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Review Contents

Drugs and Poisons	123R
Ethanol and Volatiles	123R
Cannabinoids	124R
Morphine and Related Narcotics	125R
Cocaine	126R
Amphetamines	127R
Barbiturates	128R
Miscellaneous Drugs and Poisons	128R
General Procedures	130R
Trace Evidence	131R
Petroleum Products	131R
Explosives	131R
Gunpowder and Primer Residue Detection	131R
Fingerprints	131R
Fibers and Paint	131R
Miscellaneous	132R
Forensic Biochemistry	132R
Literature Cited	135R

It is the aim of this article to present a concise survey of articles appearing in publications that primarily appeal to forensic practitioners. To accomplish this objective, we have focused our attention on the following journals: *Journal of Forensic Sciences*, *Science & Justice*, *Forensic Science International*, *Journal of the Canadian Society of Forensic Science*, *Journal of Forensic Identification*, *Forensic Science Review*, *Analytical Toxicology*, and *The Microscope*, as well as *Chemical Abstracts Selects: Forensic Chemistry*. Our survey encompasses the period from January 1994 through December 1996. Because of the normal delays in the abstraction of journal articles by Chemical Abstracts, some work covering this period will inadvertently be omitted. Hopefully these references will be included in the next biennial review.

The format selected for this survey divides coverage into three distinct areas: drug and poisons, trace evidence, and forensic biochemistry. Within the scope of each of the areas, articles have been selected to describe current forensic science practices in analytical chemistry and to outline relevant forensic science research interests. To keep our discussion concise and meaningful, we have limited our survey to drugs regulated under the United States Controlled Substances Act, ethanol, and common poisons. Furthermore, to eliminate unnecessary duplication of effort, citations of articles appearing in *Clinical Chemistry*, *Journal of Pharmaceutical Sciences*, and other pharmaceutical journals have been minimized. We believe that ample coverage of these journals is provided within the pharmaceutical and clinical chemistry reviews planned for this journal. It is recommended that interested readers consult these sections in order to obtain a complete survey of the drug-abuse subject.

DRUGS AND POISONS

Ethanol and Volatiles. Important events and trends in the evolution of chemical tests for alcohol intoxication on two continents, Europe and North America, have been reviewed (*1*).

The latest review of the recommended standards and procedures of the Canadian Society of Forensic Science Alcohol Test Committee for the performance of breath tests as well as minimum standards for training police officers has been presented (*2*). The effect of short time interval sampling between replicate breath alcohol samples has been investigated (*3*). The ratio of blood alcohol concentration to breath alcohol concentration was determined by headspace gas chromatography (GC) and an infrared (IR) analyzer for 799 individuals apprehended for driving under the influence (DUI) in Sweden (*4*). Two IR breath alcohol analyzers, the Alcotest 7110 and the Intoxilyzer 5000C, were evaluated against blood results and against the Breathalyzer 900A currently used by Canadian police agencies (*5*). The absorption time of ethanol in social drinkers was studied by determining blood alcohol concentration using the Intoxilyzer 5000 (*6*). An evaluation of the reliability of Widmark calculations based on breath alcohol measurements has been reported (*7*). Platinum-based membrane electrode assemblies have been prepared to make electrochemical measurements of breath alcohol levels (*8*). The effect of nonethanolic substances on the Alcolmeter S-L2 have been studied (*9*). Interfering substances identified in the breath of drinking drivers with the Intoxilyzer 5000S has been studied (*10*). Breath alcohol analysis was used to determine the effect of cimetidine on the blood alcohol concentration after repetitive drinking of small alcohol doses (*11*). Commercial compressed vapor−alcohol mixtures ("dry gas") were evaluated to ascertain their suitability for control tests in breath alcohol analysis (*12*). The statistical analysis of nontransformed and logarithm-transformed blood-to-breath alcohol ratios ("blood/breath ratios") has been detailed (*13*).

The effect of alcohol and energy drinks consumed at the same time on the impairment of a person's ability to drive has been discussed at a legal case of a 20-year-old car driver causing a traffic accident (*14*). A total of 9854 blood samples were analyzed to determine the reliability of the calculation of the blood alcohol level for the time of offense (*15*). The rate of disappearance of alcohol from the blood was determined in drinking drivers by taking two blood samples about 60 min apart (*16*). Breath alcohol measurements were conducted to determine the volume of distribution for ethanol in male and female subjects (*17*). Serum samples spiked with alcohol and whole blood samples submitted from outside agencies were analyzed for alcohol concentration to determine the effect of storage at various temperatures on the alcohol concentration (*18*). The suitability of headspace GC with

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a capillary column has been evaluated as a method for determining the ethanol content in different biological fluids (*19*). The forensic significance of the dilution by intravenous fluids of blood samples collected for medicolegal alcohol analysis was presented through two case reports (*20*). Comparison of ethanol concentrations in blood, serum, and blood cells was accomplished by headspace GC (*21*). GC/flame ionization detection (FID) was used to determine the serum alcohol/blood alcohol ratio in 134 samples (*22*). Three gas chromatographic procedures for the determination of ethanol in postmortem blood using internal standards alternative to 1-propanol have been presented (*23*). The relation between postmortem blood alcohol concentration (BAC) and water content in blood specimens has been described by a multiple regression equation (*24*). GC/FID was used to determine BAC in blood samples collected by transthoracic (TT) puncture to determine the effect of trauma in postmortem BAC (*25*). A series of cases was investigated with the aims to study the impact of immigrant status and alcohol abuse on the occurrence of the forensic diagnosis on the mode of death (*26*). Ethanol was determined by headspace GC in the blood and liver specimens from 103 postmortem cases (*27*). An enzymic test device, quantitative ethanol detector (QED), intended for on-the-spot analysis of ethanol in saliva, was evaluated by laboratory experiments (*28*). A study has indicated that the ratio of serotonin metabolites in urine provides a useful method to distinguish between ethanol that might have been synthesized postmortem, or generated in vitro, from ethanol excreted in urine as a result of drinking (*29*). Ethyl glucuronide, a minor ethanol metabolite, was determined by GC/mass spectrometry (MS) in serum or urine (*30*). The role of ethanol in deaths due to heroin intoxication was evaluated using radioimmunoassay (RIA) (*31*). The validity of the variables and accuracy of the Drug Evaluation and Classification program has been evaluated (*32*). The in vitro production of ethanol in urine by fermentation has been studied (*33*). A brief scientific overview of the effects of cimetidine on the blood alcohol curve and a review of a case has been described (*34*).

Headspace GC/FID was used to test ethanol in blood from fatally injured drivers in Washington state, and enzyme immunoassay (EMIT), thin-layer chromatography (TLC), and GC was used to detect drugs in both blood and urine of these same drivers (*35*). The extent of drug use among drivers suspected of driving under the influence of alcohol and/or drugs in Finland was studied (*36*). Sex differences in the use of alcohol and drugs among Norwegian drunken or drugged drivers were presented in a study (*37*). The full-evaporation headspace technique (FET), used to overcome matrix effects, was combined with capillary GC and ion trap detection (ITD) to quantitate volatile organic compounds in biological samples from victims who had inhaled smoke during an arson or accidental fire (*38*). A purge-and-trap concentrator with a Tenax trap was coupled to GC/Fourier transform infrared spectrometry (FT-IR) for the identification of volatile organic compounds in casework blood samples (*39*). The identification of acetone and 2-propanol by headspace GC in the blood of a man suspected of driving under the influence of alcohol has been reported (*40*). Congener production in blood samples during preparation and storage was studied using capillary GC (*41*). Endogenous methanol was determined in 72 men after a 12 h period of fasting and abstinence from alcohol (*42*). Methanol was determined by GC/FID, GC/MS, and enzymatic assay in the blood of an infant who survived methanol intoxication from moderate metabolic acidosis (*43*). Static headspace GC/MS was used for the qualitative and quantitative determination of residual solvents in illicit cocaine HCl and heroin HCl (*44*). Headspace GC/MS was used to detect toluene and other volatiles in the specimens collected at autopsy (*45*). Chloroform was determined by headspace GC in blood from three related homicide victims (*46*). Dichloromethane and chloroform were determined in biological specimens by headspace GC/MS in two cases involving deaths due to dichloromethane or chloroform poisoning (*47*). Carbon tetrachloride was determined by headspace GC/FID in body fluids and tissues from a victim of fatal accidental ingestion of carbon tetrachloride (*48*). A simple, precise, and sensitive headspace gas chromatographic method for the determination of tetrachloroethylene in whole blood and tissues suitable for forensic purposes has been described (*49*). Postmortem diffusion of paint thinner (toluene/ethyl acetate/2-butanol, 8:1:1 v/v) from gastric residue and contaminated airways was assessed in a human cadaver by headspace GC/FID (*50*). Chlorodifluoromethane was determined in biological tissues by headspace GC/MS in two cases of lethal poisoning (*51*). A GC method was developed for the simultaneous analyses of CO_2, H_2S, SO_2, and HCN in combustion gases produced by burning aircraft cabin materials (*52*). Propane was determined by GC in the blood of two men who died while connecting a liquefied petroleum gas pipe (*53*). Carboxyhemoglobin concentrations were determined in thermocoagulated blood on a CO-oximeter system (*54*). Methemoglobin was quantified by spectrophotometry and nitrites were determined by ion chromatography (IC) in blood from a victim of fatal methemoglobinemia caused by a liniment solution containing high amounts of sodium nitrite (*55*). A spectrophotometric method was compared to a headspace GC method for the determination of HCN in blood (*56*). Cyanide and thiocyanate were determined in the blood of two victims of fatal cyanide poisoning by GC/electron capture detection (ECD) and GC/MS (*57*). Headspace GC was used to investigate the effects of heat on blood cyanide concentrations (*58*).

Cannabinoids. High-performance liquid chromatography (HPLC)/MS was used to simultaneously separate and identify the constituents of hashish (*59*). *Cannabis sativa* L. products have been classified and profiled using HPLC/diode array detection (DAD) (*60*), pyrolysis GC (*61*), GC/MS, and cluster analysis (*62*), GC, HPLC/ultraviolet detection (UVD), and TLC (*63*), random amplification of polymorphic DNA (RAPD) using the polymerase chain reaction (PCR) (*64*), and RAPD and HPLC (*65*). The composition of the steam-distilled volatile oil of fresh and air-dried, indoor-grown marijuana was studied by GC/FID and GC/MS (*66*). A report has described the identification of Δ-9-tetrahydrocannabinol acetate in a substance that appears to have been derived from the acetylation of cannabis oil (*67*).

The increased detection of marijuana use with a 50 μg/L urine screening cutoff was validated by GC/MS (*68*). Detection times of cannabinoids in urine were determined using cannabinoid immunoassays with 20, 50, and 100 ng/mL cutoffs and using GC/MS (*69*). The effects of solution composition and container material type on the loss of 11-nor-Δ9-THC-9-carboxylic acid (THC-COOH) from solution was studied using fluorescence polarization immunoassay (FPIA) and X-ray photospectroscopy (XPS) (*70*). Base hydrolysis and two forms of enzymic hydrolysis were compared using GC/MS in a study to examine any quantified

differences between the hydrolysis methods (*71*). Urinary excretion profiles of THC-COOH in humans after single smoked doses of marijuana were studied using GC/MS (*72*). A validity study of the AccuPINCH THC test, a self-contained test for cannabinoids in urine, has been reported (*73*). On-line assays for cannabinoids, barbiturates, opiates, and cocaine from Roche Diagnostics were run on the automatic analyzer COBAS FARA II (*74*). THC-COOH was quantified in urine using an internal standard and HPLC with electrochemical detection (ECD) (*75*). A method has been presented that allows the confirmation of the presence of THC-COOH by a basic hydrolysis, solid-phase extraction (SPE) cleanup on reversed-phase (RP) disposable cartridges followed by analysis on a C8 RP column and UV detection (*76*). A GC/MS study of three major acidic metabolites of THC-COOH has been presented (*77*). THC and six of its metabolites have been quantified in plasma and urine by GC/MS (*78*). GC/MS and immunological methods, including EMIT II, Abbott ADx, and Roche OnLine immunoassay, were compared for the determination of THC-COOH in urine (*79*).

A sensitive and reliable method was developed for the identification and quantification of cannabinoids in blood using FPIA and GC/MSD (*80*). A reliable, simple, and sensitive method was devised to determine the levels of THC in human solid tissues using derivatization and GC/MS (*81*). HPLC/ECD was used to determine THC levels in brain tissue (*82*). A simple and robust analysis procedure for the screening and confirmation of THC-COOH in merconium has been presented (*83*). THC was determined in human saliva by tandem immunoaffinity chromatography and HPLC/UVD (*84*). The detection of cannabinoids in hair has been reported using GC/MS (*85*−*87*), GC/MS with negative chemical ionization (NCI) (*88*, *89*), and GC/MS/MS (*90*).

Morphine and Related Narcotics. Methods for the characterization and origin-correlated classification of opium have been reviewed (*91*). FPIA and GC/MS were used to test for codeine and morphine in the urine of people who voluntarily ingested poppy seeds from various origins (*92*). The total amount of morphine alkaloids in opium was determined by pyrolysis GC using principal component analysis (*93*). Reversed-phase HPLC and a spreadsheet computer program have been used as a method development tool for the simultaneous qualitative and quantitative determination of heroin in illicitly manufactured street samples containing byproducts originating from opium and also commonly occurring adulterants (*94*). A robotic procedure for the capillary gas chromatographic quantitation of heroin has been described (*95*). A survey and comparison of heroin seizures was performed using FT-IR (*96*). Heroin drug seizures have been analyzed by micellar electrokinetic capillary chromatography (MECC) (*97*). The total particle size distribution in six illicit heroin preparations were analyzed using a Malvern 2600 particle analyzer, sieving, and HPLC (*98*). The separation and detection of acidic and neutral impurities in illicit heroin using capillary electrophoresis (CE) has been described (*99*). The statistical evaluation of trace element composition of drug seizures of heroin for tracing geographical origin and method of manufacturing using inductively coupled plasma (ICP)-MS of up to 35 elements has been described (*100*). The formation of *O*-6-acetylmorphine in the "homebake" preparation of heroin has been studied (*101*). The kinetic determination of morphine in illicit powders has been described using a fluoride-selective electrode based on the reaction with 1-fluoro-2,4-dinitrobenzene (*102*). Codeine has been determined by a flow injection procedure based on the chemiluminescence generated by reaction with potassium permanganate in the presence of polyphosphoric acid (*103*). A HPLC method has been presented for the simple and rapid determination of hydrocodone in Tussionex Pennkinetic extended-release suspension in the presence of chlorpheniramine and several excipients (*104*).

A specific (RIA) for the determination of morphine-6-glucuronide in human plasma has been developed (*105*). Morphine and its metabolites have been determined in plasma and other body fluids by SPE and HPLC with fluorescence detection (*106*, *107*), SPE and HPLC with UV detection in series with ECD (*108*), HPLC/ECD (*109*), GC/MS (*110*), CE (*111*), immunoassay (*112*), SPE and HPLC/MS with electrospray (*113*), SPE followed by GC/MS and HPLC with amperiometric detection (*114*), and GC/MS and RIA (*115*). Underivatized codeine and dihydrocodeine were determined in body fluids by GC/surface ionization detection (*116*). Codeine and its metabolites have been determined in plasma and urine by ion-pair HPLC/UVD (*117*). GC/MS was used to identify dihydroetorphine in biological fluids (*118*).

The Abuscreen ONLINE Automated Immunoassay for detection of opiates in urine was evaluated by GC/MS and compared to EMIT and RIA (*119*). Common opiates have been analyzed in urine by HPLC (*120*), CE (*121*), four commercial immunoassays and GC/MS (*122*), EMIT and GC/MS (*123*), an enzyme-linked immunoassay (ELISA) and a latex agglutination inhibition reaction test (LAIRT) (*124*), and a bioluminescent assay (*125*). The acid and enzymic hydrolysis rates for two morphine metabolites have been compared (*126*). The storage temperature effect on the stability of morphine and codeine in urine has been studied (*127*). The facilitation of the thin-layer chromatographic identification of opiates by derivatization with acetic anhydride or methoxyamine has been reported (*128*). The urinary excretion profile of free and conjugated morphine and 6-acetylmorphine was determined by GC/MS (*129*).

Heroin and cocaine concentrations in saliva have been compared to those in blood and plasma by GC/MS (*130*). A noninvasive and nonocclusive skin patch was investigated for the systematic collection of drugs of abuse over a period of several days (*131*). Sweat testing users with a sweat patch has been reported for the detection of opioids (*132*) and codeine and phenobarbital (*133*). The detection of opiate drugs in nontraditional specimens (clothing) for 10 cases has been reported (*134*). Hydrocodone in meconium has been detected in two case studies using GC/MS (*135*). The analytical procedures for the determination of opiates in hair have been reviewed (*136*). The role of pigmentation in the incorporation of codeine and metabolites into hair has been studied (*137*). The stability of opiates in clipped natural hair has been investigated (*138*). The disposition of codeine in female human hair after multiple-dose administration has been studied (*139*). The hair samples of six opiate addicts, who died after heroin overdose, were investigated by GC/MS after extraction with 10 solvents differing in polarity and hydrophilicity in an ultrasonic bath (*140*). A sensitive method has been developed for the simultaneous quantification of opiates, cocaine, and cannabinoids in hair (*141*). The simultaneous determination of opiates, cocaine, and benzoylecgonine in human hair by GC/MS has been reported (*142*). A highly sensitive method was developed for the quantitative analysis of codeine and morphine in human hair by GC/CIMS (*143*). Methadone concentrations

in body fluids from medical examiner cases that were reviewed in Harris County, Texas, from 1987 to 1992 have been presented (*144*). The determination of methadone and its metabolites in body fluids has been reported using liquid chromatography/thermospray-tandem MS (*145*), HPLC with UV and particle beam MS detection (*146*), solid-phase microextraction (SPME) and GC/MS (*147*), and GC/positive ion chemical ionization (PICI)-MS (*148*, *149*). Methadone and its metabolites have been determined in hair by GC/PICI-MS (*150*) and RIA (*151*). A simple quantitative method for the analysis of fentanyl citrate in syringes by GC/MS has been reported (*152*). Fentanyl was determined by GC/MS in the hair of a chronic fentanyl abuser (*153*). Fentanyl was determined by GC/MS in the body fluids of a fatal victim of fentanyl poisoning resulting from a transdermal patch (*154*). An ELISA was evaluated as a screening tool for the quantitation of urinary fentanyl (*155*).

Cocaine. A new cocaine-sensitive ISFET device has been compared to GC and UV spectrophotometry for the analysis of cocaine in illicit powders (*156*, *157*). A study has outlined the preparation and testing of a reliable test material for the evaluation of cocaine and heroin detectors based on chemical systems (*158*). A survey of modern methods for the detection of cocaine and related tropane alkaloids in coca leaf, cocaine, and biological specimens has been presented which includes MS, UV, IR, Raman spectroscopy, GC, HPLC, and immunoassay techniques (*159*). Alkaloids in coca tea have been identified and quantitated by SPE followed by GC/MS (*160*). Novel chlorinated tropanes derived from the treatment of cocaine with sodium hypochlorite have been identified by GC/MS (*161*). A GC method for determining norcocaine in cocaine powder has been presented (*162*). Flow injection analysis (FIA) with amperometric detection has been applied to the determination of cocaine in confiscated samples (*163*). A sequential spectrophotometric method for the resolution of mixtures of cocaine, procaine, and lidocaine in powder samples has been proposed (*164*). An improved method for the direct identification of adulterants and diluents in street samples of cocaine using IR spectroscopy has been presented (*165*). The determination of a trace amount of cocaine on a bank note by GC/PIMS has been helpful to convict cases of drug abuse (*166*). Cocaine contamination of United States paper currency has been studied using a method of SPE and GC/MS (*167*). The influence of the injection technique on the thermal degradation of cocaine and its metabolites in GC has been studied (*168*).

A study has examined the influence exerted by changes in the route of administration on the pharmacokinetic parameters and drug-induced behavioral and physiological effects of cocaine (*169*). Blood and urine specimens were analyzed for cocaine by GC/MS in a study of the passive inhalation of cocaine (*170*). Cocaine and metabolites have been examined in blood, serum, and other body fluids by reversed-phase HPLC (*171*–*175*), liquid–liquid extraction and GC/MS (*176*, *177*), SPE and GC (*178*), and SPE and GC/PIMS (*179*). A study was conducted to examine the postmortem stability of cocaine and cocaethylene in blood and tissues (*180*). A review of the history, pharmacology, and detection methods for cocaine in newborns has been presented (*181*). Cocaine has been determined in urine by SPE and GC/MS (*182*–*185*), GC/MS (*186*, *187*), time-of-flight MS (*188*), EMIT and GC/MS (*189*), HPLC and GC/MS (*190*), HPLC/UV (*191*), HPLC/DAD (*192*), FPIA (*193*), ELISA (*194*), and RIA and GC/MS (*195*). A technique by which cocaine metabolites as well as cocaethylene can be identified and quantitated using GC/MS and deuterated internal standards has been developed that uses microwave irradiation for the rapid preparation of trimethylsilyl and *tert*-butyldimethylsilyl derivatives (*196*). A light-emitting diode has been shown to improve evanescent excitation of a fiber-optic cocaine biosensor (*197*). A fiber-optic biosensor was developed for detection of cocaine, its metabolites, and other coca alkaloids, using a monoclonal antibody against a derivatized benzoylecgonine (*198*). A new cocaine-selective membrane electrode has been developed (*199*). A piezoelectric immunosensor for the detection of cocaine has been developed (*200*). The elimination of fluconazole as an interferant in the GC/MS confirmation of benzoylecgonine has been demonstrated (*201*). GC/MS was used to evaluate the stability of ecgonine methyl ester in refrigerated and frozen postmortem urines (*202*). SPE and GC/MS was used to detect cocaine and its polar transformation products and metabolites in human urine (*203*). A study has assessed the presence of cocaine and benzoylecgonine, opiates, and ethanol in 2824 homicide victims who were ignored and who survived 2 h or less after injury in a two-year period in New York City (*204*). The effects of cocaine administration route on the formation of cocaethylene have been investigated (*205*). Cocaethylene was detected in urine using TLC and immunoassay (*206*).

The determination of cocaine in hair has been reviewed (*207*). Different extraction procedures for the determination of drugs in hair of drug addicts have been compared (*208*). The relative distribution of cocaine and heroin metabolites in hair of polidrug abusers has been studied (*209*). Segmental hair analysis has been performed to obtain information about the history of drug abuse of subjects (*210*). The incorporation of isotopically labeled cocaine and metabolites into human hair has been studied by GC/MS (*211*). In vitro binding techniques were used to evaluate the binding of radiolabeled cocaine to different types of treated and untreated hair specimens (*212*). Supercritical fluid extraction (SFE)/RIA was evaluated as a rapid screening tool for the detection of cocaine residues of human hair (*213*). A method using GC/MS for the determination of the cocaine pyrolysis product, anhydroecgonine methyl ester, in urine and hair has been described (*214*). SPE, RIA, and GC/MS was used to determine cocaine and benzoylecgonine in hair (*215*). The concentration of cocaine and benzoylecgonine in hair, saliva, skin secretions, and urine samples of cocaine-using mothers, their children, and other adults living in the same environment were compared using RIA and GC/MS (*216*). A validation study for the determination of cocaine in meconium using FPIA and GC/MS was published which compared the results to paired urine analysis by EMIT and GC/MS (*217*). Cocaine disposition in meconium from newborns of cocaine-abusing mothers and urine of adult drug abusers has been studied (*218*). Cocaethylene was determined in meconium specimens by FPIA and GC/MS (*219*). Cocaine and metabolites were determined by GC/MS in postmortem vitreous humor samples, and the results were compared to blood levels at the time of death (*220*). Sweat patches have been used to monitor levels of cocaine in the body (*221*). The formation of cocaisopropylene was demonstrated by the incubation of whole human liver homogenates with cocaine hydrochloride and 2-propanol (*222*). Benzoylecgonine has been analyzed in dried blood spots by LC-atmospheric pressure chemical ionization tandem mass spectrometry (*223*). Preliminary data regarding the use of *Vernix*

caseosa as an alternative to other biological specimens for the determination of fetal cocaine exposure has been presented (*224*).

Amphetamines. Several diazonium salts and TLC solvent systems were evaluated for the characterization of amphetamines and other basic and nonbasic drugs (*225*). Matrix effects in the infrared examination of methamphetamine salts have been studied (*226*). A hot headspace sampling GC/MS method for the determination of amphetamine and methamphetamine in betel has been described (*227*). Impurities found in methamphetamine synthesized from pseudoephedrine by reduction with hydriodic acid and red phosphorus has been investigated (*228*). Ephedra's role as a precursor in the clandestine manufacture of methamphetamine has been studied by GC/IRD and GC/MS (*229*). The synthesis of methamphetamine from allyl benzene has been investigated using GC/MS (*230*). Commercially available deuterated analogs of amphetamine and methamphetamine have been evaluated using capillary GC/MS (*231*). Interferences of alum on the analysis of methamphetamine by immunoassay in urine specimens has been studied (*232*). Specimens from four forensic cases that tested positive for amphetamines by immunoassay were confirmed for methamphetamine by MS and the data demonstrated that D-amphetamine need not be present in methamphetamine-positive cases (*233*). A total of 28 cases have been reviewed for the effects of methamphetamine on human performance and actual driving and behavior (*234*). Methamphetamine levels were determined by GC/MS in blood, urine, and other body fluids from a victim of massive fatal ingestion of methamphetamine (*235*). It has been shown that the ion mass ratio performance of GC/MS can be improved at low concentrations of methamphetamine through the internal standard selection (*236*). A GC/MS study has suggested that the current Substance Abuse and Mental Health Services Administration (SAMHSA) guidelines select for individual metabolic variations and that GC/MS confirmation of methamphetamine will result in most occasional users being ruled negative following an oral dose of methamphetamine while some will be ruled positive (*237*). A rapid method for the GC/MS confirmation of urinary amphetamine and methamphetamine as their propylchloroformate derivatives has been published (*238*). L-Methamphetamine and L-amphetamine were determined by RIA and GC/MS after derivatization with (*S*)-(−)-*N*-trifluoroacetylprolyl chloride in the urine of a person who was taking Selegiline (*239*). Distinguishing amphetamine and methamphetamine from other interfering sympathomimetic amines after various types of fluoro derivatizations and analysis by GC/CIMS has been studied (*240*). A visual membrane immunoassay has been developed for the detection of methamphetamine using an enzyme-labeled tracer derived from methamphetamine and amphetamine (*241*). Amphetamine and methamphetamine have been determined in urine by RPHPLC and SPE (*242*, *243*), GC (*244*), FPIA (*245*, *246*), and GC/MS in both electron impact and chemical ionization modes (*247*). A case history involving a fatal methamphetamine overdose at the site of a clandestine laboratory has been presented (*248*). The synthesis of amphetamine and related compounds from several arylpropenes has been investigated using GC/MS (*249*).

Literature pertaining to three potential problematic areas in forensic drug analysis of amphetamines has been reviewed (*250*). The simultaneous quantitation of amphetamine and 4′-hydroxyamphetamine in urine has been accomplished by HPLC (*251*). A CE method has been developed for the quantitation of complex seizures of amphetamines and related substances (*252*). A simple and rapid detection method for methamphetamine and amphetamine in urine has been described using SPME and GC (*253*). Amphetamines in urine have been detected using headspace SPME and chemical ionization selected-ion monitoring MS (*254*). A simple and rapid analysis of amphetamines in blood using headspace SPME and GC/MS with selected-ion monitoring has been described (*255*). MDMA, MDEA, methamphetamine, and amphetamine have been qualitatively and quantitatively determined in urine by headspace SPME and GC/MS (*256*). A systematic approach to the profiling analysis of illicit amphetamines has been developed using GC and an automated workstation (*257*). EMIT and GC/MS have been used to compare the Abuscreen on-line assay for detection of amphetamines in urine (*258*). A rapid and sensitive method for the analysis of amphetamines in urine has been described using GC/NPD (*259*). A comparison of polyclonal and monoclonal assays for the routine screening of urines for amphetamines has been reported (*260*). A HPLC system of the detection of drugs in urine has been described which uses on-line derivatization of drugs with column switching (*261*). A method for the determination of amphetamine and related compounds in urine based on on-line derivatization and HPLC has been described (*262*). An HPLC method has been described for the determination of amphetamine using fluorometric detection after derivatization (*263*). Amphetamine was detected by GC/MS in the urine of individuals who were administered Fenproperex (*264*). The development of a method for the chiral separation of a mixture of amphetamine analogs by cyclodextrin-modified CZE has been described (*265*). The enantiomers of methamphetamine-related substances were determined both by GC after derivatization and by NMR using a chiral solvating agent (*266*). The enantiomeric composition of amphetamine and methamphetamine derived from the precursor compound famprofazone has been described (*267*). D-Amphetamine and L-amphetamine were separated by HPLC analysis using a chiral crown ether column (*268*). A simple HPLC method for the separation of amphetamine isomers in urine and its application in differentiating between "street" amphetamine and prescribed D-amphetamine has been presented (*269*). A stereospecific derivatization of amphetamines, phenol alkylamines, and hydroxyamines and quantification of the enantiomers by capillary GLC/MS has been reported (*270*). A simple method for the determination of amphetamine optical isomer ratios has been described using a simple basic extraction followed by on-column derivatization and analysis by GC/MS (*271*). A simple and rapid method to distinguish enantiomers of methamphetamine and its metabolites in human has been explored by coupling direct HPLC and HPLC/thermospray-MS, both of which employ a β-cyclodextrin phenylcarbamate-bonded silica column (*272*). The TDxADx/FLx Amphetamine/Methamphetamine II FPIA for the detection of amphetamine and methamphetamine in urine was evaluated for stereoselectivity and response to specimens collected following the recommended and double the recommended dose of Vicks Nasal Inhaler (*273*). The enantiomers of methamphetamine and its metabolites were separated and quantitated in urine by HPLC with precolumn derivatization and fluorescence detection (*274*).

A comparison of mass spectrometric ionization techniques for the analysis of phenethylamines has been reported (*275*). Studies on the metabolism and the toxicological analysis of methylenedioxyphenylalkylamine designer drugs by GC/MS has been presented (*276*). 3,4-Methylenedioxyamphetamines of the ecstasy

group have been discriminated by high-performance thin-layer chromatography (HPTLC) (*277*). 3,4-Methylenedioxymethamphetamine (MDMA) and its metabolites have been analyzed in biological fluids by HPLC/DAD and GC/MS (*278*), RIA and GC/MS (*279*), FPIA and GC/MS (*280*), GC/MS (*281*), and GC/MS following chiral derivatization (*282*). A preliminary study has determined the "common-batch" members in a set of confiscated MDMA samples by measuring the natural isotope abundance (*283*). Methods have been described for the GC/MS identification of the street drug *N*-methyl-1-(3,4-methylenedioxyphenyl)-2-butananmine (MBDB or MDP-2-MB) and its differentiation from two uniquely isomeric drugs, *N*-ethyl-3,4-methylenedioxyamphetamine (MDEA) and *N,N*-dimethyl-3,4-methylenedioxyamphetamine (MDMMA) (*284*). MBDB was identified by GC/MS in urine samples from 10 people suspected of drug offenses (*285*). Synthetic methods and spectroscopic and chromatographic data have been provided for four 2,3-methylenedioxyamphetamines (2,3-MDA, *N*-methyl-2,3-MDA, *N*-ethyl-2,3-MDA, and *N,N*-dimethyl-2,3-MDA) (*286*). LC and GC/MS have been used for analysis of 4-bromo-2,5-dimethoxyphenethylamine (Nexus) and 2-propanamine and 2-butanamine analogs (*287*). The conversion of 1-phenyl-2-nitropropene to amphetamine has been investigated under a variety of reaction conditions using GC/MS (*288*). α-Phenylethylamine has been identified in the postmortem urine of known drug users (*289*) and in several judicial cases by HPLC/DAD, GC/MS, GC/FT-IR, and NMR techniques (*290*). Analysis data have been presented on 1-phenylethylamines and a number of Leuckart synthetic impurities of these amines (*291*). The detection by GC/MS of a metabolite of α-benzyl-*N*-methylphenethylamine synthesis in a mixed drug fatality involving methamphetamine has been reported (*292*). An unusual police exhibit having the physical appearance, color, and odor of methamphetamine hydrochloride was identified unequivocally on the basis of combined evidence from ^{1}H and ^{13}C NMR, mass, and IR spectroscopic examination as *N*-(2-hydroxyethyl)amphetamine hydrochloride (HEA-HCl) (*293*). *N*-Acetylmethamphetamine has been identified in a sample of illicitly synthesized methamphetamine by GC/MS (*294*). The physical characterization and GC/MS analysis of α-benzyl-*N*-methylphenethylamine (BNMPA), an impurity in illicit methamphetamine synthesis, has been reported (*295*). The metabolism and urinary excretion of BNMPA have been studied by GC/MS (*296, 297*).

A procedure has been presented for the simultaneous identification and quantification of amphetamine, methamphetamine, MDMA, and MDA in human hair (*298*). A review on the detection and incorporation of amphetamines in hair has been presented (*299*). The disposition of benzphetamine and its metabolites into hair and the comparison of benzphetamine use and methamphetamine use by hair analysis has been studied (*300*). A comparison of deprenyl use and methamphetamine use by hair analysis has been presented (*301*). Methamphetamine has been detected in sweat by EIA and GC/MS (*302*). After external decontamination, the analysis of amphetamine, MDMA, and MDA in hair and fingernails has been accomplished via hot alkaline hydrolysis and GC/MS (*303*). Tranylcypromine has been determined in biological fluids (*304*).

Barbiturates. Two-dimensional overpressured layer chromatography has been used to separate barbiturate derivatives (*305*). The analysis of pentobarbital has been used as an example for a discussion on selecting the appropriate isotopic internal standard for GC/MS analysis of drugs of abuse (*306*). The application of using 3-(1,8-naphthalimido)propyl-modified silica gel as a stationary phase in HPLC analysis of barbiturates and diastereomeric compounds has been described (*307*). Phenobarbital was determined in vertex hair by GC/MS (*308*).

Miscellaneous Drugs and Poisons. A forensic procedure for the screening and confirmation of the presence of lysergic acid diethylamide (LSD) in urine has been described together with the evaluation of a novel EIA and immunoaffinity extraction procedure (*309*). LSD, MBDB, and atropine were all identified in real samples by an online HPTLC/FT-IR method (*310*). An online immunoaffinity extraction procedure coupled with a column capillary HPLC/tandem MS method has been used for the trace analysis of LSD analogs and metabolites in human urine (*311*). A total analysis scheme for LSD in urine has been described which uses ELISA and HPLC with fluorescence detection (*312*). LSD in vitro metabolites were determined in liver by HPLC and CE coupled with tandem MS (*313*). LSD and its metabolites were detected in human hair by derivatization and GC/MS (*314*). A homogeneous microparticle-based immunoassay has been developed for the detection of D-LSD in urine and compared to GC/MS and RIA (*315*). A microplate EIA for the detection of LSD in human urine has been developed (*316*). The National Institute of Standards and Technology (NIST) in cooperation with the College of American Pathologists (CAP) has certified the concentrations of phencyclidine (PCP) in two new reference materials (*317*). Ion trap MS has been used to determine PCP in meconium (*318*) and pigmented and nonpigmented hair (*319*). SPE and GC/MS have been used to determine PCP and its metabolites in hair (*320*). A validation study has been reported of the benzodiazepine β-glucuronide primary reference material for hydrolysis and quality assurance controls (*321*). Benzodiazepines have been detected in biological fluids by immunoassays (*322, 323*), ELISA (*324*), GC/MS (*325, 326*), HPLC/DAD (*327*), automated HPLC and GC/MS (*328*), SPE and GC/MS (*329*), SPE and HPLC (*330*), immunoassay and GC/MS (*331*), and HPLC/UVD (*332*). Flunitrazepam and its metabolite were detected in hair of a chronic abuser by GC/MS/NCI (*333*). The stability of temazepam in blood under different storage temperatures was studied by HPLC/UVD (*334*). A procedure has been presented for the identification of nordiazepam and its metabolite in hair by GC/MS-NCI (*335*). GC/MS was used to analyze samples collected from sweat patches for benzodiazepines (*336*). Studies were undertaken to determine the possible role of enteric bacteria in the postmortem bioconversion of the nitrobenzodiazepines (*337*). A study was conducted to compare the sensitivity of OnLine and Emit II assays for propoxyphene use in human urine (*338*). GC/FID after a mixed-mode SPE column extraction was used to simultaneously quantify dextropropoxyphene and norpropoxyphene in urine (*339*). Capillary GC/MS was used to analyze the chemical composition of Khat (*Catha edulis*) (*340*). GC/FT-IR was used in a time study in the identification of cathinone in khat (*341*). Bufotenine and a series of related bufadienolides were identified by GC/MS in the aphrodisiac "Love Stone" and the Chinese Medication "Chan Su" (*342*). Mescaline was determined in hallucinogenic Cactaceae by ion-interaction HPLC (*343*). Chemical analysis by IR, UV, and TLC of suspected Captagon tablets seized revealed that they often contained different ingredients which would induce effects similar to those of fenethylline (*344*). A method for the simultaneous measurement of buprenorphine and its N-dealkylated metabolite,

norbuprenorphine, in human plasma was developed with NCI-tandem MS (*345*). A simple and sensitive GC/MS method has been described for the determination of phenmetrazine in urine (*346*).

Methomyl concentrations were determined in blood and other fluids from victims of fatal ingestion of methomyl (*347*). *p*-Nitrophenol and *p*-nitrophenyl were quantified by RPHPLC in the urine of a fatal victim of acute parathion ingestion (*348*). A method has been described for the simultaneous determination of fenitrothion and its metabolite in biological fluids by SPE and HPLC (*349*). Clozapine concentrations were determined by GC/NPD and GC/MS in tissue samples, blood, and liver from a suicidal overdose victim (*350*). Anileridine concentrations in blood and other tissues have been presented for 19 cases (*351*). GC/MS and GC/FID were used to quantify meprobamate in blood to generate data in an unusual case where knowledge of the first toxicological investigation was used to aid interpretation of postmortem toxicology findings in a later case (*352*). Benzhexol was quantified by HPLC in blood and other fluids of a poisoning victim (*353*). HPLC/fluorescence detection was used to determine the diastereomeric dipeptides of aspartic acid to correlate the D/L ratio of aspartic acid to actual age (*354*−*357*). Drug accumulation and elimination in *Calliphora vicina* larvae has been studied (*358*). HPLC/DAD was used to determine buflomedil in blood, urine, and gastric contents from a self-poisoning victim (*359*). RIA and HPLC/fluorescence detection was used to analyze the biological fluids from a victim of fatal, suicidal ingestion of zopiclone (*360*). Zopicolone was analyzed in postmortem specimens by GC/MS and HPLC/DAD (*361*) and by liquid−liquid extraction and HPLC/UVD (*362*). HPLC/DAD and capillary GC/MS were employed to quantify dothiepin in biological fluids, tissues, and hair from a death attributed to oral dothiepin ingestion (*363*). A specific procedure using HPLC/particle beam MS has facilitated the determination of bromisovalum in human plasma and whole blood (*364*). Antihistamine concentrations have been determined in postmortem blood and liver specimens (*365*). Aconitine alkaloids were determined by GC/SIM in the body fluids of an aconitine poisoning victim (*366*). A study was performed to compare the ONLINE and EMIT II immunoassays with GC/MS analysis of methaqualone metabolites in urine (*367*). The viability of using principal component analysis and soft independent modeling of class analogy analysis of the near-IR spectra of 10 different illicit methaqualone tablet formulations as an aid in sample differentiation was investigated (*368*). The development of a fluoroimmunoassay for the detection of buprenorphine in urine samples has been described (*369*). GC/MS and HPLC were used to detect antidepressant and antipsychotic drugs in postmortem scalp hair (*370*). Extraction methods for the detection of psychotropic drugs from human scalp hair were compared using HPLC for detection (*371*). Quantitation of opipramol and its deshydroxyethyl metabolite was performed simultaneously after liquid−liquid extraction from alkalinized samples prior to HPLC analysis (*372*). Blood concentrations of Zolpidem from an acute overdose victim were determined by GC/NPD (*373*). Zolpidem tissue concentrations were determined by GC/NPD and GC/MS in the fluids of a multiple drug related death involving Ambien (*374*). Flecainide was identified by UV spectrophotometry and GC/MS and quantitated by HPLC/UV in blood, urine, and other body fluids from a victim of an unsuspected self-poisoning with flecainide and alcohol (*375*). γ-Hydroxybutyric acid (GHB), morphine, and 6-monoacetylmorphine (6-MAM) were determined by GC/MS in autopsy body fluids (*376*). The in situ spectroscopic identification of acetaminophen in a fatal overdose case has been described using Raman microprobe spectroscopy (*377*). Chloroquine was determined by GC/MS in postmortem tissue and organs from a suicide victim (*378*). Methotrimeprazine and its metabolites were determined in blood, urine, and other organs from a victim of a fatal overdose of methotrimeprazine (*379*). Three SPE methods have been described for the analysis of β-blockers in human postmortem whole blood, urine, and equine urine (*380*). A SPE procedure has been described for the simultaneous determination of β_2 agonists in human postmortem whole blood, using GC/MS (*381*). An HPLC method for the simultaneous determination of paraquat and diquat in aqueous solutions and biological fluids has been developed (*382*). A total of 14 nonsteroidal anti-inflammatory drugs were evaluated for interference in EMIT and TDx assays for drugs of abuse (*383*). Analysis of Ketorolac in postmortem blood was done by HPLC and GC/MS following a SPE method on Amberlite XAD-2 (*384*). A metabolite of labetalol that has been mentioned in previous reports of false-positive assays for amphetamine by TLC and immunoassay has been identified by GC/MS (*385*). Nalbuphine was analyzed in drug abusers' urine by GC/MS following SPE and derivatization (*386*). Phenelzine was determined by GC/MS in the blood of two victims of fatal phenelzine poisoning (*387*). A sensitive GC/MS method for quantifying ibogaine and a metabolite in biological fluids and brain tissue has been reported (*388*). The distribution of the racemic and the enantiomeric content of (+)-metoprolol was compared by RP-HPLC and GC after ingestion of a massive fatal overdose of the racemic drug (*389*). HPLC with ketoprofen as the internal standard was used to measure sulindac and GC with codeine as the internal standard was used to measure disopyramide in the body fluids of an overdose fatality in a child involving disopyramide and sulindac (*390*). Biological fluid samples obtained at autopsy were analyzed for risperidone by HPLC from a victim resulting from the suicidal ingestion of risperidone (*391*). Venlafaxine concentrations were determined by GC and GC/MS in the blood and other fluids of two fatal poisoning victims (*392*). Distribution of venlafaxine in three postmortem cases has been described (*393*). Zipeprol and its two main metabolites were identified in urine samples from drug abusers by TLC and GC/MS (*394*).

The role of pharmacology and forensic science in the death of an asthmatic has been discussed (*395*). Extraction procedures and analytical methods have been described for the quantification of methomyl in autopsy tissue and fluid samples (*396*). A review of the toxicological findings in fatal hydrogen fluoride exposures and a report of cases has been reported (*397*, *398*). GC/FID with splitless injection was used to analyze four diazine herbicides following their rapid extraction from human whole blood using SPE (*399*). Strychnine was determined in biological samples by GC/surface ionization detection (*400*). The Fujiwara−Ross reaction was used to detect chloral hydrate and metabolites in the blood of a fatal intoxication victim (*401*). Alimemazine was determined by a selective HPLC technique in blood and tissues from a postmortem case (*402*). An HPLC/DAD method was developed for the determination of an azide benzoyl derivative in blood and tissues of a suicide victim involving sodium azide (*403*). HPTLC has been evaluated for the determination of strychnine and crimidine in biological samples (*404*). ICPMS was used and

evaluated for the practical analysis of arsenic content of body fluid samples without ashing (*405*). Methods for the determination of aluminum and strontium in illicit drugs by electrothermal atmospheric absorption spectrometry using magnesium nitrate and palladium−magnesium nitrate as chemical modifiers were developed (*406*). A method for the determination of total chromium in cocaine and heroin by flameless atomic absorption spectroscopy (AAS) has been presented (*407*). Twelve types of Chinese commercially produced medical herbal ball preparations were analyzed for mercury and arsenic levels by X-ray fluorescence spectroscopy (XFS) and AAS (*408*).

General Procedures. A review on the methodologies used in analytical toxicological studies in forensic science has been published (*409*). An overview of the current status of modern forensic toxicology including an extensive bibliography has been prepared (*410*). A review on the screening techniques used for drugs of abuse has been published (*411*). The subject of drug testing for the five mandated drug classes and circumstances other than drug abuse has been reviewed (*412*). An overview of commonly tested drugs in urine and factors that may affect analytical results has been presented (*413*). A review of the NIST reference materials that are available to support accuracy in drug testing has been presented (*414*). A computer program has been developed to assist the analyst in identifying unknown substances in forensic and clinical toxicological cases by comparing the results from a variety of chromatographic methods and their respective detection modes (*415*). The feasibility of storing forensic urine drug specimens as dry stains on Whatman No. 3 paper was studied by evaluating the stability of the drugs and recovery from the stains using GC/MS for the analysis (*416*). A study has been presented to determine the stability of common illicit drugs in stored blood at various time intervals for a period of up to five years (*417*). Drug Recognition Experts (DRE) evaluations of drivers detained for driving while impaired have been reviewed and the results compared to the urine toxicology screens (*418*). Trends in the occurrence of drugs of abuse in blood and urine of arrested and drug traffickers in the border region of Aachen have been reported (*419*). A drugs and driving database from 1158 cases has been published from the Drugs and Driving Committee of the Canadian Society of Forensic Scientists (*420*). The determination of drugs of abuse in meconium has been described (*421*, *422*). The cardiac to peripheral ratio of drug concentrations in postmortem blood samples was determined for 113 drugs representing toxicological findings in 320 cases (*423*). Three cases of multiple false-positive drug tests have been described when postmortem urine specimens were screened using EMIT (*424*). The effect of glutaraldehyde on Syva EMIT II drugs of abuse screening assays has been studied (*425*). A simple modification of a direct extraction procedure has been described which uses HPLC, GC, and GC/MS for confirmation (*426*). The Rapid Emergency Drug Identification (REMEDi) system, an automated drug-profiling system that employs HPLC with a multicolumn design, has been applied to the forensic screening of drugs (*427*, *428*). The REMEDi HS has been compared to GC/MS for the screening of drugs and poisons (*429*). The performance of the Microgencis CEDIA DAU assays for screening drugs of abuse was evaluated on the Boehringer Mannheim/Hitachi 717 in urine (*430*).

Drugs of abuse have been identified in biological fluids using GLC, HPLC, and GC/MS (*431*), SPE and GC/MS (*432*, *433*), HPLC and GC/MS (*434*), SPE and HPLC/MS (*435*), HPLC/UVD (*436*), HPLC/DAD (*437*−*441*), SPE and RP-HPLC/DAD (*442*), HPLC/electrochemical coulometric-array detector (*443*), MECC/DAD (*444*), MECC/UVD (*445*), CZE (*446*−*455*), CZE/electrospray ionization MS (*456*), CZE/MECC (*457*), SPE and GC/FID (*458*), microwave extraction and GC/NPD (*459*), ELISA (*460*), and SPE, GC/NPD, and GC/ECD (*461*). Analysis of drugs of abuse in biological fluids by liquid chromatography has been reviewed (*462*). Various applications of the HPLC analysis of the enantiomeric composition of abused drugs has been reviewed (*463*). A study was conducted to optimize the interpretation of GC/MS toxicological screenings (*464*). A simple procedure that improves the performance of a bench-top GC/MS system in the purification of mass spectra of coeluting compounds and that can be easily combined with the automatic processing of a GC/MS data file has been described (*465*). A simple procedure that allows software to determine whether a GC/MS blank injection is contaminated has been presented (*466*). A mechanism for determining interferences for the GC/MS analysis of drugs in urine has been described (*467*). Suggestions for assuring the reliability of a GC drug screen have been presented (*468*). Four homologous retention index standard series with amine structure were evaluated for the screening of blood samples for basic drugs on two capillary columns over a six-month period (*469*). Four homologous retention index standard series were evaluated for the screening of blood samples for acidic and neutral drugs on two capillary columns over a six-month period (*470*). A dual-column gas chromatographic retention index method was evaluated for the toxicological screening for basic drugs in autopsy blood samples (*471*). Seven drugs were detected by GC using internal and external index standards (*472*). The comparability of RP-HPLC retention indexes of drugs in three databases were studied (*473*). The effect of chromatographic conditions on the retention indexes of forensically relevant substances in RP-HPLC has been studied (*474*). The influence of the biological matrix on chromatographic behavior and detection of selected acidic, neutral, and basic drugs examined by means of a standardized HPLC/DAD system has been reported (*475*). A large number of specimens were screened for drugs of abuse by RIA, CEDIA, and EMIT, and the results were compared (*476*). A rapid, sensitive, and simple-to-use multianalyte diagnostic device for the detection of drugs of abuse in urine has been developed (*477*). The use of NMR spectroscopy in forensic science has been reviewed and discussed (*478*). Applications of fluorescence spectroscopy to forensic science, including drugs of abuse, have been presented (*479*). The techniques used to perform elemental and microscopic analysis in soft drink/syringe product tampering incidents have been described (*480*). Fast-neutron transmission spectroscopy (FNTS) has been used to identify light elements in illicit substances such as explosives and drugs of abuse (*481*). Fast-neutron techniques have been used to inspect cargo for illicit substances such as explosives and drugs of abuse (*482*, *483*). Lead has been determined in illicit drugs by electrothermal AAS using palladium as a chemical modifier (*484*). A mobile light source for carbon/nitrogen cameras has been developed and applied to detect concealed narcotics and explosives (*485*).

A critical evaluation of hair sample preparation procedures for the analysis of drugs has been presented (*486*). A proposal of guidelines for decontaminating hair, using immunoassay and GC/MS for the analysis of hair and the establishment of cutoff values

has been presented (*487*). The detection of drugs in hair has been discussed (*488–496*).

TRACE EVIDENCE

Petroleum Products. A new technique based on headspace solid-phase microextraction has been successfully applied to the identification of a wide range of accelerants commonly seen in arson analysis (*497*). Headspace solid-phase microextraction was used to detect accelerants in arson-suspected fire debris (*498*). Solid-phase microextraction was employed for the extraction of accelerants in aqueous solutions from fire debris (*499*, *500*). Extraction and adsorption methods for the recovery of accelerants from arson debris have been compared (*501*). The use of activated charcoal strips for fire debris extractions by passive diffusion has been studied (*502*). A GC/MS data base has been developed to aid in the identification of arson accelerants (*503*). GC/MS data interpretation for petroleum distillate identification in contaminated arson debris has been evaluated (*504*). A detection method for finding petroleum accelerant residues on partially burnt objects in arson offenses has been proposed. Residual petroleum hydrocarbons have been converted into their corresponding phenolnaphthol derivatives (*505*). A TLC method was developed for the analysis of residues from the petroleum products (e.g., gasoline, kerosene, and diesel fuel) generally encountered as accelerants in fires and arson cases (*506*). The detection and semiquantitation of kerosene in gasoline using TLC has been described (*507*). A simple and rapid reversed-phase HPLC method has been developed for the determination of the adulteration of gasoline with kerosene (*508*). A reversed-phase HPLC method has been developed for the detection and characterization of fire accelerants and their residues generally encountered in investigations of suspected arson cases (*509*). Chemical markers in weathered gasoline have been characterized by GC/MS (*510*). A method for the analysis of Solvent Yellow 124, a new marker added in diesel oil, has been presented (*511*). Wax-based products have been characterized by GC/MS (*512*). Physical and chemical parameters that govern the ignition of flammable gases and vapor have been reviewed (*513*). Canines have been evaluated with respect to their ability to detect accelerants (*514–516*).

Explosives. The investigation of post blast residues of dynamite explosives with respect to the behavior of nitroaromatic compounds has been described (*517*). Nitroglycerin-based explosives were analyzed and characterized by gas chromatography/mass spectrometry (*518*). Using GC detection, it was possible to identify patterns within the nitroaromatic isomer content of nitroglycerin-based explosives (*519*). Analysis and characterization of nitroglycerin-based explosives by proton magnetic resonance spectrometry has been studied (*520*). Potential problems associated with the detection of nonmilitary explosives have been discussed (*521*). A system has been developed for the automated analysis of organic explosive residues by HPLC with a pendant mercury drop electrode detector (*522*). Experiments have shown Raman spectra and Raman band images can be obtained from explosive particles (*523*). Raman spectroscopic studies of explosive materials have been reported (*524*). A fiber-optic probe has been developed that allows Raman spectra to be acquired remotely from a spectrometer for the detection and identification of explosive materials (*525*). Micellar electrokinetic capillary chromatography of high explosives utilizing indirect fluorescence detection was investigated (*526*). Glow discharge-ion trap mass spectrometry for the detection of traces of high explosives was described (*527*).

Gunpowder and Primer Residue Detection. A low number of GSR particles have been found on the hands of nonshooting police officers (*528*). Casework experience in the detection of GSR particles on samples from hands, hair, and clothing is reported for the period of six years (*529*). The result of a survey of gunshot residue analysis methods involving 80 forensic laboratories was reported (*530*). Gunshot residue has been recovered from human nasal mucus (*531*). Lead-free center-fire primer ammunition has been analyzed by SEM/energy-dispersive X-ray analysis (*532*). Ethyl centralite and 2,4-dinitrotoluene in gunshot residues were detected by HPLC (*533*).

Fingerprints. A cyanoacrylate cabinet for the automatic development of latent fingerprints was described (*534*). Mile red dye has been shown to significantly enhance cyanoacrylate-developed fingerprints (*535*). Cyanoacrylate fuming of footwear impressions on nonporous surfaces has been shown to enhance the detail of some impressions (*536*). A variety of stains has been studied for the purpose of enhancing cyanoacrylate fingerprints (*537*). Latent fingerprints were developed on paper using magnetic flakes (*538*). The application of magnetic flake powders to fingerprint detection has been reviewed (*539*). A study has been reported on the stability of ninhydrin-developed fingerprints enhanced by zinc complexation (*540*). Preliminary tests on cyanoacrylate-pretreated fingerprints showed that a europium chelate was the most efficient complex giving the best luminescence intensity with treated fingerprints (*541*). Substituent effects on luminescence enhancement in europium and terbium Ruhemann's purple complexes were studied (*542*). Methods for developing latent fingerprints from the glass surface of bottles have been described (*543*). Vacuum metal deposition using gold and zinc was shown to have excellent sensitivity to latent prints on glass surfaces (*544*). It was shown that a dc metal sputtering process preferentially deposits metal onto fingerprint ridges (*545*). Fluorescing agents have been used to enhance fingerprints developed with small particle reagent (*546*). Dimethylaminocinnamaldehyde has been successfully used as a fuming agent in the development of latent fingerprints (*547*). The synthesis and structure of the zinc(II) and cadmium(II) complexes produced in the photoluminescent enhancement of ninhydrin-developed fingerprints has been reported (*548*). Chemical staining methods were successfully employed for visualizing fingerprints on spent cartridge cases (*549*). Supercritical carbon dioxide has been found to be a potential replacement for fluorocarbons in the ninhydrin process (*550*). A phase-transfer catalyst has been successfully used to detect fingerprints (*551*). Techniques for developing latent fingerprints on skin has been evaluated (*552*). Techniques for developing latent fingerprints on stone have been described (*553*). A number of techniques have been explored to distinguish between fingerprints on counterfeit currency before and after the inking (*554*). An overview of the current and anticipated applications of optical techniques to the detection of latent fingerprints was presented (*555*). Fingerprint images have been obtained with the aid of a scanning laser microscope (*556*). Digital imaging techniques have been evaluated for improving fingerprint images (*557*).

Fibers and Paint.. Acrylic fibers have been classified by FT-IR (*558*). Forensic aspects of Lyocell fibers and nylon 6-based

block copolymer fibers were described (*559*). Experiments on the transfer of fibers involving various garments, car seats, drivers, and driving times were carried out in order to study their influence on the transfer of fibers to the seat of a car after it has been driven (*560*). A flow-chart system for the identification of common synthetic fibers by polarized light microscopy has been presented (*561*). Clothing purchased by mail order was used to estimate the frequency of certain fiber types (*562*, *563*). It has been shown that the evidential value of matching fibers is dependent on the number and type of tests in a given comparison (*564*). Variations in dye batch compositions in mass-produced textile fibers were demonstrated (*565*). The extraction of fiber dyes for analysis by HPLC has been described (*566*). Enzymatic digestion of cotton fibers dyed with reactive dyes produces colored solutions which can be analyzed by TLC (*567*). A method for extracting reactive dyes for TLC analysis from wool fibers has been reported (*568*). A Raman scattering procedure has been described for the analysis of a reactive dye covalently bound to a single strand of a cotton fiber (*569*). Forensic analysis of textile fiber dyes has been reviewed (*570*). The use of SEM analysis to determine the cause of fiber damage has been reviewed (*571*). The value of SEM in distinguishing textile fiber damage based on a single fiber end appearance has been questioned (*572*). Fiber damage in forensic investigations was assessed using SEM (*573*). Fibers of different textile materials, such as polyesters, viscose, and wool, were analyzed using total reflection X-ray fluorescence, a trace element pattern (*574*). Energy-dispersive X-ray fluorescence provides the capability for elemental characterization of individual carpet fibers of a few millimeters in length (*575*). SEM was used to examine fiber impressions on typewriter correction tape (*576*). The advantage of phytohistol as a mounting medium for fibers was described (*577*).

Polarized microscopy was used to examine forensic paint samples (*578*). The IR identification of several inorganic pigments used in automobile top coats has been reported (*579*). A survey of U.S. automobile original topcoats (1974−1989) for binder and pigment compounds been conducted using IR spectroscopy (*580*). Quantitative analysis of organic pigments in forensic paint samples has been accomplished using visible spectrophotometry (*581*).

Miscellaneous. The transfer and persistence of glass fragments on garments was studied (*582*). A statistical interpretation of glass evidence has been presented (*583*). A statistical model has been offered to aid in the evaluation of trace materials (*584*). A statistical analysis relating to the interpretation of the significance of glass evidence has been presented (*585*). The forensic value of soil samples has been evaluated using commonly employed forensic techniques (*586*). The forensic analysis of soil and vegetable materials has been reviewed (*587*). Color measurements of soil was shown to be highly discriminating (*588*). FT-IR has been applied to the forensic examination of documents (*589*). Quality control procedures for the TLC analysis of inks has been evaluated (*590*). Ink dating techniques have been reviewed (*591*). A new approach to estimate the age of ball point ink has been offered based on using the microspectrophotometric determination of the ratios of comparatively unstable and stable dyes in ink (*592*). A sequential multiple approach to determining the relative age of inks has been presented (*593*). Methods for dating documents have been reviewed (*594*). The analysis of ink from typewriters was carried out by TLC (*595*).

The forensic examination of lipsticks has been reviewed (*596*, *597*). Photocopy toners, consisting of different brands, as well as different models of the same brand, were analyzed by TLC (*598*). A study was undertaken to examine techniques for the analysis of photocopy toners by IR (*599*). Identification of lubricant traces from latex condoms in cases of sexual assault has been investigated (*600*). The viscosity of condom lubricants has been determined using FT-IR (*601*). Bloody shoe marks have been enhanced by leucomalachite green (*602*). A formulation for leucocrystal violet has been proposed for enhancing shoe prints in blood (*603*). Bromophenol Blue and Bromocresol Green have been successfully used for the enhancement of footwear marks (*604*). Physical and chemical techniques for the examination of tool marks and footwear impressions have been reviewed (*605*). Elastomeric products used for casting tool marks and footprints have been tested as to applicability to forensic science (*606*). Footwear impressions have been developed with magnetic flake powder (*607*). A novel use of crystal violet lactone as a security marker in the larceny of fuel has been described (*608*). Spot tests were employed to find traces of metallics on tool blades (*609*). An unusual case of oxidation colors on bulb filament after a car crash was evaluated (*610*). Fire extinguisher residues were microscopically characterized (*611*). A pyrolysis derivatization technique involving co-pyrolysis with tetramethylammonium hydroxide was used to characterize heartwood lignocellulose from selected softwoods and hardwoods (*612*).

Procedures for identifying consecutively manufactured plastic polyethylene bags has been described (*613*). A glazing-incidence X-ray fluorescence analysis has been applied to forensic samples (*614*). The application of capillary electrophoresis to problems of interest in forensic science has been reviewed (*615*). Caution must be exercised when interpreting blood patterns from a limited number of droplets (*616*). Pig blood and human blood are found to have similar physical characteristics. Hence, its valid to use pig blood for the re-enactment of a crime scene (*617*). A method is presented to recognize, identify, and compare rope and twine (*618*). Application of fluorescence spectroscopy to the analysis of a variety of physical evidence has been reviewed (*619*). Protein components from nonhuman hair were evaluated for species determination purposes (*620*).

FORENSIC BIOCHEMISTRY

The benzidine test was shown not to be sufficiently reliable in bloodstain detection (*621*). A fluorescein technique has been successfully used to develop bloodstains (*622*). The identification and species determination of bloodstains has been reviewed (*623*). Bloodstain age could be estimated from the ratio of oxyhemoglobin to total hemoglobin (*624*). HPLC of blood hemoglobin offers a sensitive and reproducible method for inferring the source of over 50 different animal species from bloodstains and blood mixtures (*625*). An enzyme-linked immunosorbent assay procedure for the determination of ABH antigens in bloodstains has been developed (*626*). ELISA was used for the detection of ABH blood group substances in body fluids (*627*). ELISA was used to detect HIV, hepatitis B, and hepatitis C markers in syringes and bloodstains (*628*). A horizontal electrophoresis method using a discontinuous polyacrylamide gel to identify haptoglobin polymorphs is described (*629*).

A rapid spot test for detecting acid phosphatase has been described (*630*). TLC has been used to simultaneously detect

spermine and choline from human semen (*631*). ELISA has been used for the detection of seminal fluid using a monoclonal antibody for prostatic acid phosphatase (*632*). Group-specific component (Gc) subtyping in semen and seminal stems was carried out using isoelectric focusing (*633*). Polymorphism of α-2-HS-glycoprotein (AHSG) was demonstrated in human semen and whole saliva samples (*634*). A simple and practical method of detecting AHSG using isoelectric focusing has been described (*635*). A sandwich ELISA procedure was developed for detecting human seminal γ-glutamyl transpeptidase (*636*). The polymorphism of γ-glutamyl transferase was investigated in semen samples. Using a simple method of starch gel electrophoresis, three common types (GGT 1, GGT 2-1, GGT 2) were observed (*637*). The retention and transfer of spermatozoa in clothing that has been machine washed has been reported (*638*). Several markers detected in urine, semen, and blood have been evaluated. In particular, DNase I polymorphism is one of the most useful markers (*639*). The forensic application of the DNase I polymorphism for individualization of used socks was described (*640*). The existence of DNase I in human sweat has been confirmed (*641*). Application of the absorption–elusion method to blood group phenotyping of the ABO, Lewis, and P_1 systems in teeth were described (*642*). F13A subtypes population frequencies have been reported (*643*).

A differential extraction of sperm and vaginal epithelial cell DNA from vaginal fluid mixed with semen has been reported (*644*). A simple and efficient method for extracting DNA from microsamples of blood has been developed (*645*). A new method for the purification of DNA on bloodstained cards was developed. This method was implemented into a high-throughput automated system using a robotic workstation (*646*). A procedure recommended for DNA typing of bloodstain cards that are properly stored in a repository and will be used as reference samples was described (*647*). Results suggest that higher amounts of genomic DNA can be recovered from blood samples stored at temperatures 4 °C or below in the presence of EDTA or heparin (*648*). The National Institute of Standards and Technology recently released a Standard Reference Material that meets the calibration and quality assurance needs of laboratories that perform DNA typing (*649*). Data indicate that human lymphoid cell lines GNI9947 and GM9948 could be adopted as reliable reference standards for DNA typing (*650*). The identification of ABO types by taking advantage of previously reported ABO DNA sequence differences has been reported (*651*). Population structure, stepwise mutations, heterozygote deficiency, and their implications in DNA forensics are described (*652*). Some of the statistical issues involved in the interpretation of DNA evidence in courts have been discussed (*653*). The strength of DNA evidence when a suspect is identified via a search through a database of the DNA profiles of known individuals has been explored (*654*). A method for establishing match criteria used in forensic DNA typing has been reported (*655*).

A review in which the use of polyacrylamide gel electrophoresis (PAGE) in characterizing DNA strands for forensic analysis is discussed (*656*). Interlaboratory comparison of autoradiographic DNA profiling measurements was reported (*657*). A replacement for ethidium bromide in forensic DNA analysis has been explored (*658*). Simultaneous amplification of the alphoid repeated sequences clustered in the centromeric regions of both the human X and Y chromosomes was performed (*659*). Gender identification of dried human bloodstains using chromosome X and Y probes has been successfully employed (*660*). Seminal components and DNA have been recovered from the vagina of a homicide victim 34-days postmortem (*661*). Samples obtained from 13-year-old microscope slides of vaginal swabs yielded DNA results (*662*). Rapid detection of mitochondrial sequence polymorphisms using multiplex soIid-phase fluorescent minisequencing has been studied (*663*). DNA sequences of PCR products from mitochondrial DNA of unrelated healthy Japanese volunteers were determined by a direct sequencing method for polymorphisms (*664*). A survey of mitochondrial D-loop variation in 15 animal species was conducted (*665*). Variation in the mitochondrial DNA control region as detected by sequence-specific oligonucleotide probes has been described for individuals in the Asian population (*666*). Findings demonstrate that human bone can be a reliable source of genomic DNA and that bone recovered from surface deposit is the most desirable for use in forensic identification (*667*). DNA from teeth was successfully applied to a set of 12 skeletons recovered from two 10-year-old Guatemalan mass graves (*668*). Transfused blood did not alter the DNA profile of the recipient (*669*).

The importance of reagent quality control in DNA restriction fragment length polymorphism (RFLP) analysis for forensic purposes has been discussed (*670*). The impact of bacterial contamination in vaginal samples has been studied with respect to RFLP analysis (*671*). Validation studies have been compiled using RFLP analysis for forensic casework (*672*). Using the fixed-bin method employed by the FBI, the probability for a random match of the DNA fragments from the crime scene and from the suspect could be underestimated (*673*). The maximum useful duration of *Hae*III incubation for several types of samples was studied (*674*). The specificity and sensitivity of radioactive and nonradioactive probes were studied (*675*). The feasibility of using chemiluminescence for routine application in forensic DNA analysis has been studied. The chemiluminescent system achieved equal or greater sensitivity than that observed for radioactive probes (*676*). A protocol for the chemiluminescent detection of RFLP profiles with the sensitivity of radioisotope-based detection systems was presented. RFLP profiles for the loci D2S44, D17S79, D1S7, D4S139, and D5S110 were obtained (*677*). Chemiluminescent detection of RFLP patterns in forensic DNA analysis has been evaluated (*678*, *679*). Probe D17S26 has been validated for forensic DNA analysis (*680*). The locus DXS52 has been shown to be a useful genetic marker system for forensic analysis (*681*). Image enhancement of RFLP autoradiograms has been reported through the use of neutral density filters (*682*). Population data for D5S110 were obtained (*683*). Population data were obtained for D1S7, D2S44, D4S139, D5S110, and D17S70 (*684*). Population data have been reported for D1S7, D2S44, D4S139, D10S28, and D17S79 (*685*). Population data were reported for D1S7, D2S44, D4S139, D5S110, and D12S11 (*686*). Population data have been obtained for D1S7, D2S44, D4S139, and D10S28 (*687*). Population data have been obtained for D2S44, D1S7, D10S28, D4S139, D17S79, and D5S110 (*688*). Allele frequencies were determined for the polymorphic DNA locus D1OS28 (*689*). DNA typing of nasal secretions has been accomplished by RFLP (*690*).

A PCR-based method was used to identify the species of forensic biological samples (*691*). The effects of inbreeding on DNA profile frequency estimates using PCR-based loci were discussed (*692*). The removal of PCR inhibitors from forensic samples has been described (*693*). Effects on typing results

arising from postamplification primer extension of heat-denatured PCR products were studied (*694*). A method for the determination of ABO genotypes using PCR amplification has been described and validated (*695*). A method for the determination of ABO genotypes using PCR amplification has been described and validated (*696*). ABO genotyping was performed by PCR amplification (*697*). PCR-based ABO genotyping was established using restriction enzyme digestion followed by horizontal polyacrylamide gel electrophoresis (*698*). A sex determination method has been developed involving the PCR amplification of the sex-determining region of the Y chromosome (*699*). Sex determination of dried blood stains using the PCR with homologous X–Y primers was successfully accomplished. A PCR-based assay described relies on amplification of a small, polymorphic region of a homologous zinc finger protein locus present on the X and Y chromosomes (*700*, *701*). Population data on the apolipoprotein B (apoB) locus has been reported (*702*). Methodology. is presented for amplified fragment length polymorphism (AMP-FLP) typing using a nonisotopic, PCR protocol. Loci analyzed were apoB, phenylalanine hydroxylase, and D1S80 (*703*). Alleles at D1S80, D17S5, apoB, and COL2A1 were amplified by PCR and resolved on a high-resolution agarose gel (*704*). Amelogenin typing by PCR has been described for gender identification (*705*). Electrophoretic methods were used for typing 3′-apoB, YNZ22, and COL2A1 (*706*). Resolution of apoB variants has been reported (*707*). Allele and genotype frequencies for the 3′-apoB locus were determined (*708*). Population data for DlS80, 3′-apoB, and YNZ22 loci have been reported (*709*).

Methods for identity testing are described that enable extraction of DNA from biological samples, determination of the quantity of human DNA, and genetic analyses of the materials using RFLP typing and/or AMP-FLP typing of PCR products (*710*). The D17S74 locus has been successfully amplified by PCR (*711*). The loci DlS80 and D2S123 have been amplified by PCR, and the amplified length polymorphic alleles were detected with a discontinuous vertical PAGE system and silver staining (*712*). The AMP-FLP D1S80 PCR amplification kit has been validated for forensic casework (*713*). A method has been developed that enables multiplex amplification and simultaneous typing of the loci DlS80 and amelogenin using discontinuous polyacrylamide gel electrophoresis and silver staining (*714*). A DlS80 typing procedure has been evaluated using simulated forensic specimens and found to be reliable (*715*). A new protocol for amplification of the DlS80 locus has been developed (*716*). The specificity of apoB, PAH, and D1S80 has been evaluated (*717*). A new allele of D1S80 has been reported (*718*). Separation of DlS80 alleles by vertical electrophoresis through a two-tier resolving gel has been reported (*719*). Population data have been reported for DIS80 (*720–724*). The usefulness of a seminested PCR method for detecting D1S80 extracted from old skeletal remains has been described (*725*).

A PCR-based DNA typing system for saliva on stamps has been developed (*726*). DNA extraction conditions were evaluated for PCR analysis of DNA from saliva deposited on a stamp (*727*). An improved method of extracting DNA from saliva stains deposited on human skin in simulated bite mark situations has been reported (*728*). The identity of human skeletal remains using mulitiplex PCR amplification has reported (*729*). The suitability of the DNA content in urine stained material was evaluated for use in forensic analysis. PCR typing was successful on 5 of the 12 samples (*730*). ABO blood group genotyping of sperm DNA isolated from contaminated vaginal fluid by a PCR-RFLP method was successfully accomplished (*731*). DNA from epidermal cells attached to the adhesive tape of stubs employed to collect and identify gunshot residue with a scanning electron microscope was extracted, amplified with PCR, and typed (*732*). Sex determination from blood and teeth by PCR amplification of the alphoid satellite family has been accomplished (*733*).

Studies were performed to evaluate the forensic applicability of the loci LDLR, GYPA, HBGG, D7S8, Gc, and HLA-DQA1 (*734*). The Amplitype Polymarker (PM) system was found to yield reproducible results in several laboratories (*735*). The PM system has been validated for forensic case work (*736*). A systematic flow chart system for HLA–DQA1 genotyping has been proposed (*737*). Typing protocols are recommended for obtaining reliable results with the PM system (*738*). A method for the purification and recovery of genomic DNA from DQA1 amplification product and its subsequent amplification and typing with the AmpliType PM PCR amplification and typing kit has been explored (*739*). Successful DQA1 typing of bloodstains on light and dark blue denim fabric was improved (*740*). A seminested PCR method was used to amplify the DQA1. The seminested PCR technique was found to enhance the sensitivity of the amplification reaction and allowed the successful typing DQA1 (*741*). PM and DQA1 typing was accomplished from pap smears, semen smears, and postcoital slides (*742*). DQA1 and amelogenin coamplification for gender identification has been reported (*743*). DQA1 types have been determined from human fingernails (*744*). Three DQA1*4 alleles (0401, 0501, 0601) were distinguished by restriction enzyme digestion of PCR product (*745*). The characterization of HLA-DRB1 by PCR amplification for forensic evidence samples has been successfully studied (*746*). Population data have been presented for DQA1 (*747–749*). Population data have been obtained for DQA1 and the PM systems (*750*). Population data for DQA1, D1S80, and HUMTH01 have been reported (*751*). Population data on the loci DQA1, PM, and D1S80 have been collected (*752–759*).

A report on the second European DNA Profiling Group collaborative short tandem repeat (STR) exercise was presented (*760*). Nine PCR-based human STR systems were investigated for species specificity (*761*). A quadruplex STR DNA typing system was demonstrated to be accurate, reliable, and robust for identifying the victims of a mass disaster (*762–764*). The identification of human remains arising from a mass disaster by STR methods has been reported (*765*). An octoplex system consisting of seven STR loci and a sex test (amelogenin locus) has been successfully implemented. The power of this system is equivalent to that achieved by four conventional single-locus probes (*766*). A highly discriminating STR procedure has been described. The test uses fluorescent detection of PCR products from either four or six STR loci and the X–Y homologous gene amelogenin, giving simultaneous sex diagnosis (*767*). An octoplex STR system has been developed for human individual identification (*768*). A triplex and duplex STR method has been proposed for forensic identification (*769*). Forensic applications of a rapid, sensitive, and precise multiplex analysis of the four short tandem repeat loci HUMVWF31/A, HUMTHO1, HUMFl3A1, and HUMMFES/FPS have been reported (*770*). Multiplex PCR amplification systems were developed using well-characterized STRs. Eight loci utilized in multiplex amplifications included HUMCSFlPO,

HUMTPOX, HUMTH01 HIJM,VWFA31, HUNIF13A01, HUNIFES-FPS, HUNIBFXIII, and HUNILIPOL (*771*). The performance of two STR triplex systems, one containing the loci HUMCSFlPO, HUNITPOX, and HUMTH01, and the other containing HUMH-PRTB, HUMFESFPS, and HUMVWFA31, has been evaluated. These systems are valid for use in DNA typing systems for forensic cases and paternity identification (*772*). A PCR-based STR system has been applied to forensic samples. The methodology involves the simultaneous amplification of alleles at four loci on different chromosomes (*773*). A strategy was developed for classifying complex STR alleles by size. Dye-labeled PCR-amplified alleles were analyzed on an automated DNA sequencer with laser-induced fluorescence detection and fragment-sizing software (*774*). A PCR-based DNA typing method using STR loci was presented. Validation of the loci and methodology has been performed to meet standards set by the forensic community (*775*). Results using radioactive and semiautomated fluorescent detection of polymorphisms for nine STR loci are described (*776*). The genetic analysis of STR markers using fluorescently tagged primers was evaluated for their suitability for DNA typing including its accuracy, precision, and sensitivity (*777*). The STR-designated HUMCD4 has been characterized (*778*). The STR locus D7S809 has been evaluated (*779*). It has been demonstrated that the application of HUMTH01 typing methods in forensic case work is reliable, robust, and efficient (*780*). The STR polymorphism HumLPL which is located in intron 6 of the lipoprotein lipase gene was studied (*781*). An automated DNA sequencer using high-sensitivity IR fluorescence technology was used to detect STR allele patterns from simulated forensic samples (*782*). Population data for DlS80 and three STRs, HUMTH01, HUMFES/FPS, and HUMACTBP2, were presented (*783*). Population data for HUMTH01 and HUMFES/FPS STR systems have been reported (*784*). Population frequencies for the HUMTH01, TP0x, and CSI1P0 were determined (*785*). Population data have been obtained for HUMVWA31, HUMTH01, HUMF13A1, and HUM-FES/FPS (*786*). Population data have been reported for CSF1PO, TP0X TH01, D3S1358, vWA, and FGA (*787*).

Saliva stems on ends of smoked cigarettes collected at various scenes of crime were analyzed by STR technology. About 80% of the samples could be typed successfully (*788*). Analysis of DNA evidence in a serial killer case was performed using the DQA1, Polymarker, and the GenePrint STR Multiplex System (*789*). The independence between STRs and PGM and Gc and EAP has been confirmed (*790*). The STR FX111B has been validated for forensic purposes (*791*).

The comprehensive forensic science reference book, *Scientific Evidence in Civil and Criminal Cases* (*792*) has been revised as has the textbook *Introduction to Forensic Science* (*793*). Garriott's *Medicolegal Aspects of Alcohol* (*794*) continues to be the leading reference source in forensic alcohol toxicology. *The Pathology of Drug Abuse* (*795*) and *Ellenhorn's Medical Toxicology, Diagnosis, and Treatment of Human Poisoning* (*796*) have both been revised and continue to serve as primary reference sources for forensic toxicologists. *The Handbook of Analytical Therapeutic Drug Monitoring and Toxicology* (*797*) provides valuable data for interpreting drug levels. Updated analytical techniques in forensic toxicology are discussed in the *Handbook of Workplace Drug Testing* (*798*) *and Drug Testing in Hair* (*799*). *The Analysis of Drugs of Abuse: An Instruction Manual* (*800*) describes updated methodology for analyzing common drugs of abuse. The subject of DNA analysis is introduced in *DNA Demystified—An Introduction to Forensic DNA Typing* (*801*) and relevant topics on the subject are discussed in detail in *The Use of DNA Markers* (*802*). DNA symposium proceedings are contained within *Advances in Forensic Haemogenetics*, Vol. 5 (*803*) and Vol. 6 (*804*). The significance of physical evidence has been reviewed in *Individualization: Principles of Procedures in Criminalistics* (*805*) and *Interpreting Evidence—Evaluating Forensic Science in the Courtroom* (*806*). Appropriate techniques for conducting a crime scene investigation has been described in *Crime Scene* (*807*), and advance topics in forensic science are reviewed in *Advances in Forensic Sciences* (*808*). *Forensic Science Applications of Mass Spectrometry* (*809*) brings the reader up to date on mass spectrometry applications and *Instrumental Data for Drug Analysis* (*810*) compiles spectral data for drugs typically analyzed in forensic laboratories. The subject of firearms analysis is thoroughly covered in *Firearms and Ballistics: Handbook of Examining and Interpreting Forensic Evidence* (*811*).

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