coholic products), coated tablets, leather, fibers, cosmetics, etc., are first extracted and then applied to the layers. About 200 mL of developing solvent in a chromatographic development tank is then used to develop the chromatograms up to 10 cm. The data for the different developing solvents and adsorbents (stationary phases) used for the separation of a variety of synthetic dyes, along with specific characteristics of the separation procedure, if any, are tabulated in Table 1. Details of specific separations follow.

## A. Cationic Dyes

Cationic dyes—Acridine Orange, Crystal Violet, Janus Green B, Methyl Violet, Neutral Red, Pyronin B, Pyronin Y (G), Safranin, Victoria Blue B, and Victoria Blue 4R—commonly used in histology, were studied by TLC on the Marshall and Lewis system (115). Marshall also separated some Sudan dyes, used for the histological staining of fats, on silica gel TLC sheets using benzene–$CHCl_3$ (10:1) as the mobile phase (115).

Owing to the poor results obtained by LC separation of the dyes Victoria Blue R, methylene blue, and fluorescein because of the similar colors of the blue dyes, a replacement dye mixture was prepared comprising Oil Red O, Victoria Blue R, and fluorescein. Preliminary studies were done using TLC with ethyl acetate or 95% ethanol as developing solvent and densitometric scanning at 370–700 nm (115a).

Wakasmundzka (115b) studied the retention behavior of 16 heteroazophenol dyes in normal-phase systems by TLC. Solutions of each of the 16 dyes, from four different heterocyclic systems, viz., 1,3,4-thiadiazole, 1,2,4-triazole, and benzimidazole conjugated with pyrocatechol, and $\beta$- and $\gamma$-resorcylic acids were applied to plates (10 × 20 cm) coated with alumina basic 60 E $HF_{254}$ (0.25 mm thickness). The mobile phases were ternary mixtures of ethyl acetate, THF, methanol, or propan-2-ol in $CH_2Cl_2$ containing 2% acetic acid. The most selective systems were those containing methanol or propan-2-ol as polar modifiers.

## B. Food Dyes

The developing systems used for the separation of food colors are recorded in Table 1. Some typical $R_f$ values of water-soluble dyestuffs (72) are recorded in Table 2 along with the $\nu_{max}$ value and percent recovery of each dye. Slightly soluble food dyes can be studied at elevated temperatures (102). Twenty-two high-boiling organic solvents were used as eluents, including hydrocarbons and esters. Using the selected solvents, indigo was chromatographed on a silica gel layer at 150°C. The data are recorded in Table 3.

Sherma (115c) reviewed TLC analysis of a number of agricultural products, foods, beverages, and plant constituents from mid-1995 to mid-1999. Techniques and applications for a wide range of analyte and sample matrix types were covered, with specification of the particular layers, mobile phases, detection methods, and quantification conditions in many cases.

Soluble dyes from spices were separated and identified on alumina plates using methanol–liquor ammonia (8:2 v/v) as mobile phase (43). Bright-colored spots of respective coal tar dyes are separated and observed with the following $R_f$ values: Rhodamine B, 0.93; Metanil Yellow, 0.87; erythrosine, 0.83; Fast Red E, 0.71; carmoisine, 0.69; Sunset Yellow FCF, 0.66; tartrazine, 0.46; Ponceau 4R, 0.32; and Amaranth, 0.22.

Food dyes permitted in Japan were investigated under fast atom bombardment (FAB) and liquid secondary ion (LSI) MS conditions with the use of various materials. The mobile phase was 10% $Na_2SO_4$ solution–methanol–ethyl methyl ketone (7:2:2) for xanthenes and 10% $Na_2SO_4$ solution–methanol–acetonitrile (10:3:3) for other dyes (102a). Seven permitted coloring materials used in foods and pharmaceutical preparations in Egypt were separated by two-dimentional TLC on cellulose layers (102b).

Oka et al. (102c) studied the identification of illicit dyes in foods by thin layer chromatography coupled with fast atomic bombardment and mass spectroscopy (TLC/FAB-MS). These dyes were extracted and transferred onto pure wool in a medium of aqueous acetic acid; the wool was then transferred into methanol. Glass plates coated with octadecyl sulfate (ODS) were used for TLC with mobile phases of aqueous 5% $Na_2SO_4$–methanol–acetonitrile (10:3:3) or aqueous 5%