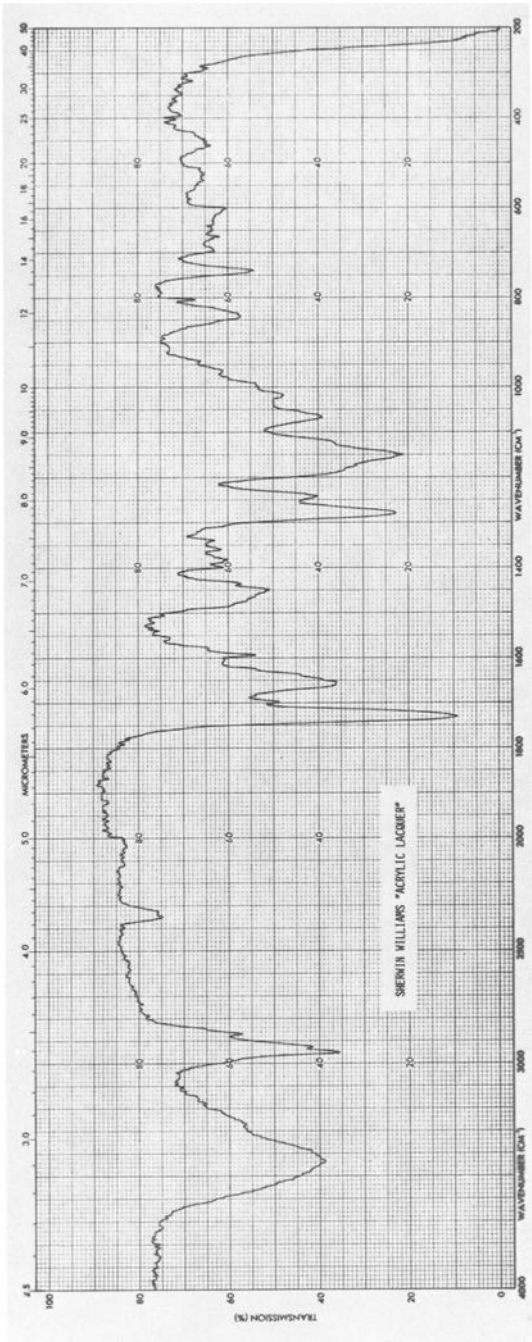

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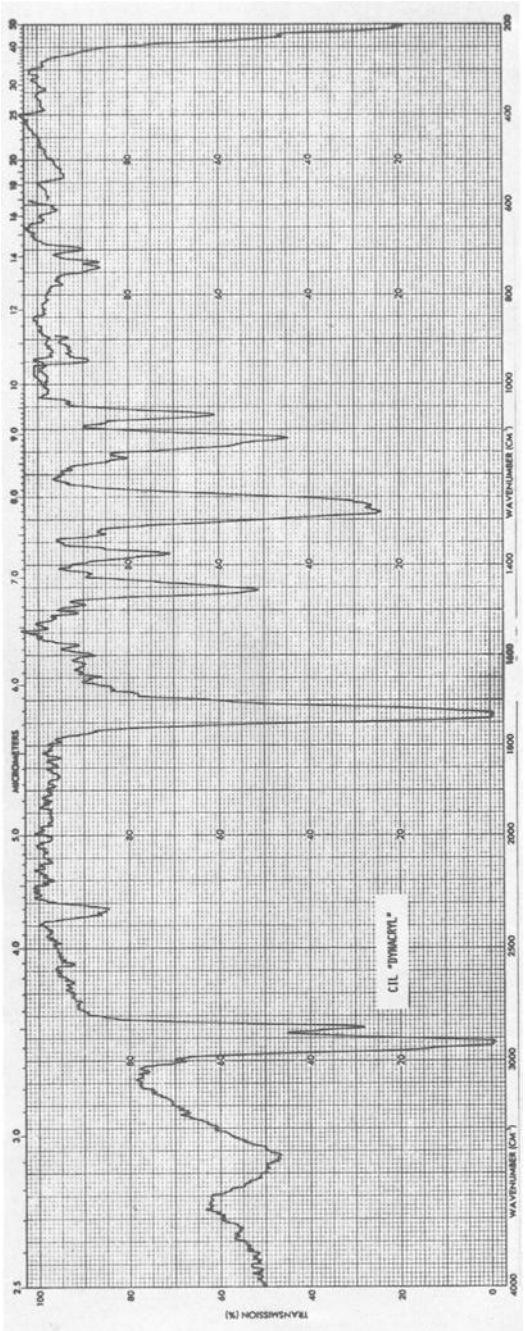
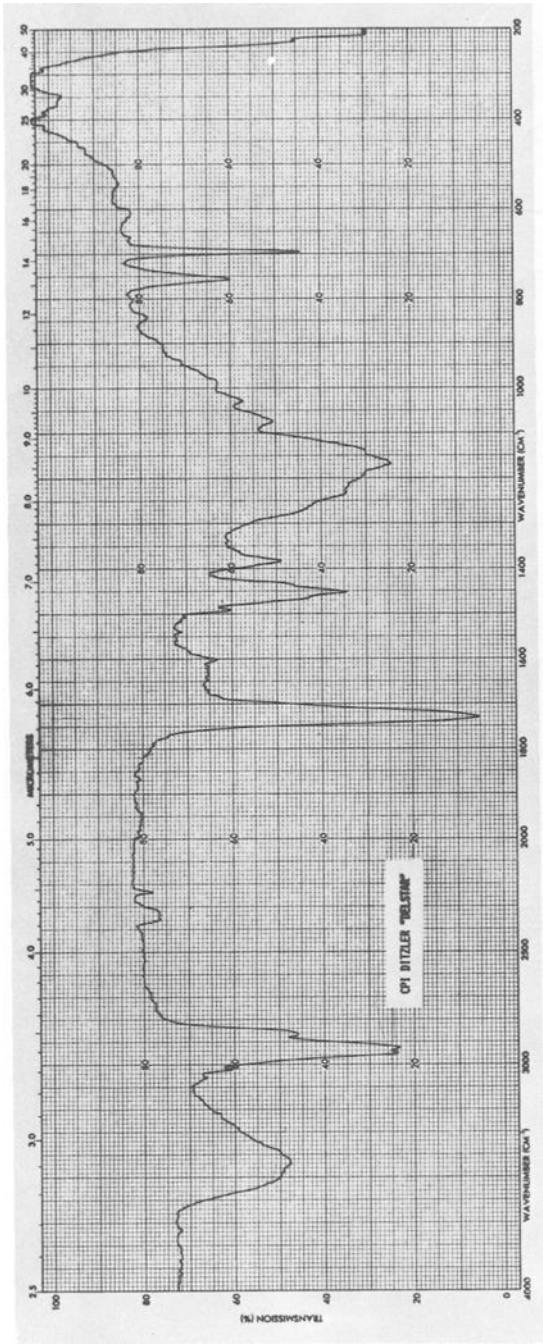


FIG. 2—*North American paint vendors' "acrylic enamel."*



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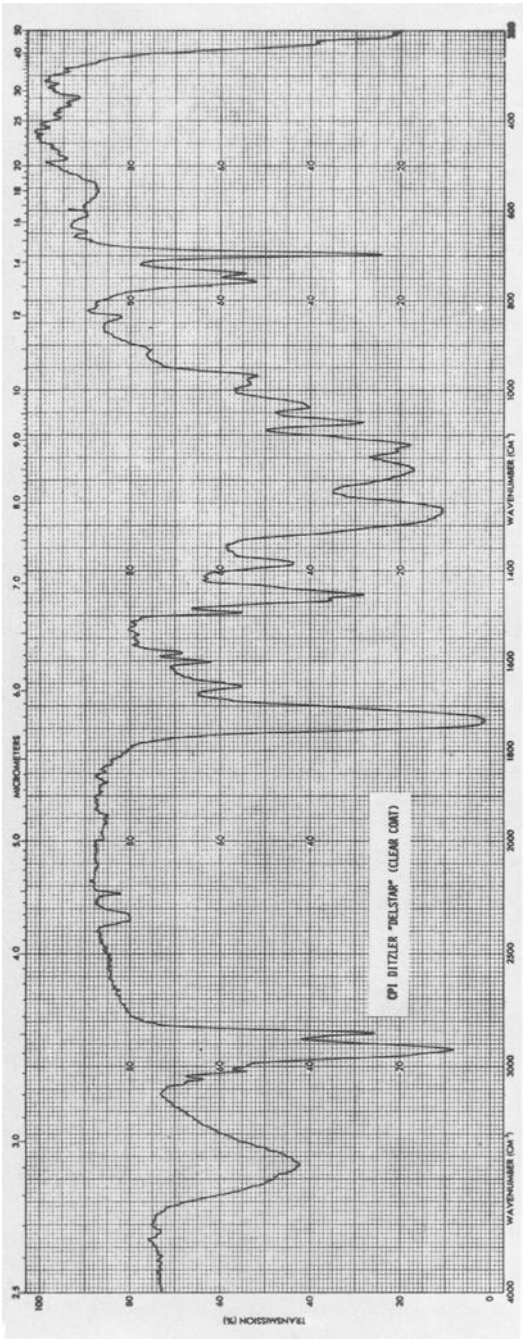

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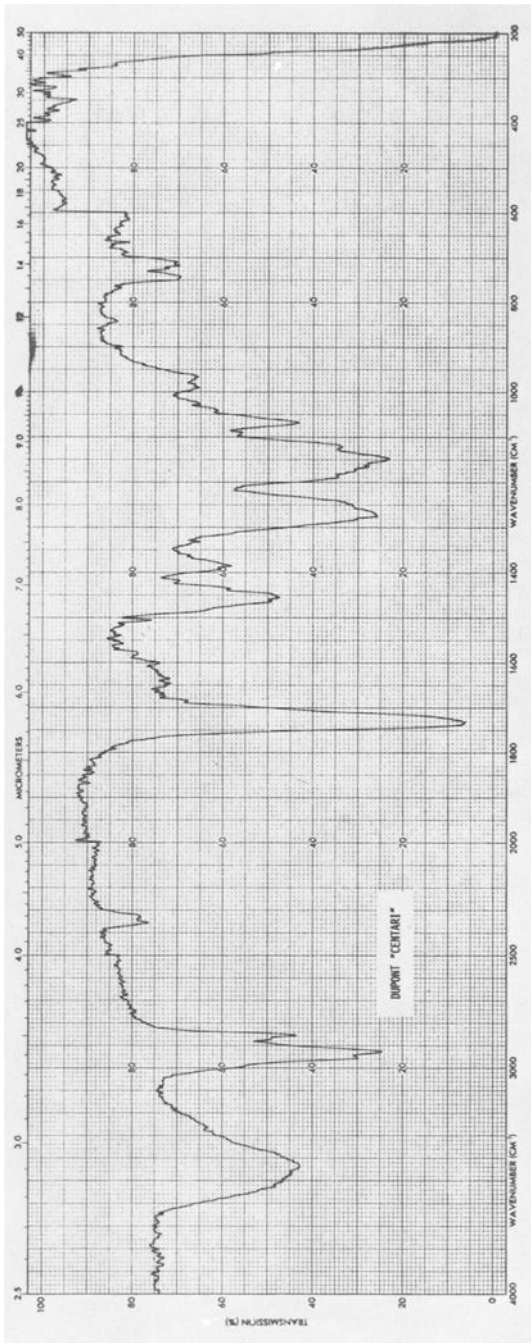

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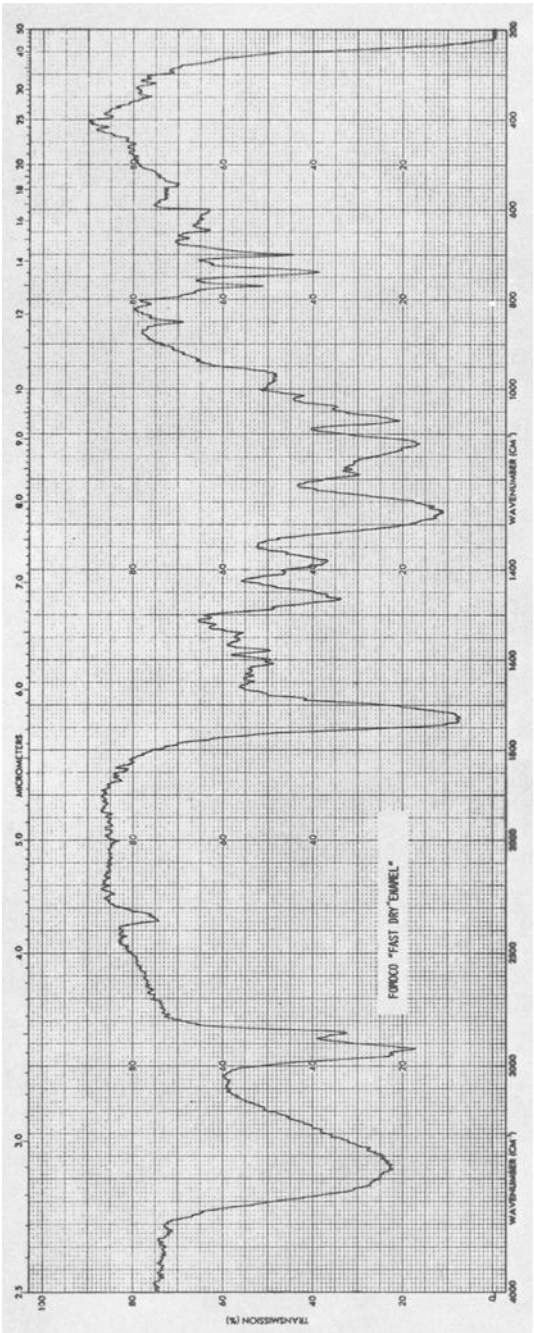

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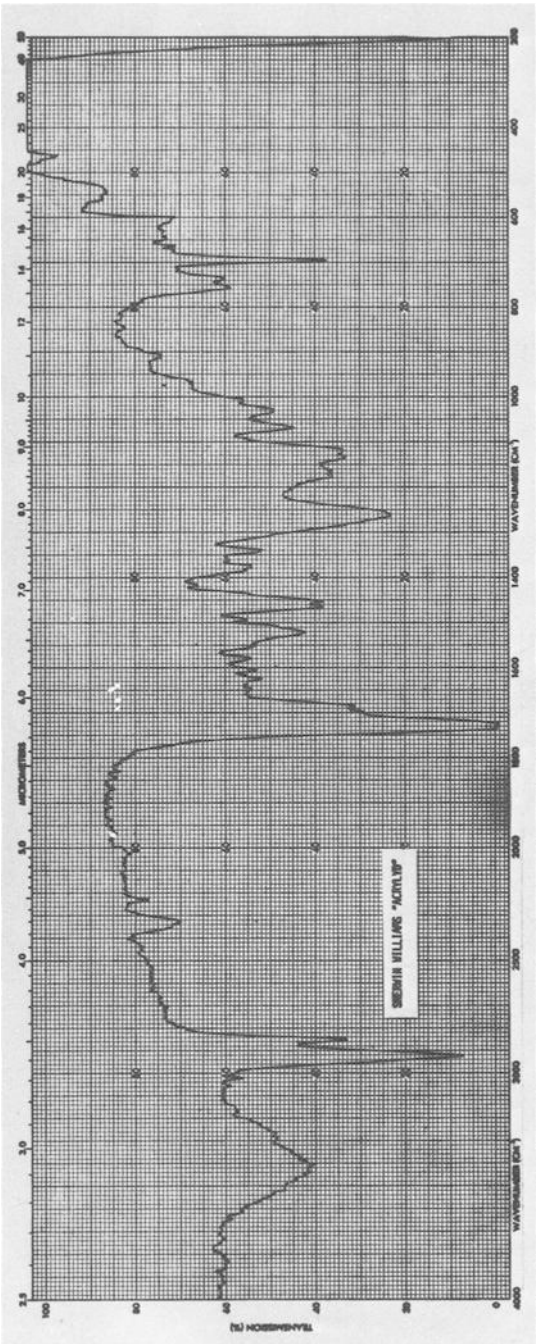

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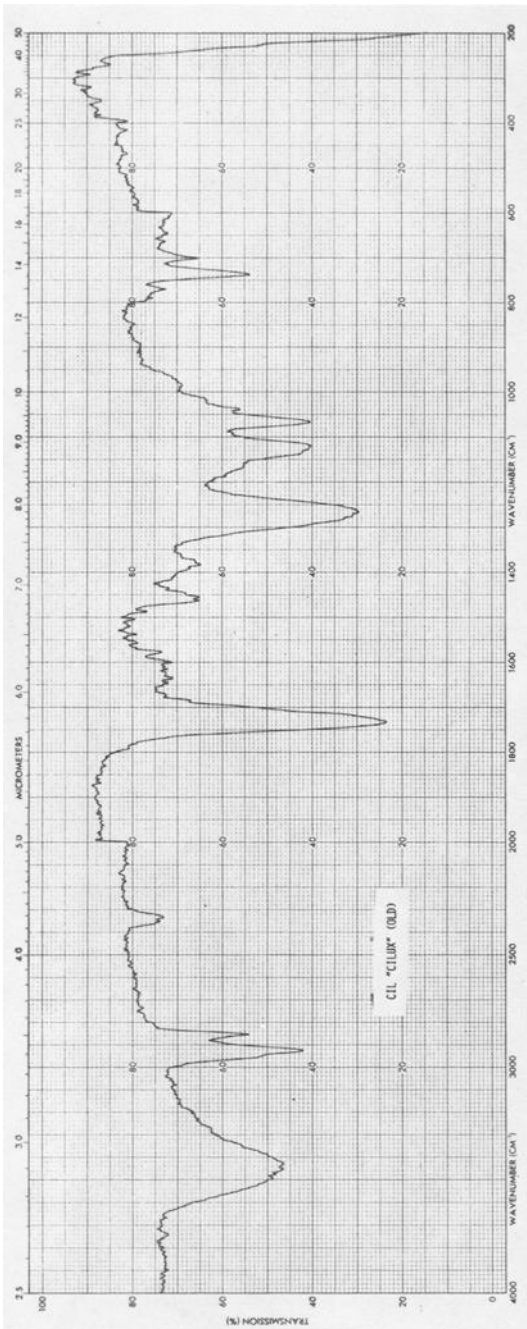
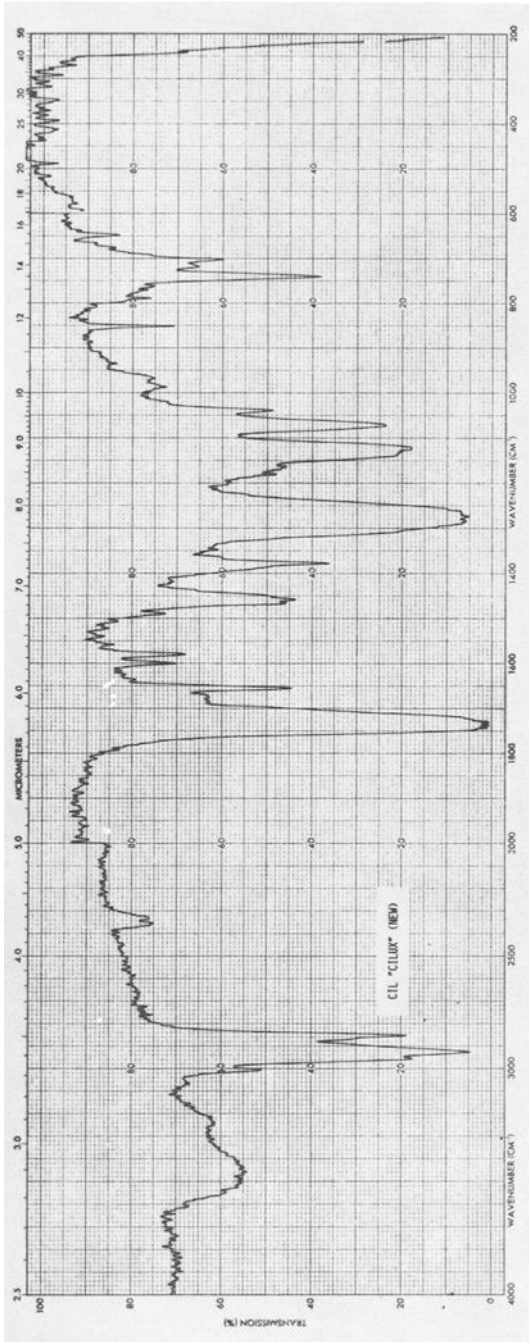


FIG. 3—*North American paint vendors' "alkyd enamel" or "baking enamel."*



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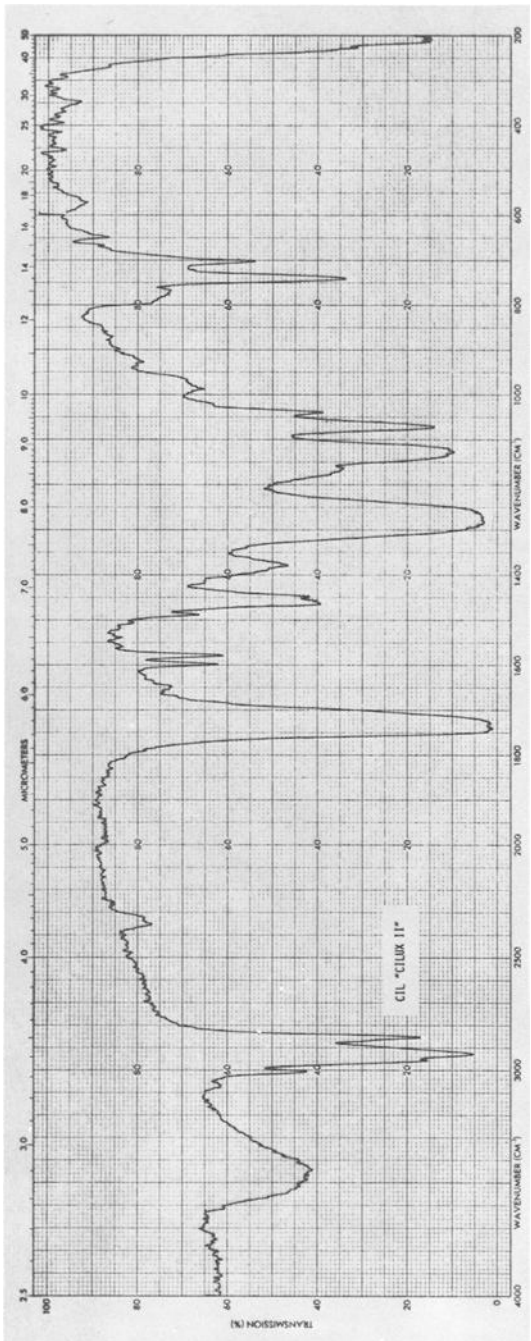

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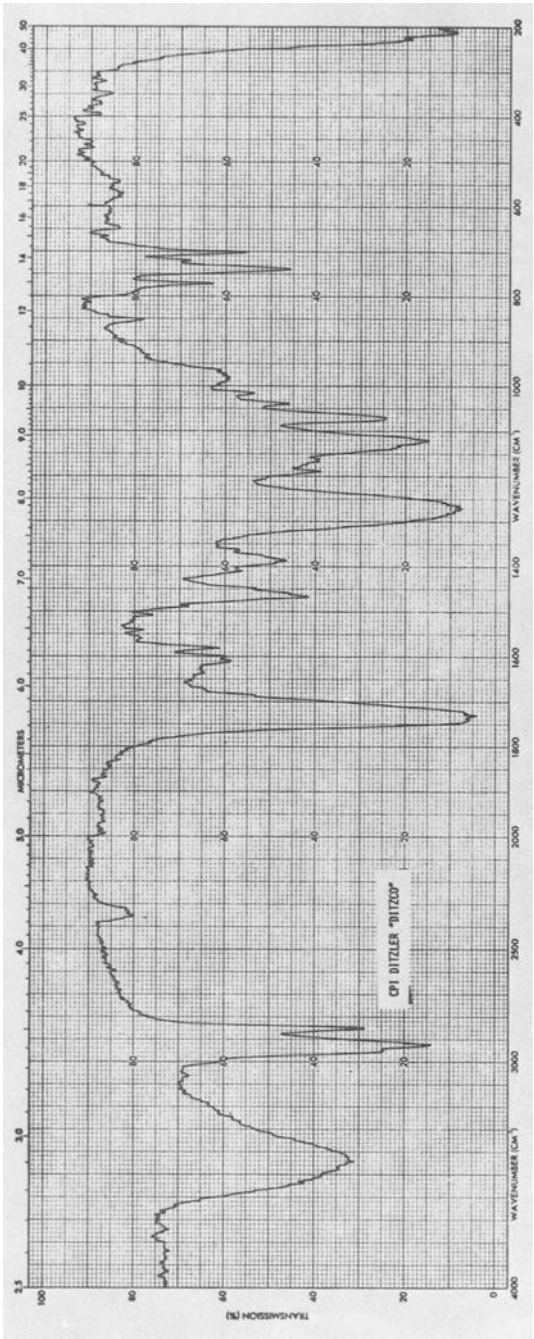

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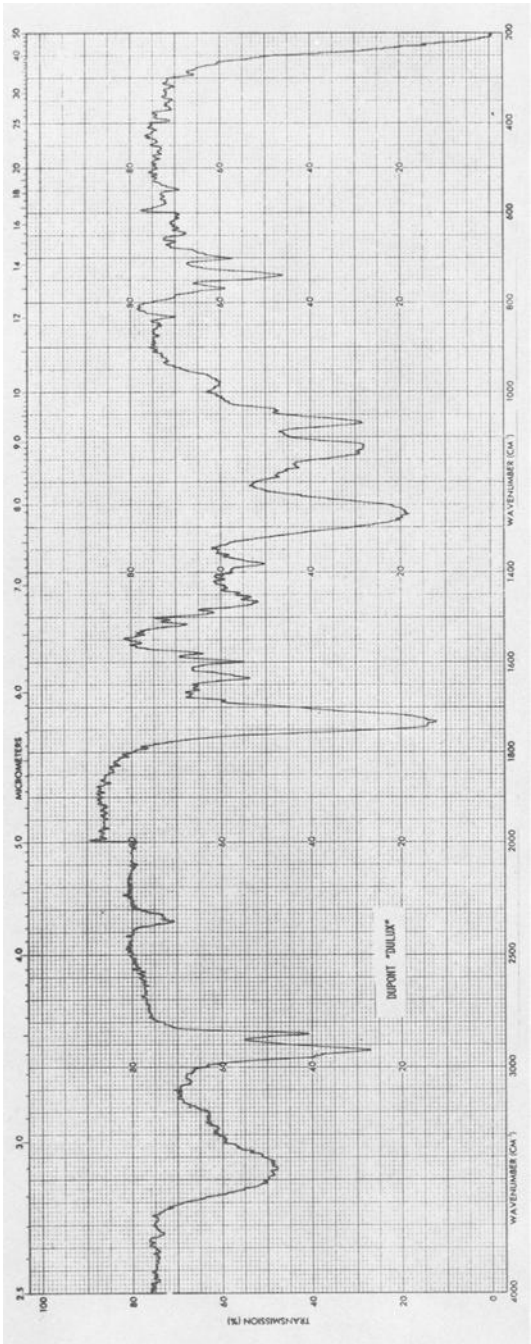

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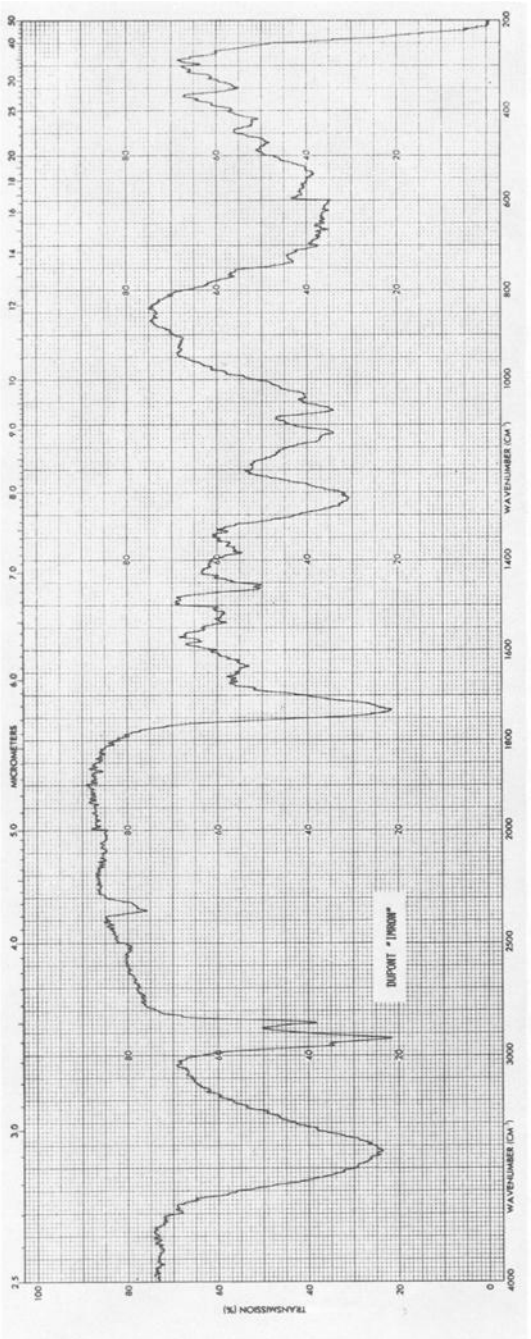

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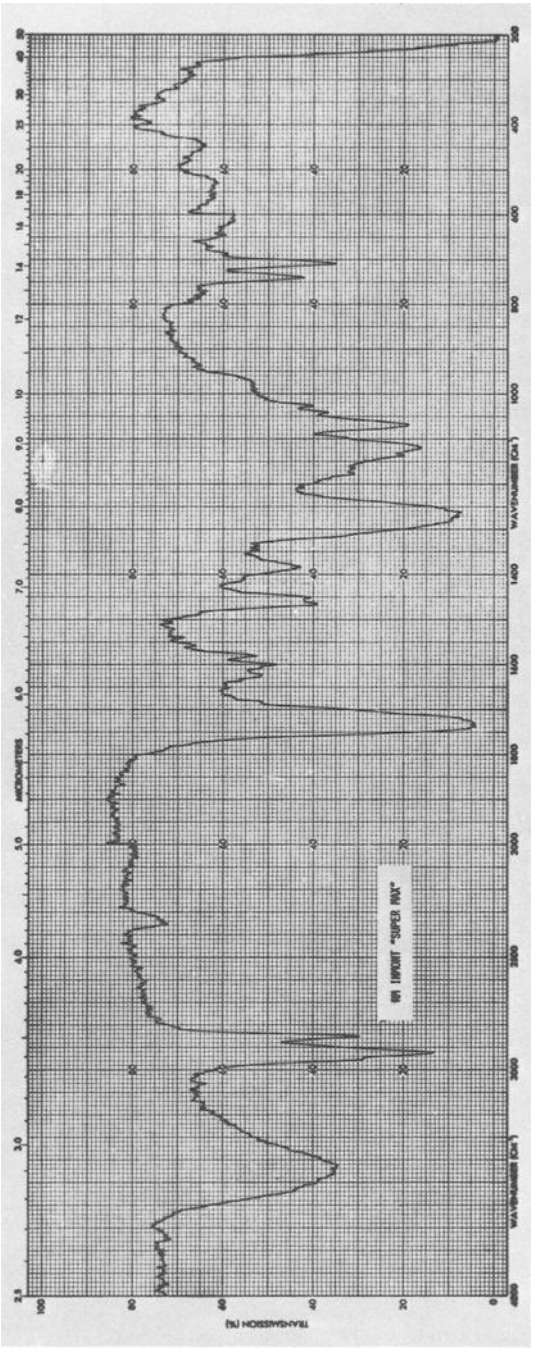

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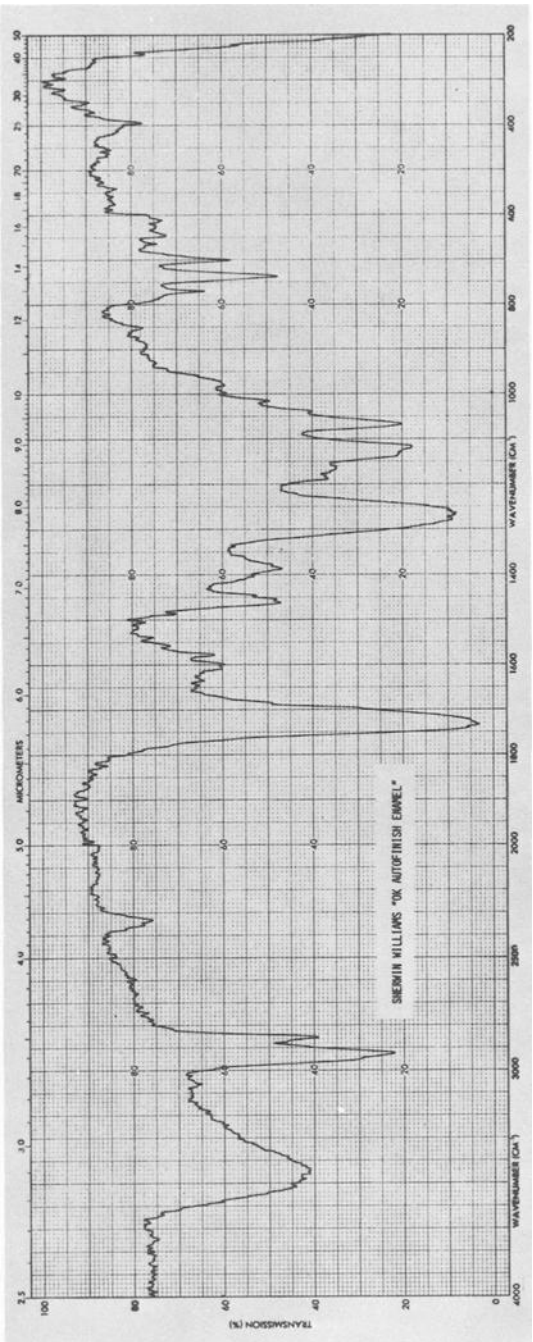

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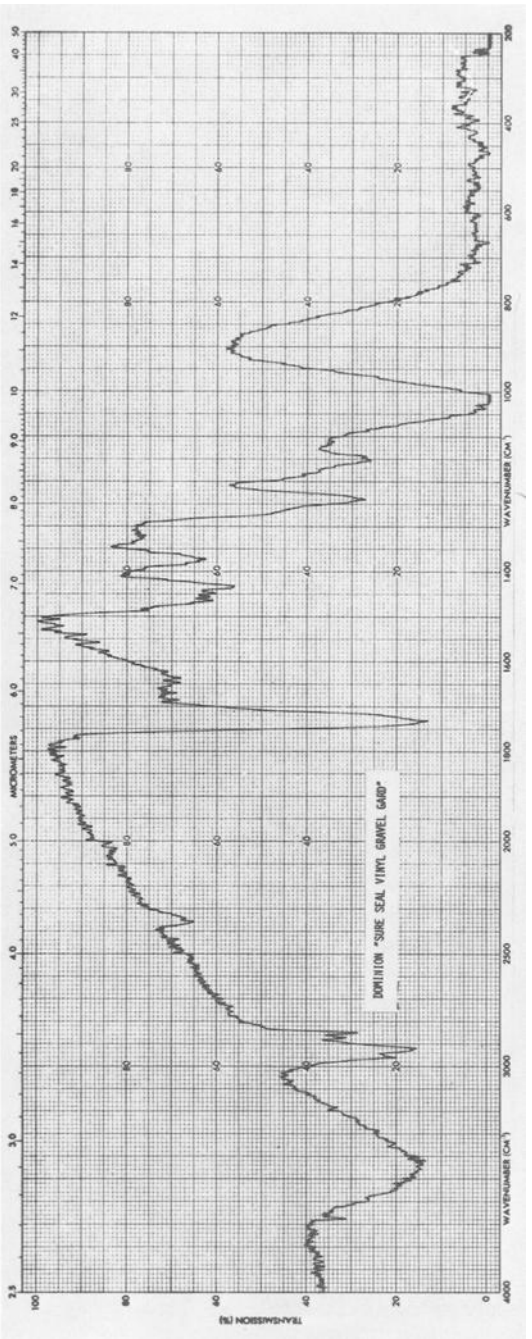
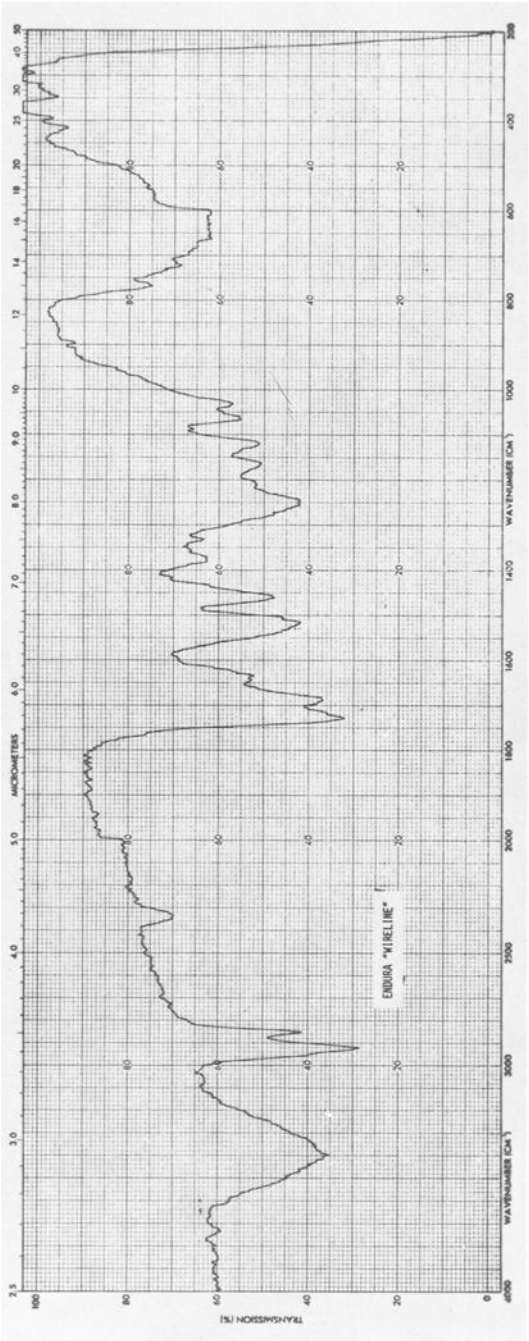


FIG. 4—*North American paint vendors' specialty finishes.*



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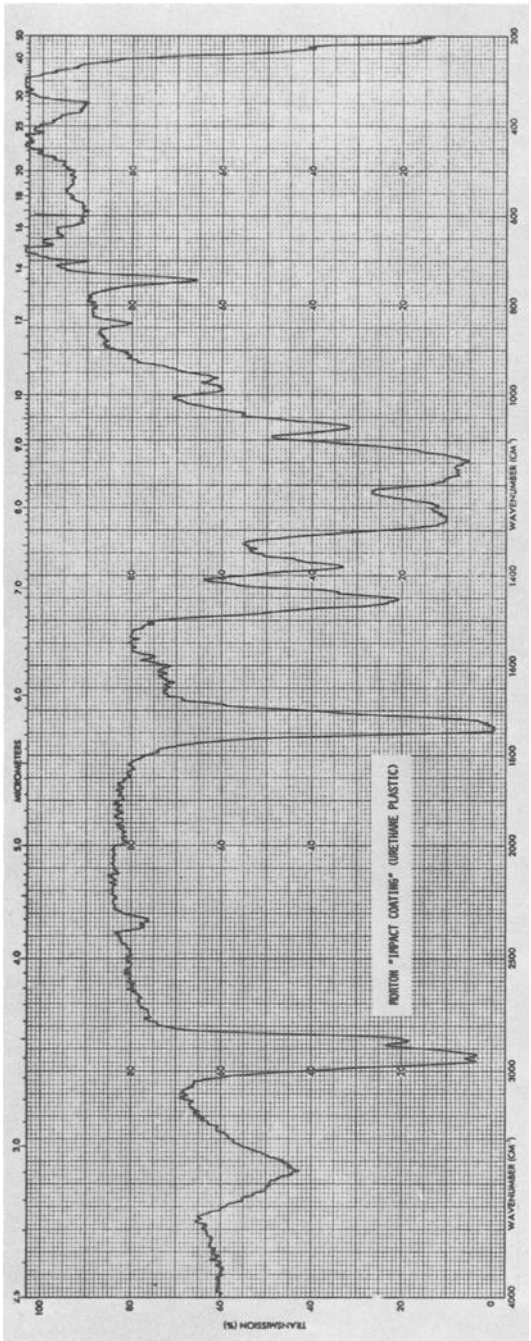

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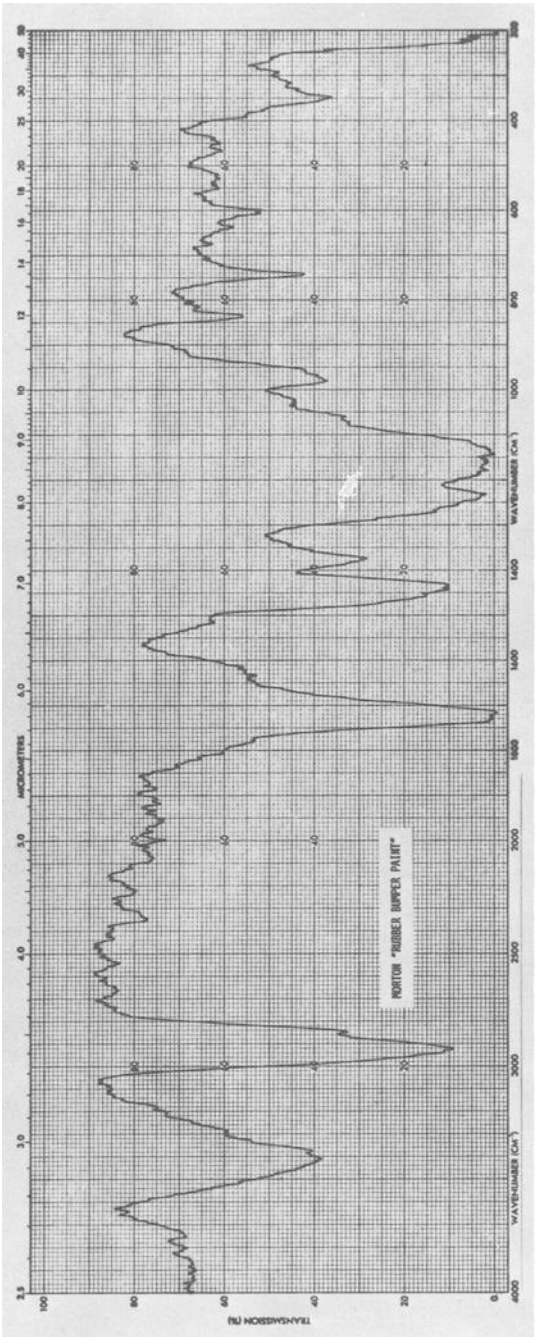

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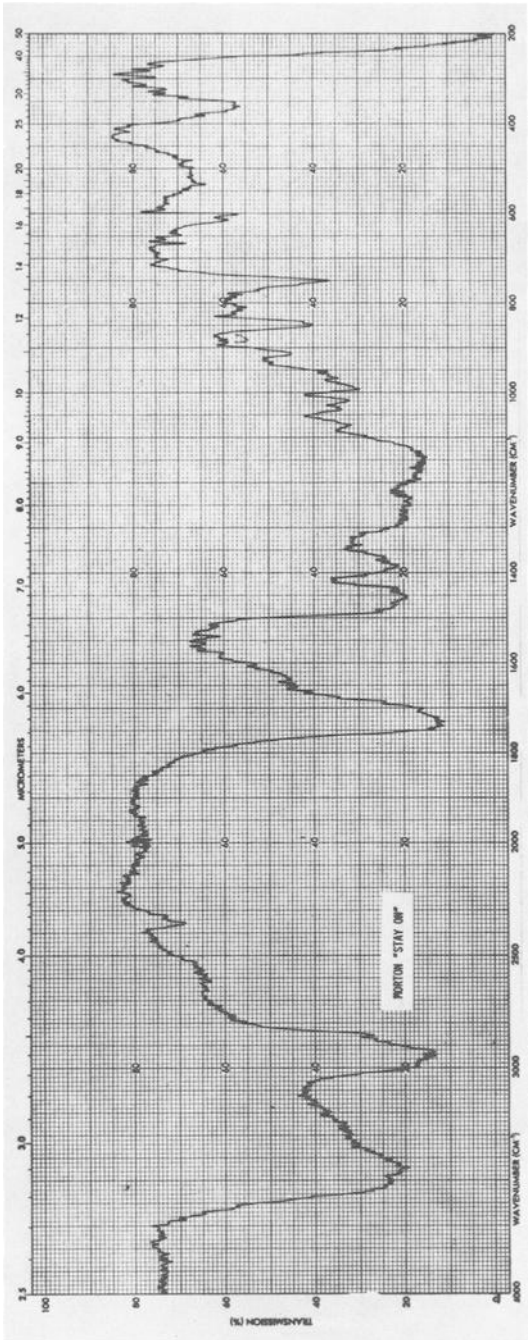

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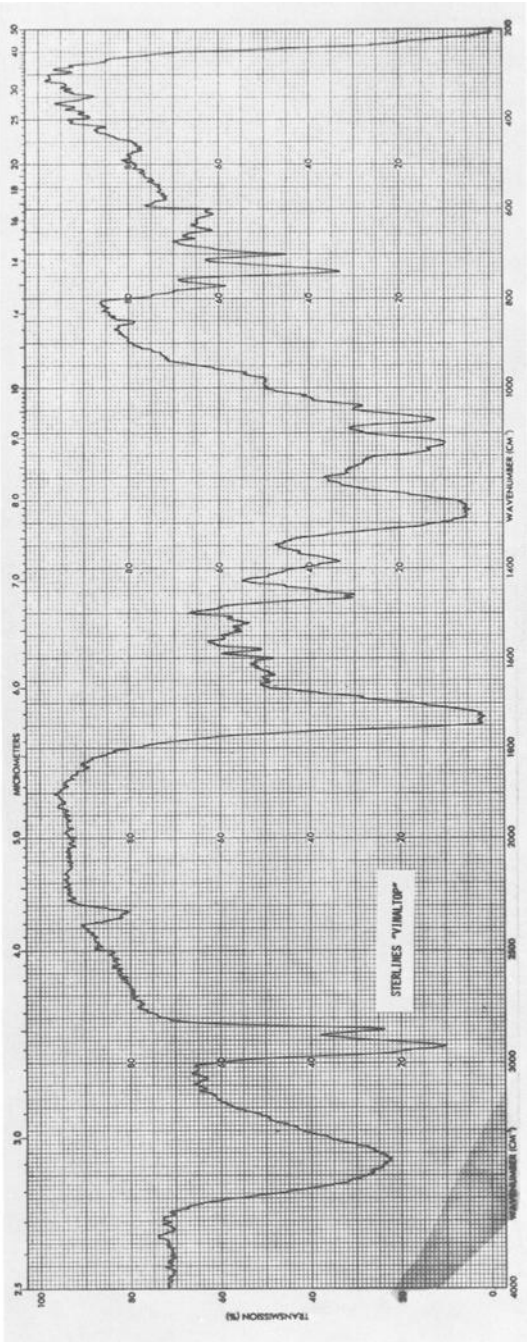

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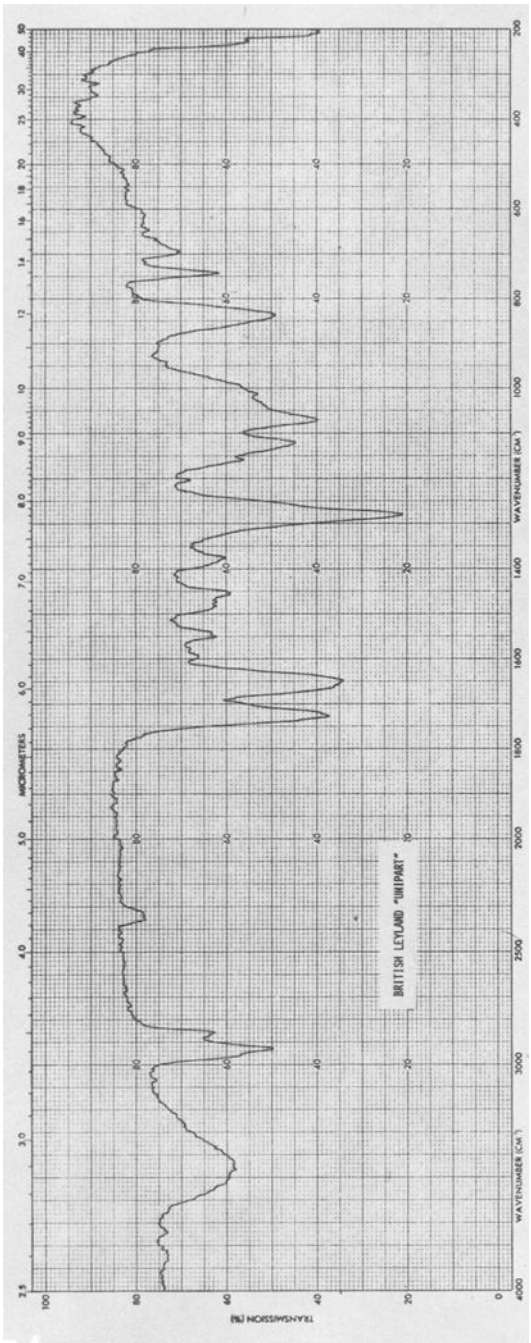
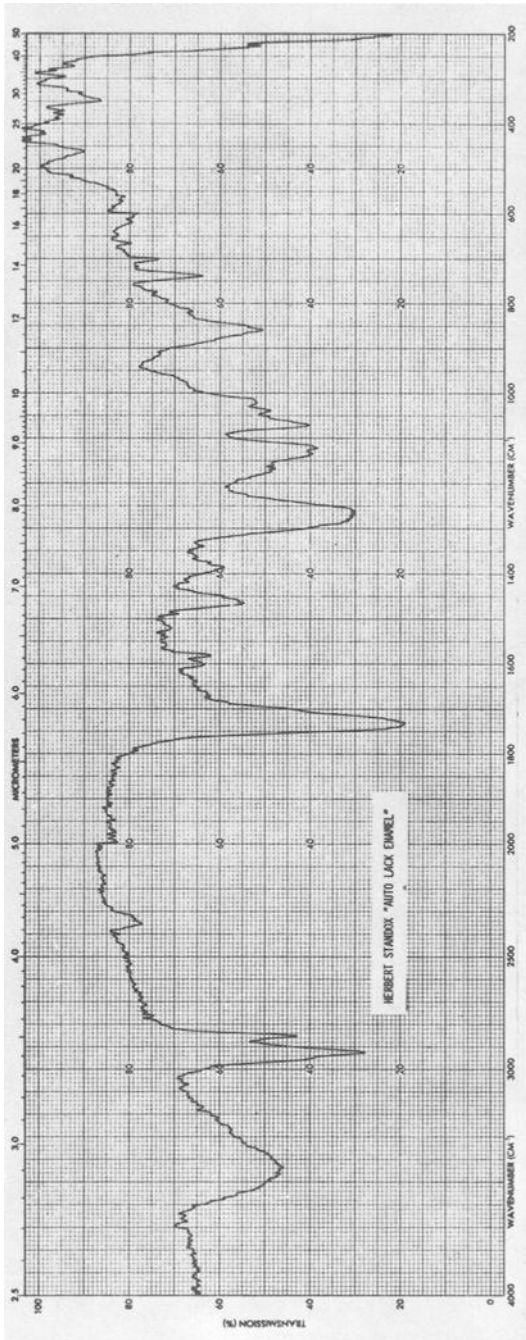


FIG. 5—*Factory package "alkyds."*



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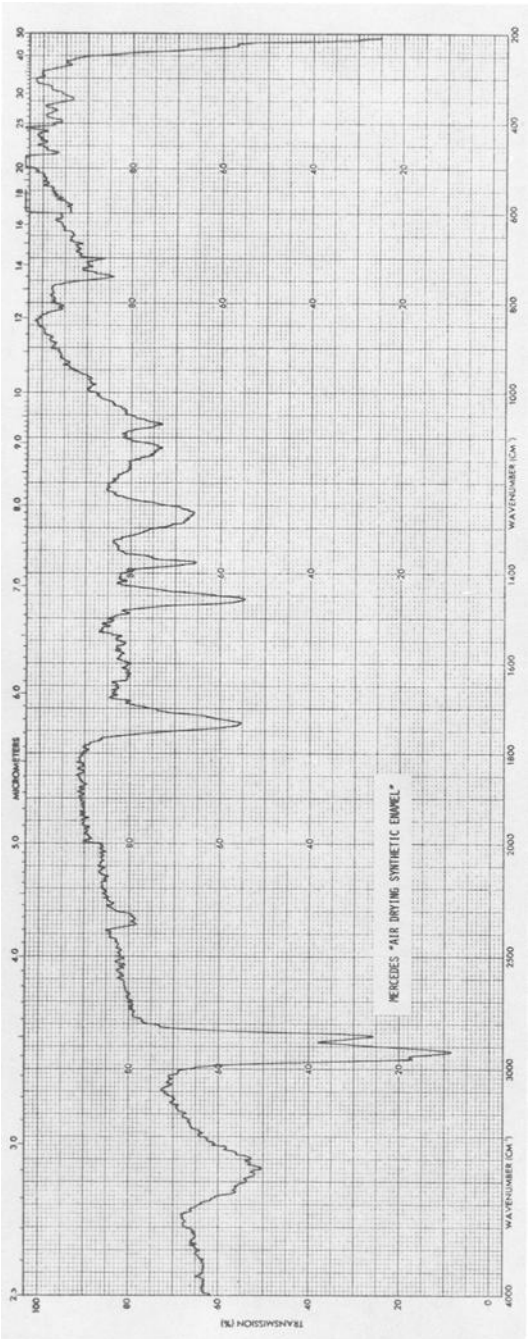

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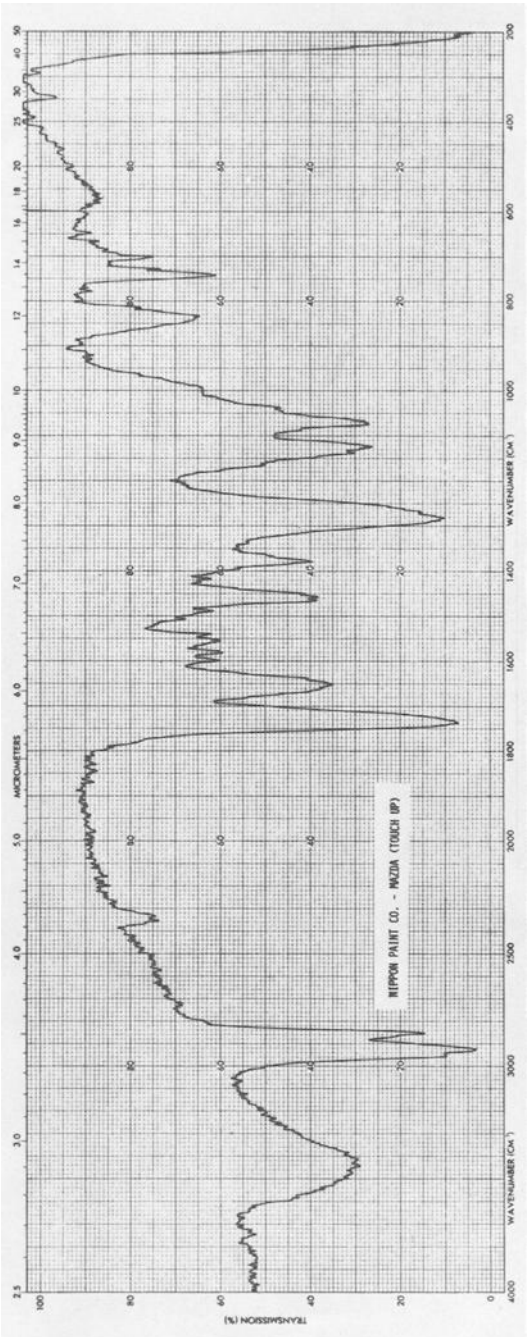

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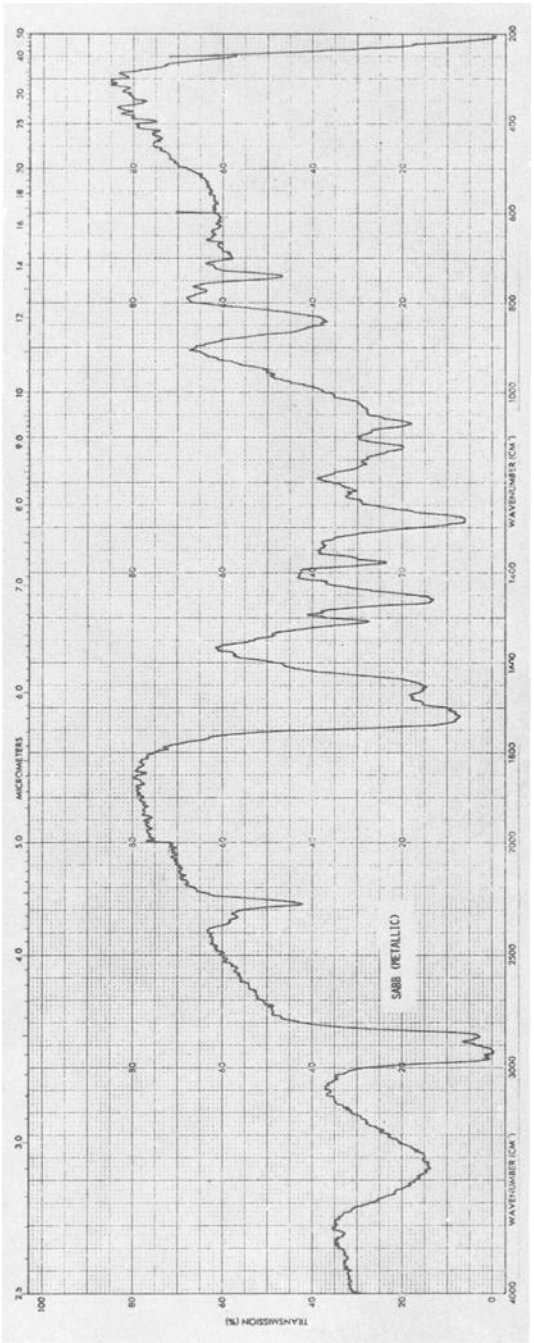

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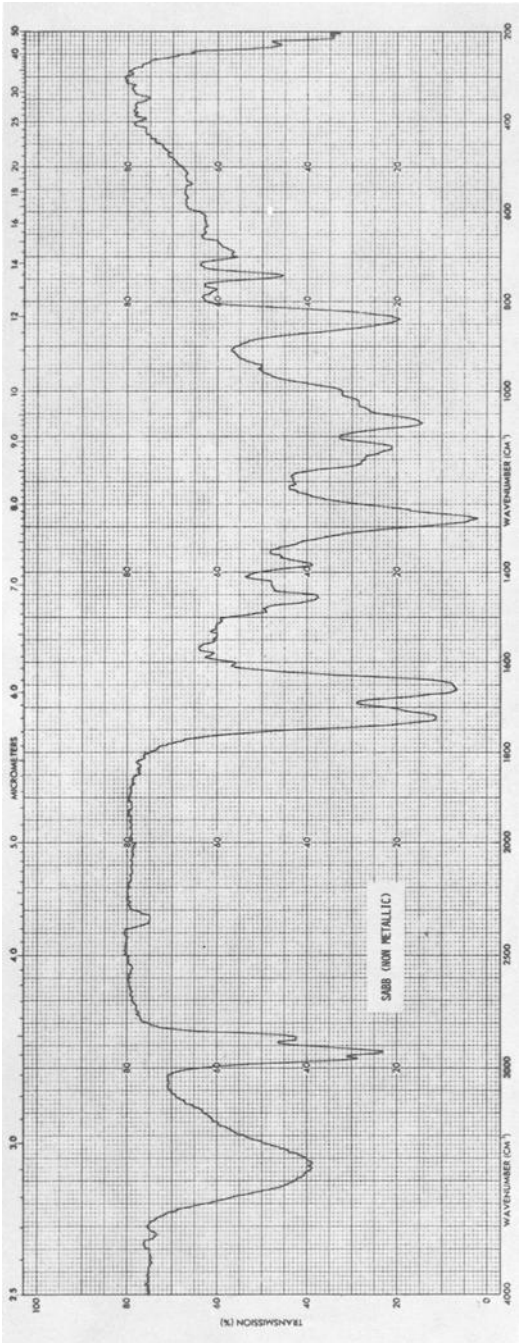

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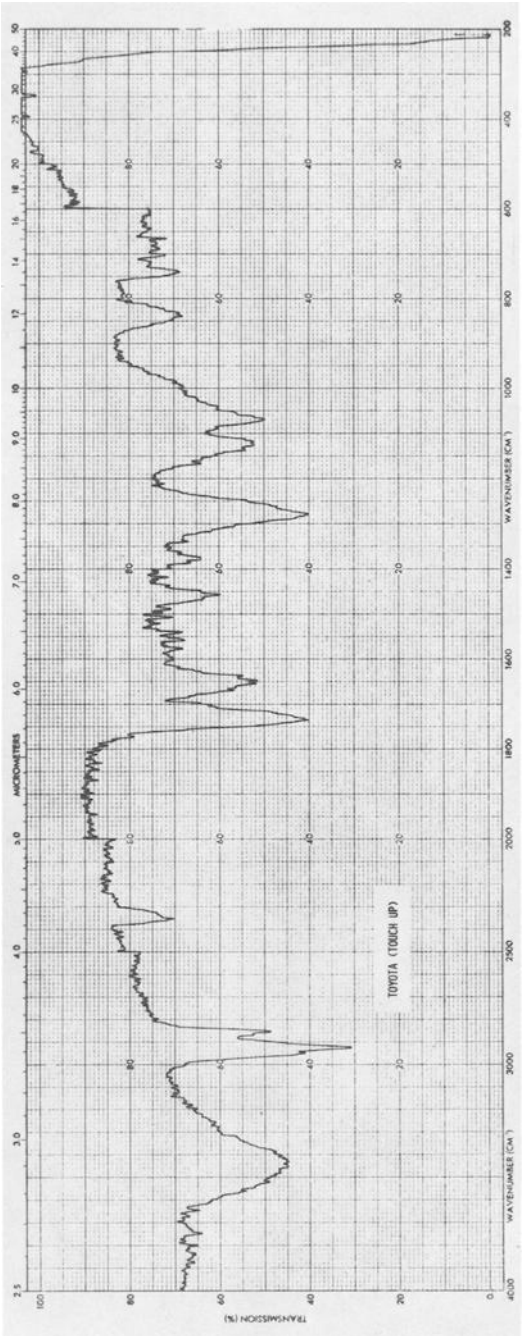

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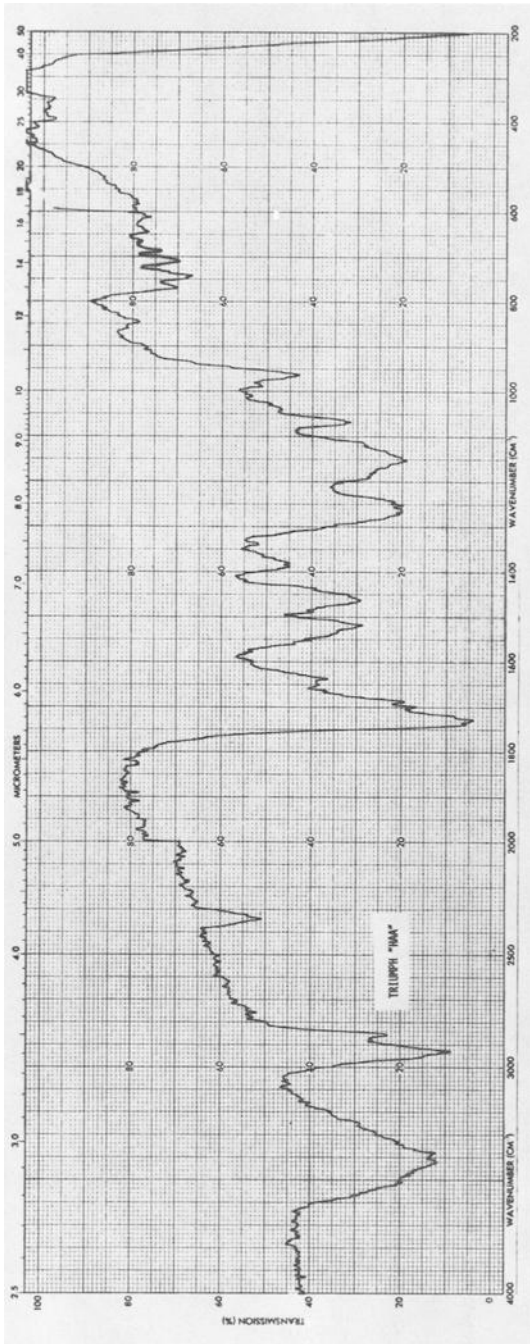

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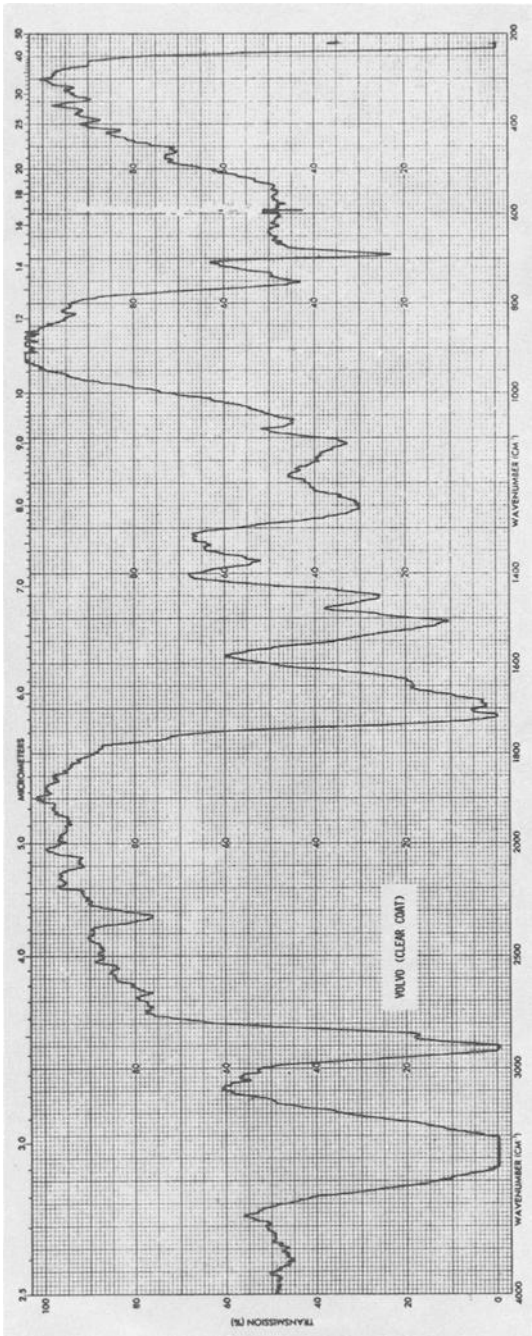

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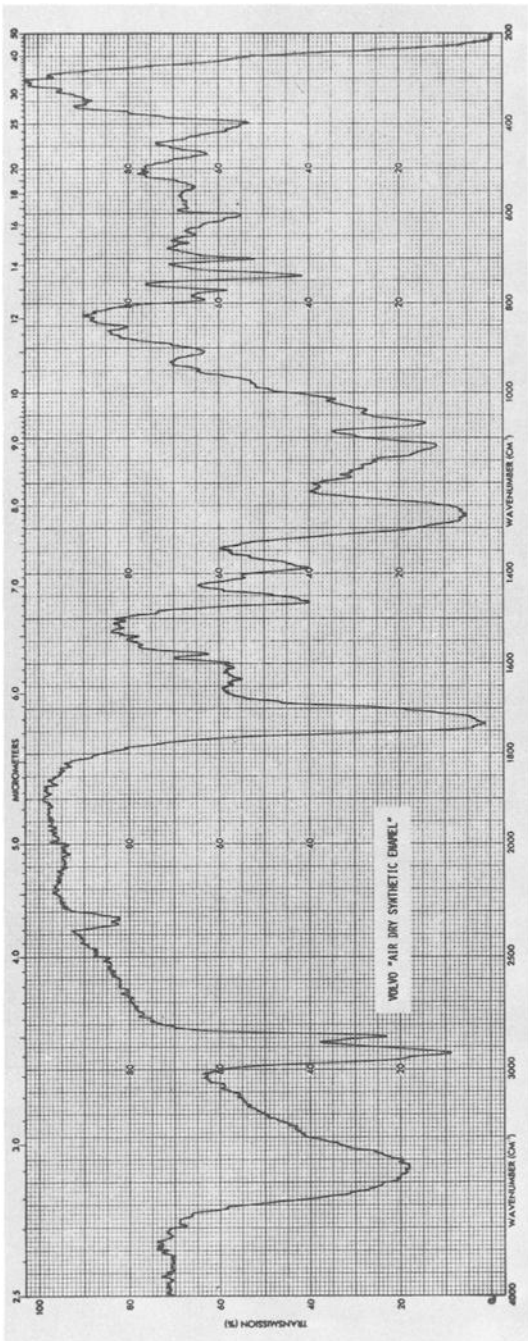

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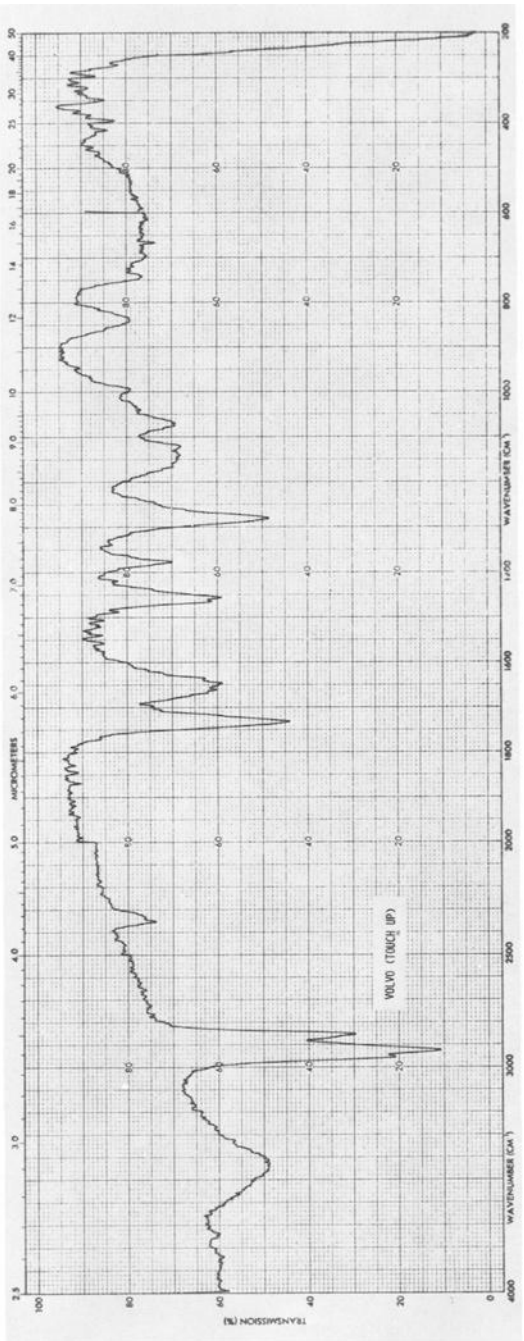

FIG. 5—*Continued.*

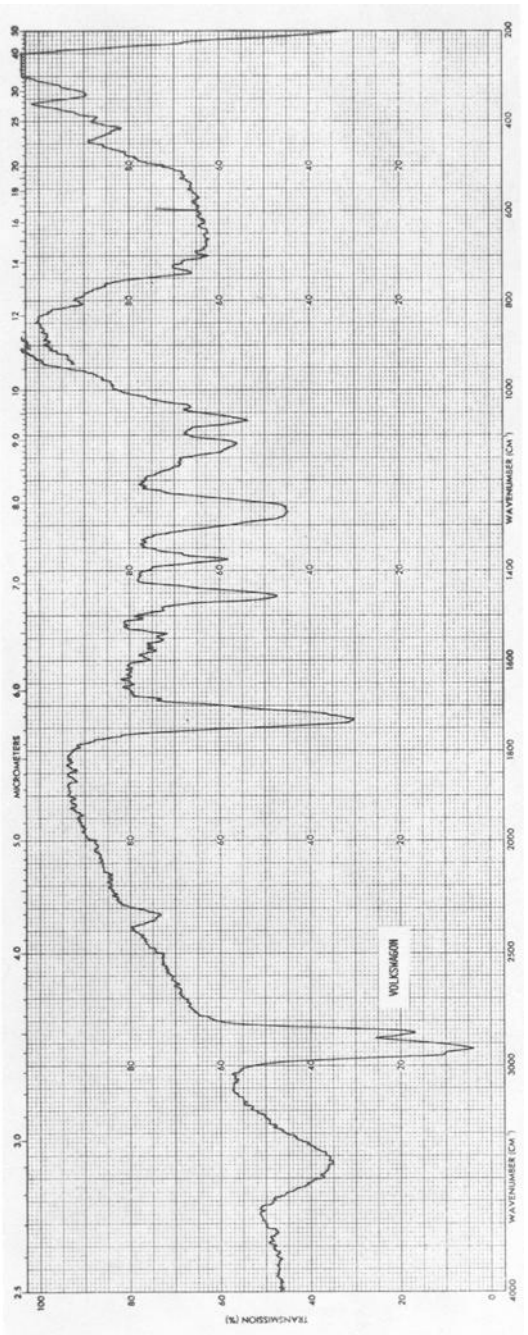

FIG. 5—*Continued.*

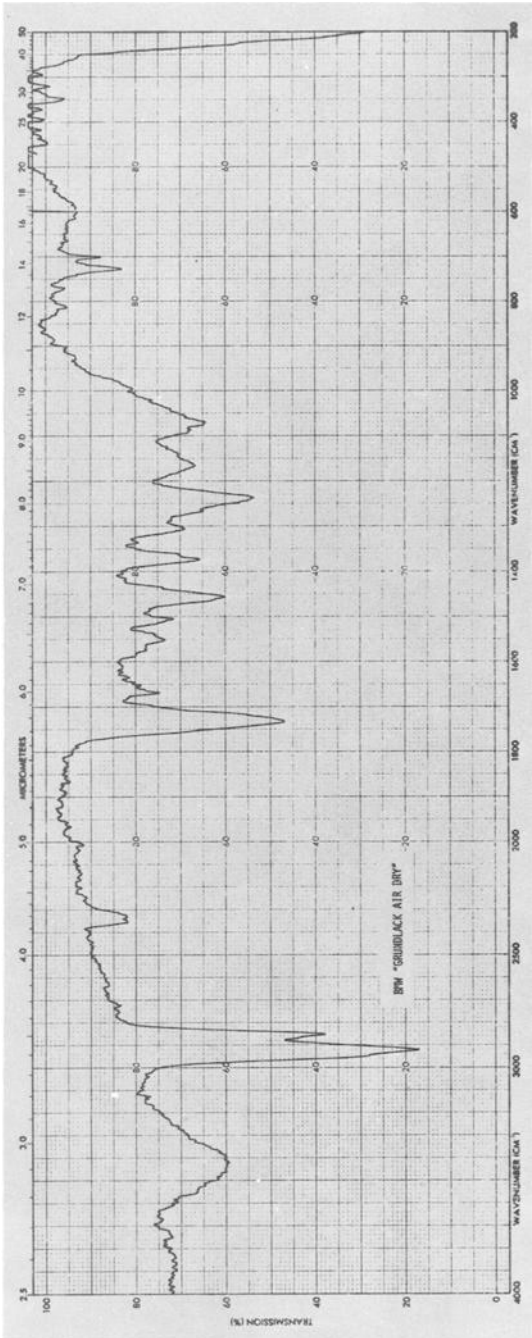

FIG. 6—Factory package "acrylics."

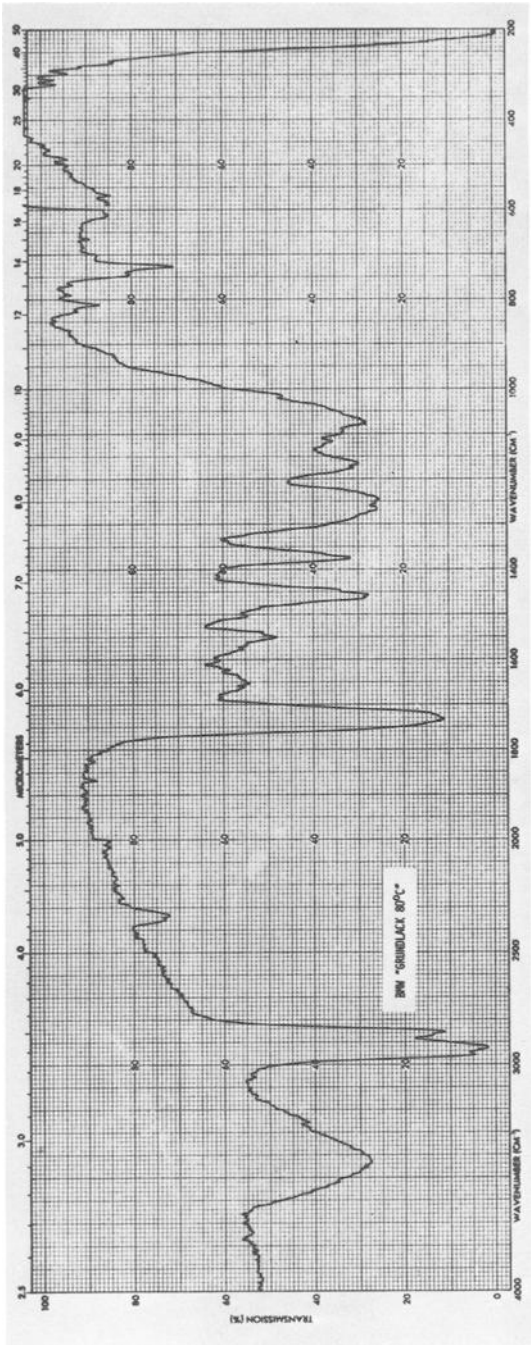

FIG. 6—*Continued.*

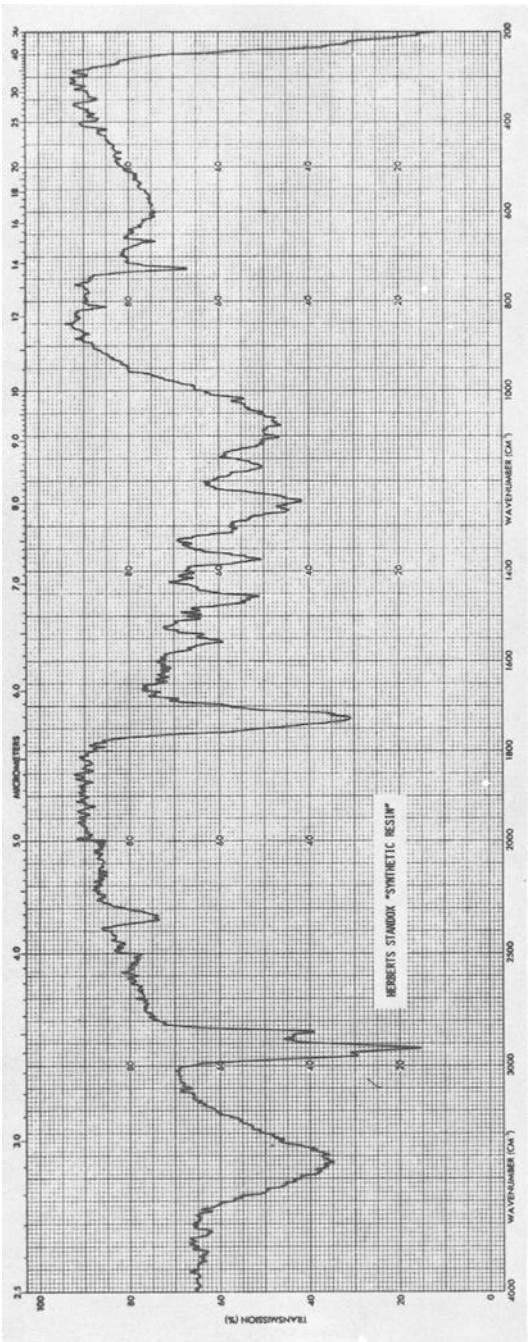

FIG. 6—*Continued.*

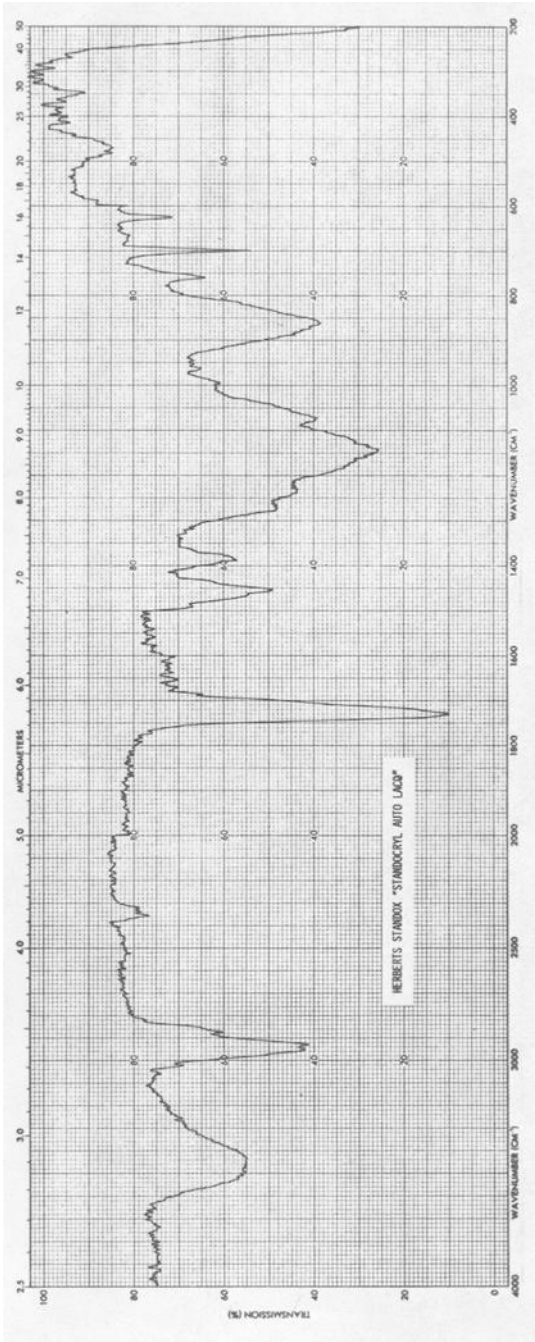

FIG. 6—*Continued.*

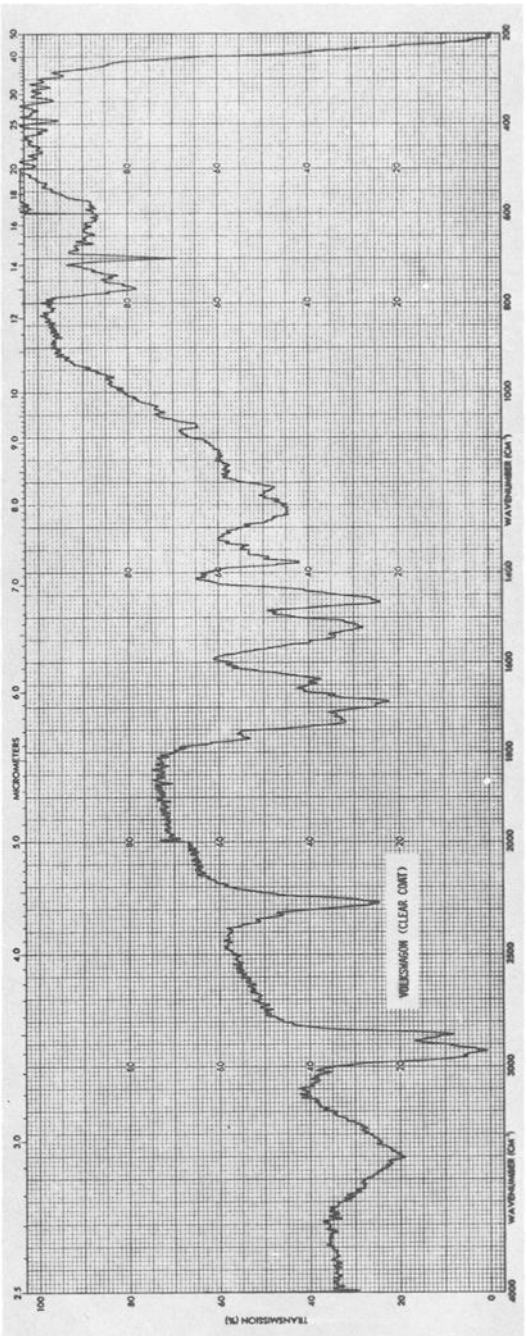

FIG. 6—*Continued.*

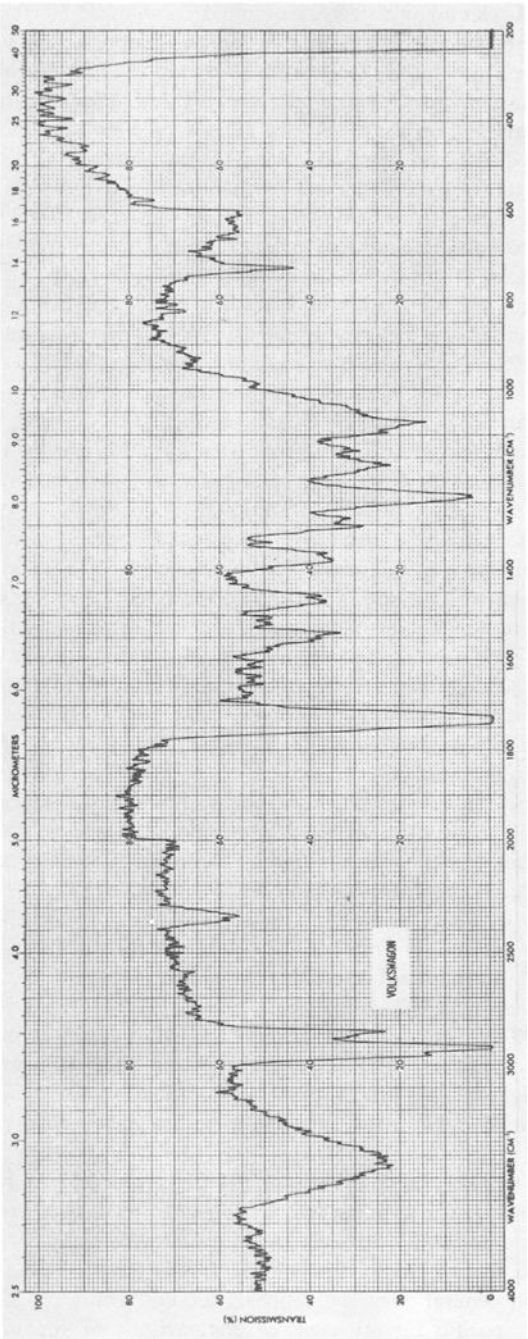

FIG. 6—*Continued.*

understanding that DuPont makes a specific Lucite product for Saab cars and that RM Inmont makes a product for Peugeot (we were unable to obtain a sample of the latter in our area). The British imported vehicles (Austin, Jaguar, and others) were being repaired with British Leyland's own factory-supplied paint while North American manufacturers' products were generally being used on Japanese imports.

For the North American vehicles, in general, the body shops used the more expensive acrylic lacquer-type finishes when repairing General Motors' vehicles to maintain compatibility with the finish already on these vehicles. The acrylic-type products were generally used for repairing Ford, Chrysler, and American Motors vehicles. However, for compatibility of chemical formulations, the alkyd finishes were still generally being employed for most trucks, imported cars, and older North American cars. When the whole vehicle required repainting no specific brand of paint appeared to be employed. In fact, the repair shops tended to use North American manufacturers' paints for all types of vehicles.

Because the products represented by the spectra in Fig. 4 are being used as protective coatings or topcoats on vehicle bodies and extensions, they were included in this survey. The Endura Wireline® products were the only finishes in Fig. 4 that were used as a true topcoat. Dominion's Sure Seal Gravel Guard® was being employed on fender wells and rocker panels to protect against stone chips and rusting. The Morton's Impact Coating®, Stay-on®, and Rubber Bumper® products were used as paint additives when extensions such as bumpers and rubber moldings were being painted. Vinyl tops and door protection moldings were restored with Sterline's Vinal Top®.

From the results of our survey, the identification and apprehension of a hit-and-run repainted motor vehicle are not impossible. In the majority (80 to 90%) of the cases, the vehicles have been repaired on a specific area and the repair shop has tried to match as closely as possible the original color of that vehicle. The forensic scientist can, therefore, supply the investigator with some information that may, within certain limits, aid him in his investigations. Of course, the investigator must bear in mind that the information is only an investigational aid and represents the most probable source he should look for. Other possibilities can never be overlooked. Following are some examples of the type of information that can be supplied.

If the physical appearances and chemical composition of the topcoat match a type employed on a specific European or British imported vehicle as a factory-packaged repaint, the investigator can then be reasonably confident that he is searching for that specific type of vehicle. If the chemical composition, as determined by IR, matches one of the IR spectra for a domestic product (Figs. 1-6), the forensic chemist can supply the investigator with certain information. The topcoat color can be closely matched, through topcoat color information books [*10,11*], to that employed for a limited range of years on a specific vehicle (for example, the 1974 to 1976 Chrysler color G8, "Deep Sherwood Metallic"). The chemical composition of the paint, as determined by IR analysis, can be matched to a specific paint manufacturer's products (for example, DuPont's Centari®). The investigator using this information can then approach the local body shops that employ this type of paint in an attempt to locate any vehicle repaired with this topcoat color.

The lack of some of the varied application techniques employed by the automotive factories and the recent trends in more "off spec" colors originating from these factories often give the body shops trouble in trying to duplicate the damaged vehicle's original finish. The continued use of innovative materials and "eyeballing" techniques by the repair shops to obtain general color and appearance uniformity on the repaired panels lends itself to more specific forensic science comparisons of repainted vehicles. For instance, the size, shape, and distribution of metallic flakes within the topcoat layer as well as its specific color become more meaningful. In addition, the fact that the chemical composition of the topcoat matches that of a DuPont Centari product as opposed to a

CIL Cilux II® becomes more significant. No longer is a repainting of an automobile "just a new look" for that vehicle.

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Address requests for reprints or additional information to
R. J. Audette, Ph.D.
Provincial Analysts Laboratory
Alberta Agriculture
O. S. Longman Building
6909—116 St.
Edmonton, Alberta, Canada T6H 4P2