Chapter 96 - Entertainment and the Arts

ENTERTAINMENT AND THE ARTS

Michael McCann

Entertainment and the arts have been a part of human history ever since prehistoric people drew cave paintings of animals they hunted or acted out in song and dance the success of the hunt. Every culture from earliest times has had its own style of visual and performing arts, and decorated everyday objects like clothing, pottery and furniture. Modern technology and more leisure time has led to a major part of the world's economy being devoted to satisfying the need for people to see or own beautiful objects and to be entertained.

The entertainment industry is a miscellaneous grouping of non-commercial institutions and commercial companies that provide these cultural, amusement and recreational activities for people. By contrast, artists and craftspeople are workers who create artwork or handicrafts for their own pleasure or for sale. They usually work alone or in groups of fewer than ten people, often organized around families.

The people who make this entertainment and art possible—artists and craftspeople, actors, musicians, circus performers, park attendants, museum conservators, professional sports players, technicians and others—often face occupational hazards that can result in injuries and illnesses. This chapter will discuss the nature of those occupational hazards. It will not discuss the hazards to people doing arts and crafts as hobbies or attending these entertainment events, although in many instances the hazards will be similar.

Entertainment and the arts can be thought of as a microcosm of all industry. The occupational hazards encountered are, in most instances, similar to those found in more conventional industries, and the same types of precautions can be used, although costs may be prohibitive factors for some engineering controls in the

arts and crafts. In these instances, emphasis should be on substitution of safer materials and processes. Table 96.1 lists standard types of precautions associated with the various hazards found in the arts and entertainment industries.

Table 96.1 Precautions associated with hazards in the arts and entertainment industries

Hazard	Precautions
Chemical hazards	
General	Training in hazards and precautions Substitution of safer materials Engineering controls Adequate storage and handling No eating, drinking or smoking in work areas Personal protective equipment Spill and leak control procedures Safe disposal of hazardous materials
Airborne contaminants (vapours, gases, spray mists, fogs, dusts, fumes, smoke)	Enclosure Dilution or local exhaust ventilation Respiratory protection
Liquids	Cover containers Gloves and other personal protective clothing Splash goggles and face shields as needed Eyewash fountain and emergency showers when needed
Powders	Purchasing in liquid or paste form Glove boxes Local exhaust ventilation Wet mopping or vacuuming

	Respiratory protection
Solids	Gloves
Physical hazards	
Noise	Quieter machinery Proper maintenance Sound dampening Isolation and enclosure Hearing protectors
Ultraviolet radiation	Enclosure Skin protection and UV goggles
Infrared radiation	Skin protection and infrared goggles
Lasers	Using lowest-power laser possible Enclosure Beam restrictions and proper emergency cutoffs Laser goggles
Heat	Acclimatization Light, loose clothing Rest breaks in cool areas Adequate liquid intake
Cold	Warm clothing Rest breaks in heated areas
Electrical hazards	Adequate wiring Properly grounded equipment Ground fault circuit interrupters where needed Insulated tools, gloves, etc.
Ergonomic hazards	Ergonomic tools, instruments, etc., of proper siz Properly designed work stations

	Proper posture Rest breaks
Safety hazards	
Machinery	Machine guards Accessible stop switch Good maintenance
Flying particles (e.g., grinders)	Enclosure Eye and face protection as needed
Slips and falls	Clean and dry walking and working surfaces Fall protection for elevated work Guardrails and toeboards on scaffolds, catwalks, etc.
Falling objects	Safety hats Safety shoes
Fire hazards	Proper exit routes Proper fire extinguishers, sprinklers, etc. Fire drills Removal of combustible debris Fireproofing of exposed materials Proper storage of flammable liquids and compressed gases Grounding and bonding when dispensing flammable liquids Removal of sources of ignition around flammabl Proper disposal of solvent- and oil-soaked rags
Biological hazards	
Moulds	Humidity control

	Removal of standing water Cleanup after flooding
Bacteria, viruses	Vaccination where appropriate Universal precautions Disinfection of contaminated materials, surface

Arts and Crafts

Artists and craftspeople are usually self-employed, and the work is done in homes, studios or backyards, using small amounts of capital and equipment. Skills are often handed down from generation to generation in an informal apprenticeship system, particularly in developing countries (McCann 1996). In industrialized countries, artists and craftspeople often learn their trade in schools.

Today, arts and crafts involve millions of people across the world. In many countries, craftwork is a major part of the economy. However, few statistics are available on the number of artists and craftspeople. In the United States, estimates gathered from a variety of sources indicate there are at least 500,000 professional artists, craftspeople and art teachers. In Mexico, it has been estimated that there are 5,000 families involved in the home-based pottery industry alone. The Pan American Health Organization found that 24% of the workforce in Latin America from 1980 to 1990 were self-employed (PAHO 1994). Other studies of the informal sector have found similar or higher percentages (WHO 1976; Henao 1994). What percentage of these are artists and craftspeople is unknown.

Arts and crafts evolve with the technology available and many artists and craftspeople adopt modern chemicals and processes for their work, including plastics, resins, lasers, photography and so on (McCann 1992a; Rossol 1994). Table 96.2 shows the range of physical and chemical hazards found in art processes.

Table 96.2 Hazards of art techniques

Technique	Material/process	Hazard
Airbrush	Pigments	Lead, cadmium, manganese, cobalt, mercury, e
	Solvents	Mineral spirits, turpentine
Batik	Wax	Fire, wax, decomposition fumes
	Dyes	See Dyeing
Ceramics	Clay dust	Silica

	Glazes	Silica, lead, cadmium and other toxic metals
	Slip casting	Talc, asbestiform materials
	Kiln firing	Sulphur dioxide, carbon monoxide, fluorides, i burns
Commercial art	Rubber cement	N-hexane, heptane, fire
	Permanent markers	Xylene, propyl alcohol
	Spray adhesives	N-hexane, heptane, 1,1,1-trichloroethane, fire
	Airbrushing	See Airbrush
	Typography	See Photography
	Photostats, proofs	Alkali, propyl alcohol
Computer art	Ergonomics	Carpal tunnel syndrome, tendinitis, poorly desi
	Video display	Glare, Elf radiation
Drawing	Spray fixatives	N-hexane, other solvents
Dyeing	Dyes	Fibre-reactive dyes, benzidine dyes, naphthol d disperse dyes, vat dyes
	Mordants	Ammonium dichromate, copper sulphate, ferro acid, etc.
	Dyeing assistants	Acids, alkalis, sodium hydrosulphite
Electroplating	Gold, silver	Cyanide salts, hydrogen cyanide, electrical haza
	Other metals	Cyanide salts, acids, electrical hazards
Enamelling	Enamels	Lead, cadmium, arsenic, cobalt, etc.
	Kiln firing	Infrared radiation, burns
Fibre arts	See also Batik, Weaving	
	Animal fibres	Anthrax and other infectious agents
	Synthetic fibres	Formaldehyde
	Vegetable fibres	Moulds, allergens, dust
Forging	Hammering	Noise
	Hot forge	Carbon monoxide, polycyclic aromatic hydroca radiation, burns

Glassblowing	Batch process	Lead, silica, arsenic, etc.
	Furnaces	Heat, infrared radiation, burns
	Colouring	Metal fumes
	Etching	Hydrofluoric acid, ammonium hydrogen fluoric
	Sandblasting	Silica
Holography (see also Photography)	Lasers	Non-ionizing radiation, electrical hazards
	Developing	Bromine, pyrogallol
Intaglio	Acid etching	Hydrochloric and nitric acids, nitrogen dioxide potassium chlorate
	Solvents	Alcohol, mineral spirits, kerosene
	Aquatint	Rosin dust, dust explosion
	Photoetching	Glycol ethers, xylene
Jewellery	Silver soldering	Cadmium fumes, fluoride fluxes
	Pickling baths	Acids, sulphur oxides
	Gold reclaiming	Mercury, lead, cyanide
Lapidary	Quartz gemstones	Silica
	Cutting, grinding	Noise, silica
Lithography	Solvents	Mineral spirits, isophorone, cyclohexanone, ker methylene chloride, etc.
	Acids	Nitric, phosphoric, hydrofluoric, hydrochloric,
	Talc	Asbestiform materials
	Photolithography	Dichromates, solvents
Lost wax casting	Investment	Cristobalite
	Wax burnout	Wax decomposition fumes, carbon monoxide
	Crucible furnace	Carbon monoxide, metal fumes
	Metal pouring	Metal fumes, infrared radiation, molten metal,
	Sandblasting	Silica
Painting	Pigments	Lead, cadmium, mercury, cobalt, manganese co
	Oil, alkyd	Mineral spirits, turpentine

	Acrylic	Trace amounts ammonia, formaldehyde
Papermaking	Fibre separation	Boiling alkali
	Beaters	Noise, injuries, electrical
	Bleaching	Chlorine bleach
	Additives	Pigments, dyes, etc.
Pastels	Pigment dusts	See Painting Pigments
Photography	Developing bath	Hydroquinone, monomethyl-p-aminophenol su
	Stop bath	Acetic acid
	Fixing bath	Sulphur dioxide, ammonia
	Intensifier	Dichromates, hydrochloric acid
	Toning	Selenium compounds, hydrogen sulphide, uran sulphur dioxide, gold salts
	Colour processes	Formaldehyde, solvents, colour developers, sulp
	Platinum printing	Platinum salts, lead, acids, oxalates
Relief printing	Solvents	Mineral spirits
	Pigments	See Painting Pigments
Screen printing	Pigments	Lead, cadmium, manganese and other pigment
	Solvents	Mineral spirits, toluene, xylene
	Photoemulsions	Ammonium dichromate
Sculpture, clay	See Ceramics	
Sculpture, lasers	Lasers	Non-ionizing radiation, electrical hazards
Sculpture, neon	Neon tubes	Mercury, cadmium phosphors, electrical hazard radiation
Sculpture, plastics	Epoxy resin	Amines, diglycidyl ethers
	Polyester resin	Styrene, methyl methacrylate, methyl ethyl keto
	Polyurethane resins	Isocyanates, organotin compounds, amines, mi
	Acrylic resins	Methyl methacrylate, benzoyl peroxide
	Plastic	Heat decomposition products (e.g., carbon mon

	fabrication	chloride, hydrogen cyanide, etc.)
Sculpture, stone	Marble	Nuisance dust
	Soapstone	Silica, talc, asbestiform materials
	Granite, sandstone	Silica
	Pneumatic tools	Vibration, noise
Stained glass	Lead came	Lead
	Colourants	Lead-based compounds
	Soldering	Lead, zinc chloride fumes
	Etching	Hydrofluoric acid, ammonium hydrogen fluoric
Weaving	Looms	Ergonomic problems
	Dyes	See Dyeing
Welding	General	Metal fumes, burns, sparks
	Oxyacetylene	Carbon monoxide, nitrogen oxides, compressed
	Arc	Ozone, nitrogen dioxide, fluoride and other flux and infrared radiation, electrical hazards
	Metal fumes	Oxides of copper, zinc, lead, nickel, etc.
Woodworking	Machining	Injuries, wood dust, noise, fire
	Glues	Formaldehyde, epoxy, solvents
	Paint strippers	Methylene chloride, toluene, methyl alcohol, etc
	Paints and finishes	Mineral spirits, toluene, turpentine, ethyl alcoh
	Preservatives	Chromated copper arsenate, pentachlorophenol

Source: Adapted from McCann 1992a.

The arts and crafts industry, like much of the informal sector, is almost completely unregulated and is often exempted from workers' compensation laws and other occupational safety and health regulations. In many countries, government agencies responsible for occupational safety and health are unaware of the risks facing artists and craftspeople, and occupational health services do not reach out to this group of workers. Special attention is needed to find ways to educate artists and craftspeople about the hazards and precautions needed with their materials and processes, and to make occupational health services available to them.

Health problems and disease patterns

Few epidemiological studies have been done on workers in the visual arts. This is mostly due to the decentralized and often unregistered nature of most of these industries. Much of the data that are available come from individual case reports in the literature.

The traditional arts and crafts can result in the same occupational diseases and injuries found in larger-scale industry, as evidenced by such old terms as potter's rot, weaver's back and painter's colic. The hazards of such crafts as pottery, metalworking and weaving were first described by Bernardino Ramazzini almost three centuries ago (Ramazzini 1713). Modern materials and processes also are causing occupational illnesses and injuries.

Lead poisoning is still one of the most common occupational illnesses among artists and craftspeople, with examples of lead poisoning being found in:

- a stained-glass artist in the United States (Feldman and Sedman 1975)
- potters and their families in Mexico (Ballestros, Zuniga and Cardenas 1983; Cornell 1988) and Barbados (Koplan et al. 1977)
- families in Sri Lanka recovering gold and silver from jeweller's waste using a molten lead procedure (Ramakrishna et al. 1982).

Other examples of occupational illnesses in the arts and crafts include:

- chromium sensitization in a fibre artist (MMWR 1982)
- neuropathy in a silk-screen artist (Prockup 1978)
- heart attacks from methylene chloride in a furniture refinisher (Stewart and Hake 1976)
- respiratory problems in photographers (Kipen and Lerman 1986)
- mesothelioma in jewellers (Driscoll et al. 1988)
- silicosis and other respiratory diseases in agate workers in India (Rastogi et al. 1991)
- asthma from carving ivory from elephant tusks in Africa (Armstrong, Neill and Mossop 1988)
- respiratory problems and ergonomic problems among carpet weavers in India (Das, Shukla and Ory 1992)
- as many as 93 cases of peripheral neuropathy from the use of hexane-based

adhesives in sandal-making in Japan in the late 1960s (Sofue et al. 1968)

- paralysis in 44 apprentice shoemakers in Morocco due to glues containing tri-orthocresyl phosphate (Balafrej et al. 1984)

- leg, arm and back pain and other occupational health problems in home-based workers making ready-made garments in India (Chaterjee 1990).

A major problem in the arts and crafts is the prevalent lack of knowledge of hazards, materials and processes and how to work safely. Individuals who do develop occupational diseases often do not realize the connection between their illness and their exposures to hazardous materials, and are less likely to obtain proper medical assistance. In addition, whole families can be at risk—not only those adults and children actively working with the materials, but also younger children and infants who are present, since these arts and crafts are commonly done in the home (McCann et al. 1986; Knishkowy and Baker 1986).

A proportionate mortality ratio (PMR) study of 1,746 White professional artists by the United States National Cancer Institute found significant elevations in deaths of painters, and to a lesser degree for other artists, from arteriosclerotic heart disease and from cancers of all sites combined. For male painters, rates of leukaemia and cancers of the bladder, kidney and colorectum were significantly elevated. Proportionate cancer mortality rates were also elevated, but to a lesser degree. A case control study of bladder cancer patients found an overall relative risk estimate of 2.5 for artistic painters, confirming the results found in the PMR study (Miller, Silverman and Blair 1986). For other male artists, PMRs for colorectal and kidney cancer were significantly elevated.

Performing and Media Arts

Traditionally, the performing arts include theatre, dance, opera, music, storytelling and other cultural events that people would come to see. With music, the type of performance and their venue can vary widely: individuals performing music on the street, in taverns and bars, or in formalized concert halls; small musical groups playing in small bars and clubs; and large orchestras performing in large concert halls. Theatre and dance companies can be of several types, including: small informal groups associated with schools or universities; non-commercial theatres, which are usually subsidized by governments or private sponsors; and commercial theatres. Performing arts groups may also tour from one location to another.

Modern technology has seen the growth of the media arts, such as the print media, radio, television, motion pictures, videotapes and so on, which enable the performing arts, stories and other events to be recorded or broadcast. Today the media arts are a multi-billion-dollar industry.

Workers in the performing and media arts include the performers themselves—actors, musicians, dancers, reporters and others visible to the public. In addition, there are the technical crews and front office people—stage carpenters, scenic artists, electricians, special effects experts, motion picture or television camera crews, ticket sellers and others—who work backstage, behind the cameras and on other non-performing jobs.

Health effects and disease patterns

Actors, musicians, dancers, singers and other performers are also subject to occupational injuries and illnesses, which can include accidents, fire hazards, repetitive strain injuries, skin irritation and allergies, respiratory irritation, performance anxiety (stage fright) and stress. Many of these types of injuries are specific to particular groups of performers, and are discussed in separate articles. Even minor physical problems can often affect a performer's peak performance capability, and subsequently end in lost time and even lost jobs. In recent years, the prevention, diagnosis and treatment of injuries to performers has led to the new field of arts medicine, originally an offshoot of sports medicine. (See "History of performing arts medicine" in this chapter.)

A PMR study of screen and stage actors found significant elevations for lung, oesophagus and bladder cancers in women, with the rate for stage actresses 3.8 times that of screen actresses (Depue and Kagey 1985). Male actors had significant PMR (but not proportionate cancer mortality ratio) increases for pancreatic and colon cancer; testicular cancer was twice the expected rate by both methods. PMRs for suicide and non–motor vehicle accidents were significantly elevated for both men and women, and the PMR for cirrhosis of the liver was elevated in men.

A recent survey of injuries among 313 performers in 23 Broadway shows in New York City found that 55.5% reported at least one injury, with a mean of 1.08 injuries per performer (Evans et al. 1996). For Broadway dancers, the most frequent sites of injury were the lower extremities (52%), back (22%) and neck (12%), with raked or slanted stages being a significant contributing factor. For actors, the most frequent sites of injuries were lower extremities (38%), the lower back (15%) and vocal cords (17%). The use of fogs and smoke on stage was listed as a major cause for the last.

In 1991, the United States National Institute for Occupational Safety and Health investigated the health effects of the use of smoke and fogs in four Broadway shows (Burr et al. 1994). All the shows used glycol-type fogs, although one also used mineral oil. A questionnaire survey of 134 actors in these shows with a control group of 90 actors in five shows not using fogs found significantly higher levels of symptoms in actors exposed to fogs, including upper-respiratory symptoms such as nasal symptoms and irritation of mucous membranes, and lower-respiratory symptoms such as coughing, wheezing, breathlessness and chest tightness. A follow-up study could not demonstrate a correlation between

fog exposure and asthma, possibly due to the low number of responses.

The motion picture production industry has a high accident rate, and in California is classified as high risk, mostly as a result of stunts. During the 1980s, there were over 40 fatalities in American-produced motion pictures (McCann 1991). California statistics for 1980–1988 show an incidence of 1.5 fatalities per 1,000 injuries, compared to the California average of 0.5 for the same period.

A large number of studies have shown that dancers have high overuse and acute injury rates. Ballet dancers, for example, have high incidences of overuse syndrome (63%), stress fractures (26%) and major (51%) or minor (48%) problems during their professional careers (Hamilton and Hamilton 1991). One questionnaire study of 141 dancers (80 females), 18 to 37 years old, from seven professional ballet and modern dance companies in the United Kingdom, found that 118 (84%) of the dancers reported at least one dance-related injury that affected their dancing, 59 (42%) in the last six months (Bowling 1989). Seventy-four (53%) reported that they were suffering from at least one chronic injury that was giving them pain. The back, neck and ankles were the most common sites of injury.

As with dancers, musicians have a high incidence of overuse syndrome. A 1986 questionnaire survey by the International Conference of Symphony and Opera Musicians of 4,025 members from 48 American orchestras showed medical problems affecting performance in 76% of the 2,212 respondents, with severe medical problems in 36% (Fishbein 1988). The most common problem was overuse syndrome, reported by 78% of string players. A 1986 study of eight orchestras in Australia, the United States and England found a 64% occurrence of overuse syndrome, 42% of which involved a significant level of symptoms (Frye 1986).

Hearing loss among rock musicians has had significant press coverage. Hearing loss is also found, however, among classical musicians. In one study, sound level measurements at the Lyric Theatre and Concert Hall in Gothenberg, Sweden, averaged 83 to 89 dBA. Hearing tests of 139 male and female musicians from both theatres indicated that 59 musicians (43%) showed worse pure tone thresholds than would be expected for their age, with brass wind instrumentalists showing the greatest loss (Axelsson and Lindgren 1981).

A 1994-1996 study of sound level measurements in the orchestra pits of 9 Broadway shows in New York City showed average sound levels from 84 to 101 dBA, with a normal showtime of 2½ hours (Babin 1996).

The carpenters, scenic artists, electricians, camera crews and other technical support workers face, in addition to many safety hazards, a wide variety of chemical hazards from materials used in scene shops, prop shops and costume shops. Many of the same materials are used in the visual arts. However, there are

no available injury or illness statistics on these workers.

Entertainment

The “Entertainment” section of the chapter covers a variety of entertainment industries that are not covered under “Arts and Crafts” and “Performing and Media Arts”, including: museums and art galleries; zoos and aquariums; parks and botanical gardens; circuses, amusement and theme parks; bullfighting and rodeos; professional sports; the sex industry; and nightlife entertainment.

Health effects and disease patterns

There are a wide variety of types of workers involved in the entertainment industry, including performers, technicians, museum conservators, animal handlers, park rangers, restaurant workers, cleaning and maintenance personnel and many more. Many of the hazards found in the arts and crafts and performing and media arts are also found among particular groups of entertainment workers. Additional hazards such as cleaning products, toxic plants, dangerous animals, AIDS, zoonoses, hazardous drugs, violence and so forth are also occupational hazards to particular groups of entertainment workers. Because of the disparateness of the various industries, there are no overall injury and illness statistics. The individual articles include relevant injury and illness statistics, where available.

DRAWING, PAINTING AND PRINTMAKING

Jack W. Snyder

Drawing involves making marks on a surface to express a feeling, experience or vision. The most commonly used surface is paper; drawing media include dry implements such as charcoal, coloured pencils, crayons, graphite, metalpoint and pastels, and liquids such as inks, markers and paints. Painting refers to processes that apply an aqueous or non-aqueous liquid medium (“paint”) to sized, primed or sealed surfaces such as canvas, paper or panel. Aqueous media include water-colours, tempera, acrylic polymers, latex and fresco; non-aqueous media include linseed or stand oils, dryers, varnish, alkyds, encaustic or molten wax, organic solvent-based acrylics, epoxy, enamels, stains and lacquers. Paints and inks typically consists of colouring agents (pigments and dyes), a liquid vehicle (organic solvent, oil or water), binders, bulking agents, antioxidants, preservatives and stabilizers.

Prints are works of art made by transferring a layer of ink from an image on a printing surface (such as woodblock, screen, metal plate or stone) onto paper, fabric or plastic. The printmaking process involves several steps: (1) preparation of the image; (2) printing; and (3) cleanup. Multiple copies of the image can be

made by repeating the printing step. In monoprints, only one print is made.

Intaglio printing involves incising lines by mechanical means (e.g., engraving, drypoint) or etching the metal plate with acid to create depressed areas in the plate, which form the image. Various solvent-containing resists and other materials such as rosin or spray paint (aquatinting) can be used to protect the part of the plate not being etched. In printing, the ink (which is linseed oil based) is rolled onto the plate, and the excess wiped off, leaving ink in the depressed areas and lines. The print is made by placing the paper on the plate and applying pressure by a printing press to transfer the ink image to the paper.

Relief printing involves the cutting away of the parts of woodblocks or linoleum that are not to be printed, leaving a raised image. Water-or linseed oil–based inks are applied to the raised image and the ink image transferred to paper.

Stone lithography involves making an image with a greasy drawing crayon or other drawing materials that will make the image receptive to the linseed oil–based ink, and treating the plate with acids to make non-image areas water receptive and ink repellent. The image is washed out with mineral spirits or other solvents, inked with a roller and then printed. Metal plate lithography can involve a preliminary counteretch that often contains dichromate salts. Metal plates may be treated with vinyl lacquers containing ketone solvents for long print runs.

Screen printing is a stencil process where a negative image is made on the fabric screen by blocking out portions of the screen. For water-based inks, the blockout materials must be water insoluble; for solvent-based inks, the reverse. Cut plastic stencils are frequently used and adhered to the screen with solvents. The prints are made by scraping ink across the screen, forcing the ink through the unblocked parts of the screen onto paper located underneath the screen, thus creating the positive image. Large print runs using solvent-based inks involve the release of large amounts of solvent vapours into the air.

Collagraphs are made using either intaglio or relief printing techniques on a textured surface or collage, which can be made of many materials glued onto the plate.

Photoprintmaking processes can use either presensitized plates (often diazo) for lithography or intaglio, or the photoemulsion can be applied directly to the plate or stone. A mixture of gum arabic and dichromates have often been used on stones (gum printing). The photographic image is transferred to the plate, and then the plate exposed to ultraviolet light (e.g., carbon arcs, xenon lights, sunlight). When developed, the non-exposed portions of the photoemulsion are washed away, and the plate then printed. The coating and developing agents can often contain hazardous solvents and alkalis. In photo screen processes, the screen can be coated with dichromate or diazo photoemulsion directly, or an indirect process can be used, which involves adhering sensitized transfer films to

the screen after exposure.

In printmaking techniques using oil-based inks, the ink is cleaned up with solvents or with vegetable oil and dishwashing liquid. Solvents also have to be used for cleaning lithography rollers. For water-based inks, water is used for cleanup. For solvent-based inks, large amounts of solvents are used for cleanup, making this one of the most hazardous processes in printmaking. Photoemulsions can be removed from screens using chlorine bleach or enzyme detergents.

Artists who draw, paint or make prints face significant health and safety hazards. The major sources of hazards for these artists include acids (in lithography and intaglio), alcohols (in paint, shellac, resin and varnish thinners and removers), alkalis (in paints, dye baths, photodevelopers and film cleaners), dusts (in chalks, charcoal and pastels), gases (in aerosols, etching, lithography and photoprocesses), metals (in pigments, photochemicals and emulsions), mists and sprays (in aerosols, air-brushing and aquatinting), pigments (in inks and paints), powders (in dry pigments and photochemicals, rosin, talc and whiting), preservatives (in paints, glues, hardeners and stabilizers) and solvents (such as aliphatic, aromatic and chlorinated hydrocarbons, glycol ethers and ketones). Common routes of exposure associated with these hazards include inhalation, ingestion and skin contact.

Among the well-documented health problems of painters, drawers and printmakers are: n-hexane-induced peripheral nerve damage in art students using rubber cement and spray adhesives; solvent-induced peripheral and central nervous system damage in silk-screen artists; bone marrow suppression related to solvents and glycol ethers in lithographers; onset or aggravation of asthma following exposure to sprays, mists, dusts, moulds and gases; abnormal heart rhythms following exposure to hydrocarbon solvents such as methylene chloride, freon, toluene and 1,1,1-trichloroethane found in glues or correction fluids; acid, alkali or phenol burns or irritation of the skin, eyes and mucous membranes; liver damage induced by organic solvents; and irritation, immune reaction, rashes and ulceration of the skin following exposure to nickel, dichromates and chromates, epoxy hardeners, turpentine or formaldehyde.

Although not well-documented, painting, drawing and printmaking may be associated with an increased risk of leukaemia, kidney tumours and bladder tumours. Suspected carcinogens to which painters, drawers and printmakers may be exposed include chromates and dichromates, polychlorinated biphenyls, trichloroethylene, tannic acid, methylene chloride, glycidol, formaldehyde, and cadmium and arsenic compounds.

The most important precautions in painting, drawing and printmaking include: substitution of water-based materials for materials based on organic solvents; proper use of general dilution ventilation and local exhaust ventilation (see figure

96.1); proper handling, labelling, storage and disposal of paints, flammable liquids and waste solvents; appropriate use of personal protective equipment such as aprons, gloves, goggles and respirators; and avoidance of products that contain toxic metals, especially lead, cadmium, mercury, arsenic, chromates and manganese. Solvents to be avoided include benzene, carbon tetrachloride, methyl *n*-butyl ketone, *n*-hexane and trichloroethylene.

Figure 96.1 Silk screen printing with slot exhaust hood

Michael McCann

Additional efforts designed to reduce the risk of adverse health effects associated with painting, drawing and printmaking include early and continuous education of young artists concerning the hazards of art materials, and laws mandating labels on art materials that warn of both short-term and long-term health and safety hazards.

SCULPTURE

Giuseppe Battista

In ancient times, the art of sculpture included engraving and carving of stone, wood, bone and other materials. Later, sculpture developed and refined modelling techniques in clay and plaster, and moulding and welding techniques in metals and glass. During the last century various additional materials and techniques have been used for the art of sculpture, including plastic foams, paper, found materials and several sources of energy such as light, kinetic energy and so on. The

aim of many modern sculptors is to involve the viewer actively.

Sculpture often utilizes the natural colour of the material or treats its surface to achieve a certain colour or to emphasize the natural characteristics or to modify the light reflections. Such techniques belong to the finishing touches of the art piece. Health and safety risks for artists and their assistants arise from the characteristics of the materials; from the use of tools and equipment; from the various forms of energy (mainly electricity) used for the functioning of tools; and from heat for welding and fusing techniques.

Artists' lack of information and their focusing on the work lead to underestimating the importance of safety; this can result in serious accidents and the development of occupational diseases.

The risks are sometimes linked to the design of the workplace or to the organization of the work (e.g., carrying out many working operations at the same time). Such risks are common to all workplaces, but in the arts and crafts environment they can have more serious outcomes.

General Precautions

These include: appropriate design of the studio, considering the type of power sources employed and the placement and movement of the artistic material; segregation of hazardous operations controlled with adequate warning displays; installation of exhaust systems for control and removal of powders, gases, fumes, vapours and aerosols; use of well-fitted and convenient personal protective equipment; efficient clean-up facilities, such as showers, sinks, eye-wash fountains and so on; knowledge of the risks associated with the use of chemical substances and of the regulations that govern their use, in order to avoid or at least reduce their potential harm; keeping informed on the possible risks of accidents and on hygiene regulations and being trained in first aid and. Local ventilation to remove airborne dust is necessary at its source, when it is produced in abundance. Daily vacuum cleaning, either wet or dry, or wet mopping of the floor and of work surfaces is highly recommended.

Main Sculpturing Techniques

Stone sculpture involves carving hard and soft stones, precious stones, plaster, cement and so on. Sculpture shaping involves work on more pliable materials—plaster and clay modelling and casting, wood sculpture, metalworking, glassblowing, plastic sculpture, sculpture in other materials and mixed techniques. See also the articles "Metalworking" and "Woodworking". Glassblowing is discussed in the chapter Glass, ceramics and related materials.

Stone sculptures

Stones used for sculpture can be divided into soft stones and hard stones. The soft stones can be worked manually with tools such as saws, chisels, hammers and rasps, as well as with electric tools.

Hard stones such as granite, and other materials, such as cement blocks, can be used to create works of art and ornaments. This involves working with electric or pneumatic tools. The final stages of the work can be partially executed by hand.

Risks

Prolonged inhalation of high quantities of certain stone dusts containing free crystalline silica, which comes out of freshly cut surfaces, can lead to silicosis. Electric and pneumatic tools can cause a higher concentration in the air of dust which is finer than that produced by manual tools. Marble, travertine and limestone are inert materials and not pathogenic to the lungs; plaster (calcium sulphate) is irritating to the skin and to the mucous membranes.

Asbestos fibre inhalation, even in small quantities, can lead to a risk of lung cancer (laryngeal, tracheal, bronchial, lung and pleural malignancies) and probably also cancer of the digestive tract and of other organ systems. Such fibres can be found as impurities in serpentine and in talc. Asbestosis (fibrosis of the lung) can be contracted only through the inhalation of high doses of asbestos fibres, which is unlikely at this type of work. See table 96.3 for a list of the hazards of common stones.

Table 96.3 Hazards of common stones

Hazardous ingredient	Stones
Free crystalline silica	Hard stones: Granites, basalt, jasper, porphyry, onyx, pietra serena
	Soft stones: steatite (soapstone), sandstone, slate, clays, some limestone
Possible asbestos contamination	Soft stones: soapstone, serpentine
Free silica and asbestos	Hard stones: marble, travertine
	Soft stones: alabaster, tufa, marble, plaster

High noise levels can be produced by the use of pneumatic hammers, electric saws and sanders, as well as manual tools. This can result in hearing loss and other effects on the autonomic nervous system (increase of heart rate, gastric disturbances and so on), psychological problems (irritability, attention deficits and so on), as well as general health problems, including headaches.

The use of electric and pneumatic tools can provoke damage to finger micro-circulation with the possibility of Raynaud's phenomenon, and facilitate degenerative phenomena to the upper arm.

Work in difficult positions and lifting heavy objects can produce low-back pain, muscle strains, arthritis and joint bursitis (knee, elbow).

The risk of accidents is frequently connected with the use of sharp tools moved by powerful forces (manual, electric or pneumatic). Often stone splinters are violently shot into the working environment during the breaking of stones; falling or rolling of improperly fixed blocks or surfaces also occurs. The use of water can lead to slipping on wet floors, and to electric shocks.

Pigment and colourant substances (especially of spray type) used to cover the final layer (paints, lakes) expose the worker to the risk of inhalation of toxic compounds (lead, chromium, nickel) or of irritating or allergenic compounds (acrylic or resins). This can affect the mucous membranes as well as the respiratory tract.

Inhalation of evaporating paints solvents in high quantities over the course of the working day or in lower concentrations for longer periods, can provoke acute or chronic toxic effects on the central nervous system.

Precautions

Alabaster is a safer substitute for soapstone and other hazardous soft stones.

Pneumatic or electric tools with portable dust collectors should be used. The working environment should be cleaned frequently using vacuum cleaners or wet mopping; adequate general ventilation must be provided.

The respiratory system can be protected from the inhalation of dusts, solvents and aerosol vapours through use of proper respirators. Hearing can be protected with ear plugs and eyes can be protected with proper goggles. To reduce the risk of hand accidents leather gloves (when necessary) or lighter rubber gloves, lined with cotton, should be used to prevent contact with chemical substances. Anti-slipping and safety shoes should be used to prevent damage to the feet caused by the possible fall of heavy objects. During complicated and long operations, proper clothes should be worn; ties, jewellery and clothes which could easily get stuck in the machines should not be worn. Long hair should be put up or under a cap. A shower should be taken at the end of every work period; work clothes and shoes should never be taken home.

Pneumatic tool compressors should be placed out of the work area; noisy areas should be insulated; numerous breaks should be taken in warm areas during the working day. Pneumatic and electric tools equipped with comfortable handles

(better if equipped with mechanical shock absorbers) which are able to direct the air away from the hands of the operator should be used; stretching and massage are suggested during the work period.

Sharp tools should be operated as far as possible from hands and body; broken tools should not be used.

Flammable substances (paints, solvents) must be kept far from flames, lit cigarettes and heat sources.

Sculpture shaping

The most common material used for sculpture shaping is clay (mixed with water or naturally soft clay); wax, plaster, concrete and plastic (sometimes reinforced with glass fibres) are also commonly used.

The facility with which a sculpture is shaped is directly proportional to the malleability of the material used. A tool (wood, metal, plastic) is often used.

Some materials, such as clays, can become hard after being heated in a furnace or kiln. Also, talc can be used as semi-liquid clay (slip), which can be poured into moulds and then fired in a kiln after drying.

These types of clays are similar to those used in the ceramic industry and may contain considerable amounts of free crystalline silica. See the article “Ceramics”.

Non-hardening clays, such as plasticine, contain fine particles of clays mixed with vegetable oils, preservatives and sometimes solvents. The hardening clays, also called polymer clays, are actually formed with polyvinyl chloride, with plasticizing materials such as various phthalates.

Wax is usually shaped by pouring it into a mould after it is heated, but it can also be formed with heated tools. Wax can be of natural or synthetic compounds (coloured waxes). Many types of waxes can be dissolved with solvents such as alcohol, acetone, mineral or white spirits, ligroin and carbon tetrachloride.

Plaster, concrete and papier mâché have different characteristics: it is not necessary to heat or to melt them; they are usually worked on a metal or fibreglass frame, or cast in moulds.

Plastic sculpture techniques can be divided into two main areas:

· work with already polymerized materials (casting, plate or sheet). They can be heated, softened, glued, cut, refined, refurbished and so on.

· work with non-polymerized plastic. The material is worked with monomers, obtaining a chemical reaction leading to polymerization.

Plastics can be formed by polyester, polyurethane, amino, phenolic, acrylic, epoxy and silicon resins. During polymerization, they can be poured into moulds, applied by hand layup, printed, laminated and skimmed by using catalyzers, accelerators, hardeners, loads and pigments.

See table 96.4 for a list of the hazards and precautions for common sculpture shaping materials.

Table 96.4 Main risks associated with material used for sculpture shaping

Materials	Hazards and precautions
Clays	Hazards: Free crystalline silica; talc can be contaminated by asbestos; during heating operations, toxic gases can be released.
	Precautions: See “Ceramics”.
Plasticine	Hazards: Solvents and preservatives can cause irritation to skin and mucous and allergic reactions in certain individuals.
	Precautions: Susceptible individuals should find other materials.
Hard clays	Hazards: Some hardening or polymer clay plasticizers (phthalates) are possible reproductive or carcinogen toxins. During heating operations, hydrogen chloride can be released, especially if overheated.
	Precautions: Avoid overheating or using in an oven also used for cooking.
Waxes	Hazards: Overheated vapours are flammable and explosive. Acrolein fumes, produced by decomposition from overheating wax, are strong respiratory irritants and sensitizers. Wax solvents can be toxic by contact and inhalation; carbon tetrachloride is carcinogenic and highly toxic to the liver and kidneys.
	Precautions: Avoid open flames. Do not use electric hot plates with exposed heating elements. Heat to minimum temperature necessary. Do not use carbon tetrachloride.
Finished plastics	Hazards: Heating, machining, cutting plastics can result in decomposition to hazardous materials such as hydrogen chloride (from polyvinyl chloride), hydrogen cyanide (from polyurethanes and amino plastics), styrene (from polystyrene) and carbon monoxide from the combustion of plastics. Solvents used for gluing plastics are also fire and health hazards.

	Precautions: Have good ventilation when working with plastics and solvents.
Plastics resins	Hazards: Most resin monomers (e.g., styrene, methyl methacrylate, formaldehyde) are hazardous by skin contact and inhalation. Methyl ethyl ketone peroxide hardener for polyester resins can cause blindness if splashed in the eyes. Epoxy hardeners are skin and respiratory irritants and sensitizers. Isocyanates used in polyurethane resins can cause severe asthma.
	Precautions: Use all resins with proper ventilation, personal protective equipment (gloves, respirators, goggles), fire precautions and so forth. Do not spray polyurethane resins.
Glassblowing	See Glass, ceramics and related materials.

PHOTOGRAPHY

David Richardson

Black-and-White Processing

In black-and-white photographic processing, exposed film or paper is removed from a light-tight container in a darkroom and sequentially immersed in trays containing aqueous solutions of developer, stop bath and fixer. After a water washing and drying, the film or paper is ready for use. The developer reduces the light-exposed silver halide to metallic silver. The stop bath is a weakly acidic solution that neutralizes the alkaline developer solution and stops further reduction of the silver halide. The fixer forms a soluble complex with the unexposed silver halide, which, together with various water-soluble salts, buffers and halide ions, is subsequently removed from the emulsion in the washing process. Rolls of film are usually processed in closed canisters to which the various solutions are added.

Potential health hazards

Because of the wide variety of formulae used by various suppliers, and different methods of packaging and mixing photoprocessing chemicals, only a few generalizations can be made regarding the types of chemical hazards in black-and-white photoprocessing. The most frequent health issue is the potential for contact dermatitis, which most frequently arises from skin contact with developer solutions. Developer solutions are alkaline and usually contain hydroquinone; in some cases they may contain *p*-methylaminophenolsulphate (also known as Metol or KODAK ELON) as well. Developers are skin and eye irritants and may cause an allergic skin reaction in sensitive individuals. Acetic acid is the principal

hazardous component in most stop baths. Although concentrated stop baths are strongly acidic and may cause skin and eye burns following direct contact, the working-strength solutions are usually slight to moderate skin and eye irritants. Fixers contain photographic hypo (sodium thiosulphate) and various sulphite salts (e.g., sodium metabisulphite), and present a low health hazard.

In addition to potential skin and eye hazards, gases or vapours emitted from some photoprocessing solutions may present an inhalation hazard, as well as contribute to unpleasant odours, especially in poorly ventilated areas. Some photochemicals (e.g., fixers) may emit gases such as ammonia or sulphur dioxide resulting from the degradation of ammonium or sulphite salts, respectively. These gases may be irritating to the upper respiratory tract and eyes. In addition, acetic acid emitted from stop baths may also be irritating to the upper respiratory tract and eyes. The irritant effect of these gases or vapours is concentration dependent and is usually observed only at concentrations that exceed occupational exposure limits. However, because of a wide variation in individual susceptibility, some individuals (e.g., persons with pre-existing medical conditions such as asthma) may experience effects at concentrations below occupational exposure limits. Some of these chemicals may be detectable by odour because of the chemical's low odour threshold. Although the odour of a chemical is not necessarily indicative of a health hazard, strong odours or odours that are increasing in intensity may indicate that the ventilation system is inadequate and should be reviewed.

Risk management

The key to working safely with photoprocessing chemicals is to understand the potential health hazards of exposure and to manage the risk to an acceptable level. Recognition and control of potential hazards begins with reading and understanding product labels and safety data sheets.

Avoiding skin contact is an important goal in darkroom safety. Neoprene gloves are particularly useful in reducing skin contact, especially in mixing areas where more concentrated solutions are encountered. Gloves should be of sufficient thickness to prevent tears and leaks, and should be inspected and cleaned frequently—preferably thorough washing of the outer and inner surfaces with a non-alkaline hand cleaner. In addition to gloves, tongs may also be used to prevent skin contact; barrier creams are not appropriate for use with photochemicals because they are not impervious to all photochemicals and may contaminate processing solutions. A protective apron, smock or lab coat should be worn in the darkroom, and frequent laundering of work clothing is desirable. Protective goggles also should be used, especially in areas where concentrated photochemicals are handled.

If photoprocessing chemicals contact the skin, the affected area should be flushed as rapidly as possible with copious amounts of water. Because materials such as

developers are alkaline, washing with a non-alkaline hand cleaner (pH of 5.0 to 5.5) may aid in reducing the potential to develop dermatitis. Clothing should be changed immediately if there is any contamination with chemicals, and spills or splashes should be immediately cleaned up. Hand-washing facilities and provisions for rinsing the eyes are particularly important in the mixing and processing areas. If concentrated or glacial acetic acid is used, emergency shower facilities should be available.

Adequate ventilation is also a key factor to safety in the darkroom. The amount of ventilation required varies according to room conditions and processing chemicals. General room ventilation (e.g., 4.25 m^3/min supply and 4.8 m^3/min exhaust, equivalent to ten air changes per hour in a 3 × 3 × 3 m room), with a minimum outside air replenishment rate of 0.15 $m^3/min/m^2$ floor area, is usually adequate for photographers who undertake basic black-and-white photoprocessing. The exhaust air should be discharged outside the building to avoid redistributing potential air contaminants. Special procedures such as toning (which involves the replacement of silver by silver sulphide, selenium or other metals), intensifying (which involves making parts of the image darker by the use of chemicals such as potassium dichromate or potassium chlorochromate) and mixing operations (where concentrated solutions or powders are handled) may require supplementary local exhaust ventilation or respiratory protection.

Colour Processing

There are a number of colour processes that are more complex and also involve the use of potentially hazardous chemicals. Colour processing is described in the chapter Printing, photography, and reproduction industries. As with black-and-white photoprocessing, avoiding skin and eye contact and providing adequate ventilation are key factors to safety in colour processing.

METALWORKING

Angela Babin

Metalworking involves casting, welding, brazing, forging, soldering, fabrication and surface treatment of metal. Metalworking is becoming even more common as artists in developing countries are also starting to use metal as a basic sculptural material. While many art foundries are commercially run, art foundries are also often part of college art programmes.

Hazards and Precautions

Casting and foundry

Artists either send work out to commercial foundries, or can cast metal in their own studios. The lost wax process is often used for casting small pieces. Common metals and alloys used are bronze, aluminium, brass, pewter, iron and stainless steel. Gold, silver and sometimes platinum are used for casting small pieces, particularly for jewellery.

The lost wax process involves several steps:

1. making the positive form
2. making the investment mould
3. burning out of the wax
4. melting the metal
5. slagging
6. pouring the molten metal into the mould
7. removing the mould

The positive form can be made directly in wax; it can also be made in plaster or other materials, a negative mould made in rubber and then the final positive form cast in wax. Heating the wax can result in fire hazards and in decomposition of the wax from overheating.

The mould is commonly made by applying an investment containing the cristobalite form of silica, creating the risk of silicosis. A 50/50 mixture of plaster and 30-mesh sand is a safer substitute. Moulds can also be made using sand and oil, formaldehyde resins and other resins as binders. Many of these resins are toxic by skin contact and inhalation, requiring skin protection and ventilation.

The wax form is burnt out in a kiln. This requires local exhaust ventilation to remove the acrolein and other irritating wax decomposition products.

Melting the metal is usually done in a gas-fired crucible furnace. A canopy hood exhausted to the outside is needed to remove carbon monoxide and metal fumes, including zinc, copper, lead, aluminium and so on.

The crucible containing the molten metal is then removed from the furnace, the slag on the surface removed and the molten metal poured into the moulds (figure 96.2). For weights under 80 pounds of metal, manual lifting is normal; for greater weights, lifting equipment is needed. Ventilation is needed for the slagging and pouring operations to remove metal fumes. Resin sand moulds can also produce hazardous decomposition products from the heat. Face shields protecting against infrared radiation and heat, and personal protective clothing resistant to heat and

molten metal splashes are essential. Cement floors must be protected against molten metal splashes by a layer of sand.

Figure 96.2 Pouring molten metal in art foundry

Ted Rickard

Breaking away the mould can result in exposure to silica. Local exhaust ventilation or respiratory protection is needed. A variation of the lost wax process called the foam vaporization process involves using polystyrene or polyurethane foam instead of wax, and vaporizing the foam during pouring of the molten metal. This can release hazardous decomposition products, including hydrogen cyanide from polyurethane foam. Artists often use scrap metal from a variety of sources. This practice can be dangerous due to possible presence of lead- and mercury-containing paints, and to the possible presence of metals like cadmium, chromium, nickel and so on in the metals.

Fabrication

Metal can be cut, drilled and filed using saws, drills, snips and metal files. The metal filings can irritate the skin and eyes. Electric tools can cause electric shock. Improper handling of these tools can result in accidents. Goggles are needed to protect the eyes from flying chips and filings. All electrical equipment should be properly grounded. All tools should be carefully handled and stored. Metal to be fabricated should be securely clamped to prevent accidents.

Forging

Cold forging utilizes hammers, mallets, anvils and similar tools to change the shape of metal. Hot forging involves additionally heating the metal. Forging can create great amounts of noise, which can cause hearing loss. Small metal splinters may damage the skin or eyes if precautions are not taken. Burns are also a hazard with hot forging. Precautions include good tools, eye protection, routine clean-up, proper work clothing, isolation of the forging area and wearing ear plugs or ear muffs.

Hot forging involves the burning of gas, coke or other fuels. A canopy hood for ventilation is needed to exhaust carbon monoxide and possible polycyclic aromatic hydrocarbon emissions, and to reduce heat build-up. Infrared goggles should be worn for protection against infrared radiation.

Surface treatment

Mechanical treatment (chasing, repousse) is done with hammers, engraving with sharp tools, etching with acids, photoetching with acids and photochemicals, electroplating (plating a metallic film onto another metal) and electroforming (plating a metallic film onto a non-metallic object) with acids and cyanide solutions and metal colouring with many chemicals.

Electroplating and electroforming often use cyanide salts, ingestion of which can be fatal. Accidental mixing of acids and the cyanide solution will produce hydrogen cyanide gas. This is hazardous through both skin absorption and inhalation—death can occur within minutes. Disposal and waste management of spent cyanide solutions is strictly regulated in many countries. Electroplating with cyanide solutions should be done in a commercial plant; otherwise use substitutes that do not contain cyanide salts or other cyanide-containing materials.

Acids are corrosive, and skin and eye protection is needed. Local exhaust ventilation with acid-resistant ductwork is recommended.

Anodizing metals such as titanium and tantalum involves oxidizing these at the anode of an electrolytic bath to colour them. Hydrofluoric acid can be used for precleaning. Avoid using hydrofluoric acid or use gloves, goggles and a protective apron.

Patinas used to colour metals can be applied cold or hot. Lead and arsenic compounds are very toxic in any form, and others can give off toxic gases when heated. Potassium ferricyanide solutions will give off hydrogen cyanide gas when heated, arsenic acid solutions give off arsine gas and sulphide solutions give off hydrogen sulphide gas. Very good ventilation is needed for metal colouring (figure 96.3). Arsenic compounds and heating of potassium ferrocyanide solutions should be avoided.

Figure 96.3 Applying a patina to metal with slot exhaust hood

Ken Jones

Finishing processes

Cleaning, grinding, filing, sandblasting and polishing are some final treatments for metal. Cleaning involves the use of acids (pickling). This involves the hazards of handling acids and of the gases produced during the pickling process (such as nitrogen dioxide from nitric acid). Grinding can result in the production of fine metal dusts (which can be inhaled) and heavy flying particles (which are eye hazards).

Sandblasting (abrasive blasting) is very hazardous, particularly with actual sand. Inhalation of fine silica dust from sandblasting can cause silicosis in a short time. Sand should be replaced with glass beads, aluminium oxide or silicon carbide. Foundry slags should be used only if chemical analysis shows no silica or dangerous metals such as arsenic or nickel. Good ventilation or respiratory protection is needed.

Polishing with abrasives such as rouge (iron oxide) or tripoli can be hazardous since rouge can be contaminated with large amounts of free silica, and tripoli contains silica. Good ventilation of the polishing wheel is needed.

Welding

Physical hazards in welding include the danger of fire, electric shock from arc-

welding equipment, burns caused by molten metal sparks, and injuries caused by excessive exposure to infrared and ultraviolet radiation. Welding sparks can travel 40 feet.

Infrared radiation can cause burns and eye damage. Ultraviolet radiation can cause sunburn; repeated exposure may lead to skin cancer. Electric arc welders in particular are subject to pink eye (conjunctivitis), and some have cornea damage from UV exposure. Skin protection and welding goggles with UV- and IR-protective lenses are needed.

Oxyacetylene torches produce carbon monoxide, nitrogen oxides and unburned acetylene, which is a mild intoxicant. Commercial acetylene contains small amounts of other toxic gases and impurities.

Compressed gas cylinders can be both explosive and fire hazards. All cylinders, connections and hoses must be carefully maintained and inspected. All gas cylinders must be stored in a location which is dry, well ventilated and secure from unauthorized persons. Fuel cylinders must be stored separately from oxygen cylinders.

Arc welding produces enough energy to convert the air's nitrogen and oxygen to nitrogen oxides and ozone, which are lung irritants. When arc welding is done within 20 feet of chlorinated degreasing solvents, phosgene gas can be produced by the UV radiation.

Metal fumes are generated by the vaporization of metals, metal alloys and the electrodes used in arc welding. Fluoride fluxes produce fluoride fumes.

Ventilation is needed for all welding processes. While dilution ventilation may be adequate for mild steel welding, local exhaust ventilation is necessary for most welding operations. Moveable flanged hoods, or lateral slot hoods should be used. Respiratory protection is needed if ventilation is not available.

Many metal dusts and fumes can cause skin irritation and sensitization. These include brass dust (copper, zinc, lead and tin), cadmium, nickel, titanium and chromium.

In addition, there are problems with welding materials that may be coated with various substances (e.g., lead or mercury paint).

NEW TECHNOLOGY IN ART

William E. Irwin

This article describes the basic health and safety concerns associated with the use of lasers, neon sculpture and computers in the arts. Creative artists often work

very intimately with the technology, and in experimental ways. This scenario too often increases the risk of injury. The primary concerns are for eye and skin protection, for reducing the possibilities of electrical shock and for preventing exposure to toxic chemicals.

Lasers

Laser radiation may be hazardous to the eyes and skin of artists and audiences by both direct viewing and reflection. The degree of laser injury is a function of power. Higher-power lasers are more likely to cause serious injury and more hazardous reflections. Lasers are classified and labelled by their manufacturer in classes I to IV. Class I lasers exhibit no laser radiation hazard and Class IV are very dangerous.

Artists have used all laser classes in their work, and most use visible wavelengths. Besides the safety controls required of any laser system, artistic applications require special considerations.

In laser exhibits, it is important to isolate the audience from direct beam contact and scattered radiation, using plastic or glass enclosures and opaque beam stops. For planetariums and other indoor light shows, it is critical to maintain direct beam or reflected laser radiation at Class I levels where the audience is exposed. Class III or IV laser radiation levels must be kept at safe distances from performers and the audience. Typical distances are 3 m away when an operator controls the laser and 6 m away without continuous operator control. Written procedures are needed for set-up, alignment and testing of Class III and IV lasers. Required safety controls include warning in advance of energizing these lasers, key controls, fail-safe safety interlocks and manual reset buttons for Class IV lasers. For Class IV lasers, appropriate laser goggles should be worn.

Scanning laser art displays often used in the performing arts use rapidly moving beams that are generally safer since the duration of inadvertent eye or skin contact with the beam is short. Still, operators must employ safeguards to ensure exposure limits will not be exceeded if the scanning equipment fails. Outdoor displays cannot allow aircraft to fly through hazardous beam levels, or the illumination with greater than Class I levels of radiation of tall buildings or personnel in high-reach equipment.

Holography is the process of producing a three-dimensional photograph of an object using lasers. Most images are displayed off-axis from the laser beam, and intrabeam viewing is typically not a hazard. A transparent display case around the hologram can help reduce the possibilities of injury. Some artists create permanent images from their holograms, and many chemicals used in the development process are toxic and must be managed for accident prevention. These include pyrogallic acid, alkalis, sulphuric and hydrobromic acids, bromine, parabenzoquinone and dichromate salts. Safer substitutes are available for most

of these chemicals.

Lasers also have serious non-radiological hazards. Most performance-level lasers use high voltages and amperage, creating significant risks of electrocution, particularly during design stages and maintenance. Dye lasers use toxic chemicals for the active lasing medium, and high-powered lasers may generate toxic aerosols, especially when the beam strikes a target.

Neon Art

Neon art uses neon tubes to produce lighted sculptures. Neon signage for advertising is one application. Producing a neon sculpture involves bending leaded glass to the desired shape, bombarding the evacuated glass tube at a high voltage to remove impurities from the glass tube, and adding small amounts of neon gas or mercury. A high voltage is applied across electrodes sealed into each end of the tube to give the luminous effect by exciting the gases trapped in the tube. To obtain a wider range of colours, the glass tube can be coated with fluorescent phosphors, which convert the ultraviolet radiation from the mercury or neon into visible light. The high voltages are achieved by using step-up transformers.

Electrical shock is a threat mostly when the sculpture is connected to its bombarding transformer to remove impurities from the glass tube, or to its electrical power source for testing or display (figure 96.4). The electrical current passing through the glass tube also causes the emission of ultraviolet light that in turn interacts with the phosphor-covered glass to form colours. Some near-ultraviolet radiation (UVA) may pass through the glass and present an eye hazard to those nearby; therefore, eyewear that blocks UVA should be worn.

Figure 96.4 Neon sculpture manufacture showing an artist behind a protective barrier

Fred Tschida

Some phosphors that coat the neon tube are potentially toxic (e.g., cadmium compounds). Sometimes mercury is added to the neon gas to create a particularly vivid blue colour. Mercury is highly toxic by inhalation and is volatile at room temperature.

Mercury should be added to the neon tube with great care and stored in unbreakable sealed containers. The artist should use trays to contain spillage, and mercury spill kits should be available. Mercury should not be vacuumed up, as this may disperse a mist of mercury through the vacuum cleaner's exhaust.

Computer Art

Computers are used in art for a variety of purposes, including painting, displaying scanned photographic images, producing graphics for printing and television (e.g., on-screen credits), and for a variety of animated and other special effects for motion pictures and television. The latter is a rapidly expanding use of computer art. This can bring about ergonomic problems, typically due to repetitive tasks and uncomfortably arranged components. The predominant complaints are discomfort in the wrists, arms, shoulders and neck, and vision problems. Most complaints are of a minor nature, but disabling injuries such as chronic tendinitis or carpal tunnel syndrome are possible.

Creating with computers often involves long periods manipulating the keyboard or mouse, designing or fine tuning the product. It is important that computer users take a break away from the screen periodically. Short, frequent breaks are more effective than long breaks every couple of hours.

Regarding the proper arrangement of components and the user, design solutions for correct posture and visual comfort are the key. Computer work station components should be easy to adjust for the variety of tasks and people involved.

Eye strain may be prevented by taking periodic visual breaks, preventing glare and reflection and by placing the top of the monitor so that it is at eye level. Vision problems may also be avoided if the monitor has a refresh rate of 70 Hz, so that image flicker is reduced.

Many kinds of radiation effects are possible. Ultraviolet, visible, infrared, radio frequency and microwave radiation emissions from computer hardware are generally at or below normal background levels. The possible health effects of lower-frequency waves from the electrical circuitry and electronic components are not well understood. To date, however, no solid evidence identifies a health risk from exposure to the electromagnetic fields associated with computer monitors. Computer monitors do not emit hazardous levels of x rays.

FIBRE AND TEXTILE CRAFTS

Gail Coningsby Barazani

Contemporary fibre or textile artists use a wide range of processes, such as weaving, needlework, papermaking, leatherworking and so forth. These can be done by hand or aided by machines (see table 96.5). They may also use many processes for preparing fibres or finished textile, such as carding, spinning, dyeing, finishing and bleaching (see table 96.6). Finally the fibreworks or textiles may be painted, silk-screened, treated with photographic chemicals, scorched or otherwise modified. See separate articles in this chapter describing these techniques.

Table 96.5 Description of fibre and textile crafts

Process	Description
Basketry	Basketry is the making of baskets, bags, mats, etc., by hand weaving, plaiting and coiling techniques using materials such as reeds, cane and sisal fibre. Knives and scissors are often used, and coiled baskets are often sewed together.
Batik	Batik involves the creating of dye patterns on fabric by applying molten wax to the fabric with a djanting to form a resist, dyeing the fabric and removing the wax with solvents or by ironing between newsprint.
Crocheting	Crocheting is similar to knitting except that a hook is used to loop threads into the fabric.
Embroidery	The embellishment of a fabric, leather, paper or other

Embroidery	The embellishment of a fabric, leather, paper or other materials by sewing of designs worked in thread with a needle. Quilting comes under this category.
Knitting	Knitting is the craft of forming a fabric by interlocking of yarn in a series of connected loops using long hand or mechanized needles.
Lacemaking	Lacemaking involves the production of ornamental openwork of threads that have been twisted, looped and intertwined to form patterns. This can involve very fine and intricate hand stitching.
Leatherworking	Leather crafts involve two basic steps: cutting, carving, sewing and other physical processes; and cementing, dyeing and finishing the leather. The first can involve a variety of tools. The latter can involve the use of solvents, dyes, lacquers and such. For tanning, see the chapter Leather, fur and footwear.
Macramé	Macramé is the ornamental knotting of yarn into bags, wall hangings or similar materials.
Papermaking	Papermaking involves preparing the pulp and then making the paper. A variety of plants, wood, vegetables, used paper rags and so forth can be used. The fibres must be separated out, often by boiling in alkali. The fibres are washed and placed in a beater to complete preparation of the pulp. Then paper is made by trapping the pulp on a wire or fabric screen, and allowed to dry in the air or by being pressed between layers of felt. The paper can be treated with sizings, dyes, pigments and other materials.
Silk screen printing	See “Drawing, Painting and Printmaking”.
Weaving	Weaving uses a machine called a loom to combine two sets of yarn, the warp and the weft, to produce fabric. The warp is wound on large reels, called beams, which run the length of the loom. The warp yarns are threaded through the loom to form vertical parallel threads. The weft is fed from the side of the loom by bobbins. The loom shuttle carries the weft yarns across the loom horizontally under and above alternate warp threads. A starch sizing is used to protect warp threads from breaking during weaving. There are many types of looms, both hand-operated and mechanical.

Table 96.6 Description of fibre and textile processes

Process	Description
Carding	Process of cleaning and straightening fibres into parallel lines by combing it (by hand or by special machinery) and twisting the fibres into a rope-like form. This process can create large amounts of dust.
Spinning	A foot-pedal-operated spinning wheel is used to turn the spindle, which combines several fibres into twisted, elongated yarn.
Finishing	The woven fabric can be singed to remove projecting hairs, desized with enzymes, and scoured by boiling in alkali to remove fats and waxes.
Dyeing	Yarn or fabric can be dyed using a variety of types of dyes (natural, direct, acid, basic, disperse, fibre-reactive and more) depending upon the type of fabric. Many dyeing processes involve heating the dyebath to near boiling. Many dyeing assistants can be used, including acids, alkalis, salt, sodium hydrosulphite and, in the case of natural dyes, mordants such as urea, ammonium dichromate, ammonia, copper sulphate, and ferrous sulphate. Dyes are usually purchased in powder form. Some dyes may contain solvents.
Bleaching	Fabrics can be bleached with chlorine bleaches to remove colour.

No material is off limits for artists, who may use any of thousands of animal, vegetable or synthetic materials in their work. They gather materials such as weeds, vines or animal hair from the outdoors, or purchase products from suppliers who may have altered them by treating them with oils, fragrances, dyes, paints or pesticides (e.g., rat poison in twine or rope intended for agricultural use). Imported animal or vegetable materials that have been processed to eliminate disease carrying insects, spores or fungi are also used. Old rags, bones, feathers, wood, plastics or glass are among many other materials incorporated in fibre crafts.

Potential Sources of Health Hazards in the Fibre Arts

Chemicals

Health hazards in fibre or textile arts, as in any workplace, include air pollutants such as dusts, gases, fumes and vapours that are inherent in the materials or are produced in the work process, and can be inhaled or affect the skin. In addition to chemical hazards of dyes, paints, acids, alkalis, mothproofing agents and so on, fibre or textile materials may be contaminated with biological materials that can cause disease.

Vegetable dusts

Workers heavily exposed to dusts of raw cotton, sisal, jute and other vegetable fibres in industrial workplaces have developed various chronic lung problems such as “brown lung” (byssinosis), which begins with chest tightness and shortness of breath, and can be disabling after many years. Exposure to vegetable dusts in general may cause lung irritation or other effects such as asthma, hay fever, bronchitis and emphysema. Other materials associated with vegetable fibres, such as moulds, mildew, sizing materials and dyes, may also cause allergic or other reactions.

Animal dusts

Animal products used by fibre artists such as wool, hair, hides and feathers may be contaminated with bacteria, moulds, lice or mites that are capable of causing “Q” fever, mange, respiratory symptoms, skin rashes, anthrax, allergies and so on, if they are not treated or fumigated before use. Fatal cases of inhalation anthrax have occurred in craft weavers, including the 1976 death of a California weaver.

Synthetic materials

The effects of dusts of polyesters, nylon, acrylic, rayon and acetates are not well known. Some plastic fibres may release gas or components or residues which are left in the fabric after processing, as in the case of formaldehyde released by polyesters or permanent-press fabrics. Sensitive individuals have reported allergic responses in rooms or stores where these materials were present, and some have developed skin rashes after wearing clothing of these fabrics, even after repeated washings.

Heating, scorching or otherwise altering synthetic materials chemically may release potentially hazardous gases or fumes.

Physical Effects of Working with Fibres and Textiles

The physical characteristics of materials may affect the user. Rough, thorny or abrasive materials can cut or abrade skin. Glass fibres or stiff grasses or rattan can penetrate the skin and cause infections or rashes.

Much of fibre or fabric work is done while the worker is seated for prolonged periods, and involves repetitious motion of arms, wrists, hands and fingers, and often the entire body. This may produce pain and eventual repetitive strain injuries. Weavers, for example, can develop back problems, carpal tunnel syndrome, skeletal deformation from weaving in a squatting position on older types of looms (particularly in young children), hand and finger disorders (e.g., swollen joints, arthritis, neuralgia) from threading and tying knots, and eyestrain from poor lighting (figure 96.5). Many of the same problems can occur in other fibre crafts involving sewing, tying knots, knitting and so forth. Needlework crafts

can also involve hazards of needle pricks.

Figure 96.5 Weaving with a hand loom

Lifting of large papermaking screens containing water-saturated pulp can cause possible back injuries due to the weight of the water and pulp.

Precautions

As with all work, the adverse effects depend upon the amount of time spent working on a project each day, the number of workdays, weeks or years, the quantity of work and the nature of the workplace, and the type of work itself. Other factors such as ventilation and lighting also affect the health of the artist or craftsperson. One or two hours a week spent at a loom in a dusty environment may not affect a person seriously, unless that person is highly allergic to dusts, but a prolonged period of work in the same environment over months or years may result in some health effects. However, even one episode of untrained lifting of a heavy object can cause injury to the spine.

Generally, for prolonged or regular work in fibre art or textiles:

· Obtain and use only treated or fumigated animal or vegetable materials. Other materials should be cleaned or washed, and stored in closed containers to minimize dusts.

· Damp mop or wipe work area surfaces frequently.

- In many countries, manufacturers are required to provide information that describes the hazardous aspects of chemicals such as dyes, adhesives, paints or solvents in any product purchased, such as a manufacturer's Material Safety Data Sheet (MSDS). Request such information.

- Avoid eating, drinking or smoking in the work area.

- Take frequent rest and exercise periods when work involves repetitive motion.

- Modify work processes to reduce the need for excessive lifting or straining. For example, in papermaking use smaller screens or have another person assist in lifting the screen with the pulp.

- Use exhaust ventilation for regular or prolonged use of dusty materials, spray painting, heating of wax or work with solvent-containing materials such as oil-based paints or permanent ink markers.

- Avoid boiling acids and alkalis if possible. Wear gloves, goggles, face shield and protective apron.

- Remember that dusts, gases and vapours travel throughout buildings and may affect others present, particularly infants, children, the aged and the chronically ill.

- Consult an industrial hygienist or safety and health professional when planning a production workshop.

CERAMICS

Monona Rossol

Foodware, sculpture, decorative tiles, dolls and other ceramic or clay items are made in both large and small professional studios and shops, classrooms in public schools, universities and trade schools, and in homes as a hobby or cottage industry. The methods can be divided into ceramics and pottery, although terminology can vary in different countries. In ceramics, objects are made by slip casting—pouring a slurry of water, clay and other ingredients into a mould. The clay objects are removed from the mould, trimmed and fired in a kiln. Some ware (bisque ware) is sold after this stage. Other types are decorated with glazes that are mixtures of silica and other substances which form a glass surface. In pottery, objects are formed from plastic clay, usually by hand-forming or wheel-throwing, after which they are dried and fired in a kiln. Objects may then be glazed. Slip cast ceramics usually are glazed with china paints, which are commercially produced in dry or liquid pre-packaged form (figure 96.6). Potters may glaze their ware with these commercial glazes or with glazes they compound themselves. All types of ware are produced, from terra cotta and earthenware, which are fired at low

temperatures, to stoneware and porcelain, which are fired at high temperatures.

Figure 96.6 Decorating a pot with China paints

Clay and Glaze Materials

All clays and glazes are mixtures of silica, aluminium and metallic minerals. These ingredients usually contain significant amounts of respirable-sized particles such as those in silica flour and ball clays. Clay bodies and glazes are composed of essentially the same types of minerals (see table 96.7) , but glazes are formulated to melt at lower temperatures (have more flux) than the bodies on which they are applied. Lead is a common flux. Raw lead minerals such as galena and lead oxides derived from burning car battery plates and other scrap are used as fluxes, and have poisoned potters and their families in some developing countries. Commercially sold glazes for industrial and hobby use are more likely to contain lead and other chemicals which have been mixed and pre-fired into powdered frits. Glazes are formulated to mature in either oxidation or reduction firing (see below) and may contain metal compounds as colourants. Lead, cadmium, barium and other metals may leach into food when glazed ceramic wares are used.

Table 96.7 Ingredients of ceramic bodies and glazes

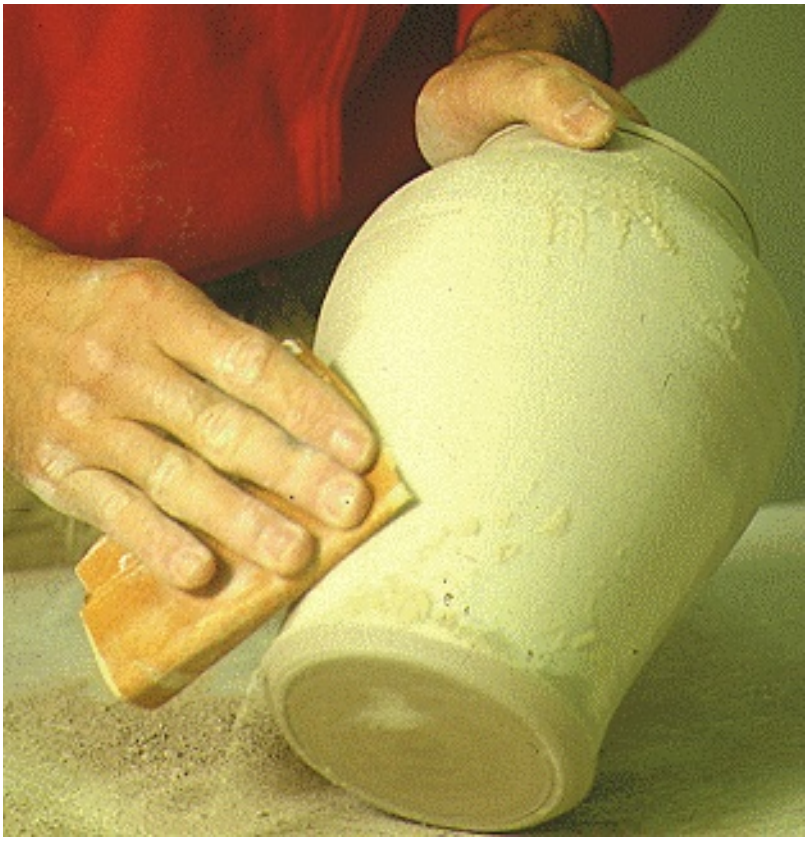
Basic constituents		
Clays (hydroaluminium silicates)	Alumina	Silica
Kaolins and other white clays	Aluminium oxide, corundum	Quartz from fli

Kaolins and other white clays Red iron-rich clays Fire clays Ball clays Bentonite	Aluminium oxide, corundum, usual source in glazes is from clays and feldspars	Quartz from fi diatomaceous from calcined minerals
Other ingredients and some mineral sources		
Fluxes	Opacifiers	Colourants
Sodium, potassium, lead, magnesium, lithium, barium, boron, calcium, strontium, bismuth	Tin, zinc, antimony, zirconium, titanium, fluorine, cerium, arsenic	Cobalt, copper manganese, ca vanadium, nic
Sources include oxides and carbonates of metals above, feldspars, talc, nepheline syenite, borax, colemanite, whiting, lead frits, lead silicates	Sources include oxides and carbonates of metals above, cryolite fluorspar, rutile, zirconium silicate	Sources includ carbonates an metals above, and other met

Other special surface treatments include metallic lustre glazes containing tack oils and solvents such as chloroform, iridescent effects obtained by fuming metallic salts (usually chlorides of tin, iron, titanium or vanadium) onto surfaces during firing, and new paints containing plastic resins and solvents, which look like fired ceramic glazes when dry. Specially textured clay bodies may include fillers such as vermiculite, perlite and grog (ground fire brick).

Exposure to clay and glaze ingredients occurs during mixing, sanding and spray-applying glazes, and when grinding or chipping fired glaze imperfections from the bottoms of pottery or from kiln shelves (figure 96.7). Cleaning kiln shelves exposes workers to flint, kaolin and other kiln wash ingredients. Silica dust from fired kiln wash or bisque is more hazardous because it is in the cristobalite form. Hazards include: silicosis and other pneumoconioses from inhalation of minerals such as silica, kaolin, talc and fibrous amphibole asbestos in some talcs; toxicity from exposure to metals such as lead, barium and lithium; dermatitis from sensitizing metals such as chrome, nickel and cobalt; cumulative trauma disorders such as carpal tunnel syndrome ("potter's thumb") from wheel throwing; back injuries from digging clay, lifting 100-pound sacks of bulk minerals or from wedging (hand working clay to remove air bubbles); slips and falls on wet floors; shocks from electric pottery wheels and other equipment used in wet areas; allergies to moulds in clay; fungal and bacterial infections of nail beds and skin; and accidents with clay mixers, pug mills, blungers, slab rollers and the like.

Figure 96.7 Exposure to clay and glaze dusts while hand sanding a pot



Henry Dunsmore

Precautions: outlaw open lead burning; use substitutes for raw lead, lead frits, cadmium and asbestos-containing materials; isolate work from family areas and children; practice housekeeping and hygiene; control dust; use local exhaust ventilation for glaze spraying and dusty processes (figure 96.8); use respiratory protection; work with adequate rest periods; lift safely; guard machines; and use ground fault interrupters on wheels and all other electrical equipment.

Figure 96.8 Local exhaust ventilation for clay mixing

Michael McCann

Kiln Firing

Kilns vary from railroad-car size to a few cubic inches for firing test tiles and miniatures. They are heated with electricity or fuels such as gas, oil or wood. Electric kilns produce ware fired in primarily oxidizing atmospheres. Reduction firing is achieved by adjusting fuel/air ratios in fuel-fired kilns to create chemically reducing atmospheres. Firing methods include salt firing, raku (putting red-hot pots into organic matter such as damp hay to produce a smoky reduced clay body), climbing kilns (many-chambered wood or coal fired kilns built on hillsides), sawdust firing (kilns packed tight with pots and sawdust) and open-pit firing with many fuels including grass, wood and dung.

Primitive fuel-fired kilns are poorly insulated because they are usually made of fired clay, brick or mud. Such kilns can burn large amounts of wood and can contribute to fuel shortages in developing countries. Commercial kilns are insulated with refractory brick, castable refractory or ceramic fibre. Asbestos insulation is still found in older kilns. Refractory ceramic fibre is in very wide use in industry and hobby kilns. There are even small fibre kilns which are heated by putting them in home kitchen microwave ovens.

Kiln emissions include combustion products from fuels and from organic matter that contaminates clay and glaze minerals, sulphur oxides, fluorine and chlorine from minerals such as cryolite and sodalite, and metal fumes. Salt firing emits hydrochloric acid. Emissions are especially hazardous when fuels such as painted or treated wood and waste oils are burned. Hazards include: respiratory irritation or sensitization from aldehydes, sulphur oxides, halogens and other emissions;

asphyxiation from carbon monoxide; cancer from inhalation of asbestos or ceramic fibre; eye damage from infrared radiation from glowing hot kilns; and thermal injury and burns.

Precautions: use clean-burning fuels; design fuel-efficient, well-insulated kilns; substitute refractory brick for asbestos or ceramic fibre; encapsulate or remove existing fibre insulation; locally vent indoor kilns; locate kilns in areas free of combustible materials; equip electric kilns with two automatic shut-offs; wear infrared-blocking goggles and gloves when handling hot objects.

WOODWORKING

Michael McCann

Woodworking is practised as an art form and utilitarian craft all over the world. It includes wood sculpture, furniture and cabinet making (figure 96.9), musical instrument making and so on. Techniques include carving (figure 96.10), laminating, joining, sawing, sanding, paint removing, painting and finishing. Woodworking uses a large number of different types of hard and soft woods, including many exotic tropical woods, plywood and composition boards, and sometimes woods treated with pesticides and wood preservatives.

Figure 96.9 Furniture making

Figure 96.10 Carving wood with hand tools

Hazards and Precautions

Woods

Many woods are hazardous, especially tropical hardwoods. Types of reactions can include skin allergies and irritation from the sap, wood dust or sometimes the wood, as well as conjunctivitis, respiratory allergies, hypersensitivity pneumonia and toxic reactions. Inhalation of hardwood dust is associated with a particular type of nasal and nasal sinus cancer (adenocarcinoma). See the chapter Woodworking industry.

Precautions include avoiding use of sensitizing woods for people who have a history of allergies, or for objects where people would be in frequent contact with the wood, and controlling dust levels by using local exhaust ventilation or wearing a toxic-dust respirator. When handling woods that can cause skin irritation or allergies, the artist should wear gloves or apply a barrier cream. Hands should be washed carefully after work.

Plywoods and composition board

Plywood and composition board (e.g., particle board) are made by gluing thin sheets of wood, or wood dust and chips, together with either urea-formaldehyde glues or phenol-formaldehyde glues. These materials can emit unreacted formaldehyde for some years after manufacture, with composition board emitting more formaldehyde. Heating these materials or machining them can cause decomposition of the glue to release formaldehyde. Formaldehyde is a skin, eye and respiratory irritant and strong sensitizer, and a probable human carcinogen.

Precautions include using low-formaldehyde products whenever possible, not storing large amounts of plywood or composition board in the shop, and using dust collectors connected to woodworking machines that are exhausted to the outside.

Wood preservatives and other treatments

Pesticides and preservatives are often applied to wood when it is being timbered, processed or shipped. Pentachlorophenol and its salts, creosote and chromated copper arsenate (CCA) have been banned for sale in the United States as wood preservatives because of possible carcinogenicity and reproductive hazards. They can, however, still be found in older woods, and chromated copper arsenate is still allowed as a commercial treatment (e.g., "green" lumber, playground equipment and other outdoor uses). A variety of other chemicals can be used in treating wood, including fire retardants and bleaches.

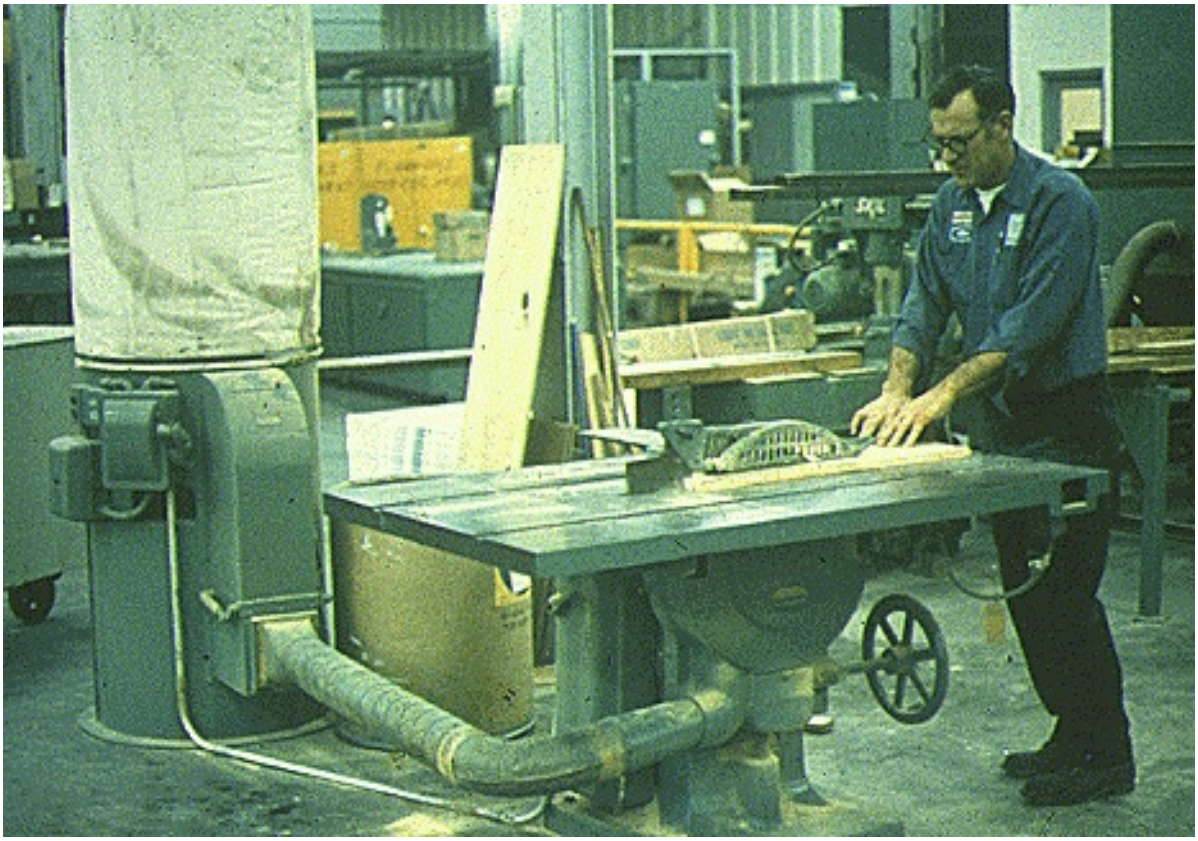
Precautions include not handling woods that have been treated with pentachlorophenol or creosote, using local exhaust ventilation when machining CCA-treated wood or wearing a respirator with high-efficiency filters. Wood that has been treated with creosote, pentachlorophenol or chromated copper arsenate should not be burned.

Carving and machining wood

Woods can be hand carved with chisels, rasps, hand saws, sandpaper and the like, or they can be machined with electric saws, sanders and other woodworking machines. Hazards include exposure to wood dusts, excessive noise levels from woodworking machines, accidents from using tools and machines, electrical shock or fire from faulty wiring, and wood fires. Vibrating tools—for example, chain saws—can cause "white fingers" (Raynaud's phenomenon), involving numbness of the fingers and hands.

Precautions include equipping woodworking machines with dust collectors (figure 96.11) and machine guards, cleaning up sawdust to avoid fire hazards, wearing goggles (and sometimes face shields) and reducing noise. Using the appropriate machine for the desired operation, and repairing defective machines immediately; keeping hand tools sharpened, and using them safely; keeping all electrical equipment and wiring in good repair, and avoiding extension cords which can be tripped over; not wearing ties, long loose hair, loose sleeves or other items that could catch in machinery are some other precautions.

Figure 96.11 Woodworking machines with dust collector



Michael McCann

Gluing wood

A variety of glues are used for laminating and joining wood, including contact adhesives, casein glue, epoxy glues, formaldehyde-resin glues, hide glues, white glue (polyvinyl acetate emulsion) and the cyanoacrylate “instant” glues. Many of these contain toxic solvents or other chemicals, and can be skin, eye and respiratory hazards.

Precautions include avoiding formaldehyde resin glues; using water-based glues rather then solvent-type glues; wearing gloves or barrier creams when using epoxy glues, solvent-based adhesives or formaldehyde-resin glues; and having good ventilation when using epoxy glues, cyanoacrylate glues and solvent-based glues. Sources of ignition should be avoided when using flammable solvents.

Painting and finishing

Wood can be painted with most types of paint; can be stained, lacquered or varnished; and can be treated with linseed or other types of oil. Other materials that are used in finishing wood include shellacs, polyurethane coatings and waxes. Many materials are sprayed. Some woodworkers mix their own paints from dry pigments. Hazards include inhalation of toxic pigment powder (especially lead chromate pigments), skin and inhalation hazards from solvents, fire hazards from flammable solvents, and spontaneous combustion from rags soaked with oil or turpentine.

Precautions include using ready-made paints rather than mixing your own; avoiding eating, drinking or smoking in the work area; using water-based paints rather than solvent-based ones; and placing oil- and solvent-soaked rags in self-closing oily-waste cans, or even a pail of water.

Precautions with solvents include wearing gloves and goggles, as well as having adequate ventilation; doing the operation outside; or wearing a respirator with organic vapour cartridges. Materials should be brushed on whenever possible, to avoid the hazards of spraying. Spraying finishes inside an explosion-proof spray booth, or wearing a respirator with organic vapour cartridges and spray filters; avoiding open flames, lit cigarettes and other sources of ignition (e.g., lit pilot lights) in the area when applying flammable finishes, or when spraying, are other precautions to be taken.

Paint stripping

Stripping old paint and varnish from wood and furniture is done with paint and varnish removers containing a wide variety of toxic and often flammable solvents. “Non-flammable” paint strippers contain methylene chloride. Caustic soda (sodium hydroxide), acids, blowtorches and heat guns are also used to remove old paint. Old stains on wood are often removed with bleaches, which can contain corrosive alkalis and oxalic acid, hydrogen peroxide or hypochlorite. Heat guns and torches can vaporize the paint, possibly causing lead poisoning with lead-based paint, and are a fire hazard.

See the previous section for precautions with solvent-based paint strippers. Gloves and goggles should be worn when handling caustic soda, oxalic acid bleaches or chlorine-type bleaches. An eyewash fountain and emergency shower should be available. Avoid using torches or heat guns to remove lead-containing paint.

JEWELLERY

Tsun-Jen Cheng and Jung-Der Wang

Jewellery manufacturing can include working with a variety of materials, such as precious and semi-precious stones, synthetic stones, shells, coral, pearls, precious metals, metal enamels and newer materials such as epoxy resins and vinyl polymers. These can be used to make rings, earrings, necklaces, pendants and a variety of other personal decorative items. Jewellery manufacturing shops vary in size, and different manufacturing processes may be adopted. Thus, health hazards may vary from one workshop to another.

Processes, Hazards and Precautions

Precious stones and settings

Much jewellery manufacturing involves the setting of precious stones into bases of precious metals or alloys of precious metals. Stones are initially cut into desired sizes, then polished. Base metals are cast, then ground and polished. Traditionally, the metal settings were made using “injection” mouldings. Alloys of low melting point, including alloys of cadmium and mercury, have also been used for metal casting. Recently, “lost wax” methods have been used to achieve a better quality of casting. Stones are held on metal bases using adhesives, soldering or mechanical clamping by parts of the metal frame. Metal bases are usually plated with precious metals.

Health hazards may result from exposure to metal fumes, wax fumes or dust of stones and metals, and visual impairment from poor lighting. Working with fine parts of jewellery items generally requires proper ventilation, adequate illumination and the use of magnifying lenses. In addition, proper ergonomic design in the workplace is recommended.

Stone cutting and polishing

Precious, semi-precious and synthetic stones (including diamond, jade, ruby, garnet, jasper, agate, travertine, opal, turquoise and amethyst) are usually cut to the desired size with small saws before setting. Injury hazards include abrasions and lacerations of the skin or eyes; other health hazards include dust inhalation (e.g., silicosis from quartz stones).

Precautions include proper ventilation, dust collectors, using magnifying lenses, local illumination, eye protection and ergonomic design of tools and working environments.

Lost wax metal casting

Rubber or silicon moulds are made from original moulds that are custom-made or designed by artists. Wax is subsequently injected into these moulds. Moulds (called investments) of plaster of Paris and/or silica are made to enclose these wax moulds. The whole investment is then heated in the kiln or oven to drain the wax out of the block, then filled with molten metal with the aid of centrifugation. The mould is shattered to recover the metal piece. This is polished, and also may be electroplated with a thin layer of precious metal.

Precious metals and their alloys, including gold, silver, platinum and copper as well as zinc and tin, are commonly used in constructing metal pieces. Injury hazards include fire or explosion from flammable gas used for melting metals, and burns from heated plaster casts or blocks, molten metal spillage, oxyacetylene torches or ovens; other health hazards include inhalation of metal fumes or dusts

of silver, gold, zinc, lead, tin and so on.

Precautions include using alternative casting methods to lower the level of exposures and toxicity, proper local exhaust ventilation for metal dust and fumes, dust collectors, personal protective equipment including goggles, insulating gloves and working gowns, and proper storage of flammable gas.

Enamelling

Enamelling involves the fusion of pre-ground, powdered lead or borosilicate glass particles mixed with various coloured oxides onto a base metal to form an enamelled surface. Base metals can include silver, gold or copper. Common colourants include antimony, cadmium, cobalt, chromium, manganese, nickel and uranium.

Cleaning

The metal surface must first be cleaned with a torch or in a kiln to burn off oils and grease; it is then pickled with dilute nitric or sulphuric acid, or the safer sodium bisulphate, to remove firescale. Hazards include thermal and acid burns. Precautions include protective gloves, goggles and apron.

Application

Some enamellists grind and sift their enamels to obtain desired particle sizes. Application techniques include brushing, spraying, stencilling and sifting or wet packing of the enamel onto the metal surface. Inhalation of enamel powder or spray mist is the greatest hazard, particularly with lead-based enamels. Precautions include use of lead-free enamels and respiratory protection. In cloisonné, different enamel colours are separated by metal wires that have been soldered onto the metal. (See the discussion on silver soldering below). In champleve, designs are etched with ferric chloride or nitric acid, and depressed areas filled with enamels. Another technique involves applying enamels mixed with resin in turpentine. Ventilation and precautions to prevent skin contact are required.

Firing

The enamelled metal is then fired in a small kiln. Ventilation is required to remove toxic metal fumes, fluorides and decomposition products (from gums and other organic materials in the enamel). Other hazards include thermal burns and infrared radiation. Infrared goggles and heat-protective gloves are recommended.

The enamel piece can then be finished by such methods as filing the edges and grinding and sanding the enamelled surface. Standard precautions against dust

inhalation and eye contact are needed.

Metal jewellery

Metal jewellery can be made by cutting, bending and otherwise fabricating metals, electroplating, anodizing, soldering, gluing, finishing and so on. Many of these processes are discussed in “Metalworking”. Some specific applications are discussed below.

Electroplating

Gold, silver, copper and strong acid as well as cyanide are used in the electroplating process. Injury hazards include electrical shock and burns from acid or alkali spillage; other health hazards include the inhalation of metal, acid and cyanide mist, organic solvents, as well as hydrogen cyanide gas.

Precautions include substitution of non-cyanide plating solutions, avoidance of mixing cyanide solution with acids, local exhaust ventilation, using a tank cover to reduce mist production, proper storage of chemicals, electrical precautions and adequate personal protective equipment.

Soldering or gluing

Soldering involves metals such as tin, lead, antimony, silver, cadmium, zinc and bismuth. Safety hazards include burns; other health hazards include the inhalation of metal fumes, including lead and cadmium (Baker et al. 1979), and fluoride and acid fluxes.

Using epoxy resin and quick-drying agents with solvents to bind stones and metal pieces is a common practice. Injury hazards from gluing include fire and explosion; other health hazards include the inhalation of solvents and skin contact with epoxy resin, other adhesives and solvents.

Precautions include avoidance of lead and cadmium solders, adequate local exhaust ventilation, proper storage of chemicals, adequate illumination and personal protective equipment.

Metal grinding and polishing

Rotating wheels and linear actuators of varied sizes are used for grinding, polishing and cutting. Injury hazards include skin abrasions; other health hazards include the inhalation of metal dusts, as well as repetitive motion, vibration, awkward position and forces.

Precautions include adequate local exhaust ventilation, dust collectors, goggles for

eye protection and ergonomic designs for workplaces and tools.

Shells

Mother-of-pearl (from oyster shells) and coral, as well as abalone and other shells, can be made into jewellery by cutting, drilling, sawing, shaving, grinding, polishing, finishing and so on. Hazards include hand and eye injuries from flying particles and sharp edges, respiratory irritation and allergic reactions from inhalation of fine shell dust, and, in the case of mother-of-pearl, possible hypersensitivity pneumonia and ossification with inflammation of tissues covering the bones, especially in young people.

Precautions include cleaning shells thoroughly to remove organic matter, wet grinding and polishing techniques, and local exhaust ventilation or respiratory protection. Goggles should be worn to prevent eye injury.

Beads

Beads can be made from a variety of materials, including glass, plastic, seed, bone, shells, pearls, gemstones and so on. A newer material used for beads and other jewellery is heat-cured polyvinyl chloride (polymer clays). Hazards include inhalation of dust from drilling the holes for the string or wire used to hold the beads, and possible eye injuries. Precautions include wet drilling, ventilation or respiratory protection and goggles. The polymer clays can release hydrogen chloride, a respiratory irritant, if heated above recommended temperatures. Using cooking ovens for heat curing is not recommended. There has also been concern about plasticizers such as diethylhexyl phthalate, a possible carcinogen and reproductive toxin, present in these polymer clays.

GRAPHIC ARTS

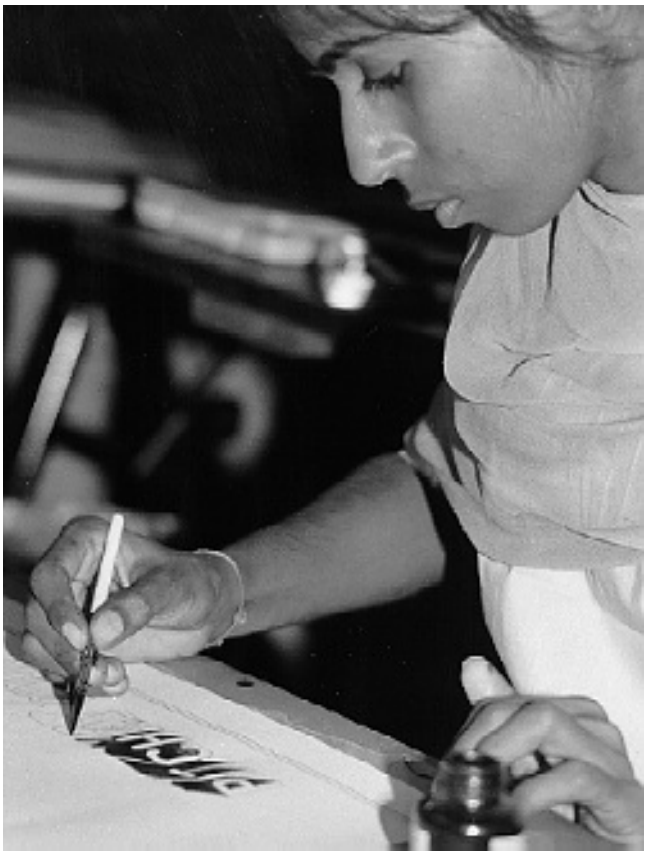
Stephanie Knopp

The term graphic arts (also called graphic design, commercial art, visual design or visual communication) refers to the organization of ideas and concepts in a visual form that conveys a particular message to a target audience. Graphic designers work in a wide array of venues, including magazines, books, posters, packaging, film, video, exhibition design and, most recently, in digital forms such as computer screen design, multimedia presentations and pages on the World Wide Web. There are two types of visual communicators: graphic designers, who work with typography and page layout as well as photography and illustration; and illustrators, who work exclusively with visual images. Frequently the two roles overlap, but most commonly graphic designers hire illustrators to create visualizations of the ideas that will be used within a typographic context.

Graphic Design

The hazards of graphic design were very different in the late 1990s compared to only a few years earlier when some designers were still producing traditional mechanicals for offset printing (figure 96.12). Now, virtually all page layout and graphic design is produced in a digital format before it is printed on paper. Much graphic design is even created exclusively for a final digital form: a floppy disk, CD-ROM or a page on the Internet. Graphic designers use computers to create and store both text and images. These digitally created artworks are stored on floppy disks, removable storage cartridges or CD-ROMs, and then given to the client for the final presentation (package design, magazine, film titles, poster, business stationery or many other applications).

Figure 96.12 Hand lettering for graphic arts



Graphic designers must now be concerned with the potential hazards of prolonged work at a computer. Unfortunately, this technology is too new to know all the associated hazards. At present the hazards identified from working for extended periods at a visual display unit (VDU) (also called a video display terminal, or VDT) include eyestrain, headaches, backaches, stiff necks, sore hands and wrists, dizziness, nausea, irritability and stress. There have also been reports of skin rashes and dermatitis associated with VDU use. While the health effects of VDU use have been studied for a couple of decades, there are no proven links between long-term use of VDUs and long-term health problems. VDUs do emit comparatively low-level radiation, but there are no hard data to support any permanent adverse health effects from VDU use.

Ergonomic computer workstations, elimination of glare and frequent work breaks enable graphic designers to work more safely than most other artistic professions. Generally the digital revolution has greatly reduced the health hazards previously associated with the graphic design profession.

Illustration

Illustrators create images in a wide variety of media and techniques for use in various commercial venues. For example, an illustrator may create work for magazines, book jackets, packaging, movie posters, advertising and many other forms of promotion and publicity. Generally illustrators are freelancers who are hired by art directors for a particular project, though some illustrators work for publishing houses and greeting card companies. Since illustrators generally create their own workspaces, the burden for creating a safe working environment usually falls upon the individual.

The materials used by professional illustrators are as varied as the techniques and styles exhibited in contemporary illustration. Therefore, it is imperative that each individual artist be aware of any hazards associated with his or her particular medium. Among the materials commonly used by illustrators are drawing and painting materials such as markers, water colours, oil paints, coloured inks, coloured pencils, dry pastels, oil pastels, dyes, acrylic paints and gouache.

Many commonly used colours contain hazardous ingredients such as xylene and petroleum distillates; pigments may contain such dangerous ingredients as mercury, cadmium, cobalt and lead. Precautions include working in a well-ventilated studio, wearing gloves and a respirator when using oil-based materials (particularly from aerosols) and substituting safer materials (water- and alcohol-based colours) when possible. Materials such as pastels can be hazardous when they become airborne dust; good ventilation is particularly important when using any material that can be breathed into the lungs. A final general precaution is to avoid eating, drinking or smoking while working with any toxic artists' materials.

The wide assortment of materials used by illustrators requires an individual approach to safe working conditions, since each artist has a personal technique and selection of materials. Manufacturers in some countries are required by law to provide information about product ingredients and hazards. Each individual artist should carefully scrutinize every material used, working in the safest possible manner with the available media.

Adhesives

Adhesives used include rubber cement, spray mount, contact cement, electric waxers, dry-mount tissues, glue sticks, hot-melt glue guns, adhesive transfer materials, double-coated tape and water-soluble glues. Associated hazards include: dangerous chemicals such as n-hexane (a neurotoxin) in some rubber

cements and contact cement; cyanoacrylate instant-action glues; airborne toxic chemicals and fire hazards associated with spray adhesives; and possible burns from hot-melt glue gun use. Many of the commonly used adhesives (rubber cement in particular) can also cause skin irritation.

Proper ventilation and use of gloves can prevent many of the hazards associated with common adhesives. Substitution of non-toxic adhesives whenever possible, such as electric waxers, adhesive transfer materials, dry-mount tissues, double-coated tapes, and water-soluble glues is recommended. Heptane-containing rubber cements and spray adhesives are less toxic than hexane types, although they are still flammable.

Solvents

Solvents include rubber cement thinner, turpentine, acetone, correction fluid and mineral spirits.

Hazards include skin irritation, headaches, damage to respiratory and nervous systems, kidney and liver damage, and flammability. Primary precautions include substituting safer solvents whenever possible (for example, mineral spirits are less toxic than turpentine) or switching to water-based pigments that do not require solvents for cleanup. Excellent ventilation or respiratory protection, careful storage, use of gloves and chemical splash goggles are also important when using any solvents.

Aerosol sprays

Aerosol sprays include fixative spray, spray markers, varnish, texture sprays and airbrush colours.

Hazards include respiratory problems, skin irritation, headaches, dizziness and nausea from toxic chemicals such as toluene and xylene; long-term adverse effects include damage to kidneys, liver and central nervous system. Sprays are also frequently flammable; care must be exercised to use them away from heat or flames. Precautions include using a respirator or adequate studio ventilation (such as a spray booth), and working with non-toxic pigments when using an airbrush.

Cutting tools

The various types of cutting tools can include paper cutters, razor knives and mat cutters. The hazards can range from cuts and, in the case of large paper cutters, the severing of fingers. Precautions include careful use of knives and cutters, keeping hands away from blades, and maintaining blades in sharp condition.

DANCERS

Itzhak Siev-Ner

Dance involves patterned and rhythmic body movements, usually performed to music, that serve as a form of expression or communication. There are many different types of dances, including ceremonial, folk, ballroom, classical ballet, modern dance, jazz, flamenco, tap and so forth. Each of these has its unique movements and physical demands. Audiences associate dance with grace and enjoyment, yet very few people regard dance as one of the most demanding and strenuous athletic activities. Sixty-five to 80% of dance-related injuries are in the lower limbs, out of which about 50% are in the foot and ankle (Arheim 1986). Most of the injuries are due to over-use (about 70%) and the rest are of the acute type (ankle sprain, fractures and so on).

Dance medicine is a multidisciplinary profession because causes of injuries are multifactorial and hence treatment should be comprehensive and take into consideration the specific needs of dancers as artists. The goal of the treatment should be to prevent potentially dangerous specific stresses, allowing the dancer to keep active, acquiring and perfecting physical creativity and psychological well-being.

Training should preferably start at an early age in order to develop strength and flexibility. However, incorrect training results in injury to young dancers. Proper technique is the main concern, as incorrect posture and other bad dancing habits and methods will cause permanent deformities and over-use injuries (Hardaker 1987). One of the most basic movements is the turn-out—opening of the lower limbs outwards. This should take place in the hip joints; if it is forced more than the anatomic external rotation these joints will allow, compensations occur. The most common compensations are rolling-in of the feet, internal flexing of the knees and hyperlordosis of the lower back. These positions contribute to deformities such as hallux valgus (displacement of the great toe towards the other toes). Inflammations of tendons such as the flexor hallucis longus (the tendon for the great toe) and others may also result (Hamilton 1988; Sammarco 1982).

Being cognizant of individual anatomic differences in addition to the unusual biomechanical loads, such as in point position (standing on the tip of the toes), allows one to take actions to prevent some of these undesired outcomes (Teitz, Harrington and Wiley 1985).

The environment of dancers has great influence on their well-being. A proper floor should be resilient and absorb shock to prevent cumulative trauma to the feet, legs and spine (Seals 1987). Temperature and humidity also influence performance. Diet is a major issue as dancers are always under pressure to keep slim and look light and pleasing (Calabrese, Kirkendal and Floyd 1983).

Psychological maladjustment may lead to anorexia or bulimia.

Psychological stress may contribute to some hormonal disturbances, which may present as amenorrhoea. The incidence of stress fractures and osteoporosis may increase in hormonally imbalanced dancers (Warren, Brooks-Gunn and Hamilton 1986). Emotional stress due to competition between peers, and direct pressure from choreographers, teachers and directors may enhance psychological problems (Schnitt and Schnitt 1987).

A good screening method for both students and professional dancers should detect psychological and physical risk factors and avoid problems.

Any change in activity levels (whether return from a holiday, sickness or pregnancy), intensity of work (rehearsals before a premiere tour), choreographer, style or technique, or environment (such as floors, stages or even type of dance shoes) makes the dancer more vulnerable.

HISTORY OF PERFORMING ARTS MEDICINE

While interest in the physiology of music making dates back to antiquity, the first real summary of the occupational diseases of performing artists is Bernardino Ramazzini's 1713 treatise Diseases of Workers. Sporadic interest in arts medicine continued through the eighteenth and nineteenth centuries. In 1932 the English translation of Kurt Singer's Diseases of the Music Profession: A Systematic Presentation of Their Causes, Symptoms and Methods of Treatment appeared. Th was the first textbook to bring together all the current knowledge on performing ar medicine. After World War II, the medical literature began to feature case reports c injured artists. The musical literature also began to carry short items and letters. There was a parallel growth of awareness among dancers.

One of the catalysts for the development of performing arts medicine as a cross-disciplinary field was the Danube Symposium on Neurology, held in Vienna in 197 The conference focused on music and led to the publication of Music and the Bra Studies in the Neurology of Music, by MacDonald Critchley and R.A. Henson. Also 1972 the first Care of the Professional Voice Symposium was organized by the Voic Foundation. This has become an annual conference, with proceedings appearing i the Journal of Voice.

While injured performers and the health professionals serving them began to cooperate more closely, the general public was unaware of these developments. In 1981 a New York Times article described the hand problems suffered by pianists G Graffman and Leon Fleisher, and their treatment at Massachusetts General Hospit These were virtually the first well-known musicians to admit to physical problems the publicity generated by their cases brought forth a large, previously unknown group of injured artists.

Since then, the field of performing arts medicine has advanced rapidly, with conferences, publications, clinics and associations. In 1983 the first Medical Problems of Musicians and Dancers symposium was held, in conjunction with the Aspen Music Festival, in Aspen, Colorado. This has become an annual conference and is perhaps the most important in the field. Meetings such as these usually include lectures by health professionals as well as demonstrations and master class by artists.

In 1986 the journal Medical Problems of Performing Artists was launched. This is t only journal completely dedicated to arts medicine, and it publishes many of the Aspen symposium presentations. Related journals include the Journal of Voice, Kinesiology and Medicine for Dance, and the International Journal of Arts-Medicin In 1991 the Textbook of Performing Arts Medicine, edited by Robert Sataloff, Alice Brandfonbrener and Richard Lederman, became the first modern, comprehensive text on the subject.

As publishing grew and conferences continued, clinics serving the performing arts community were organized. Generally these clinics are in large cities that support orchestra or dance company, such as New York, San Francisco and Chicago. There are now more than twenty such centres in the United States and several in various other countries.

Those active in the field of performing arts medicine have also founded associatio to further research and education. The Performing Arts Medicine Association, set in 1989, now co-sponsors the Aspen symposiums. Other organizations include the International Association for Dance Medicine and Science, the International Arts-Medicine Association and the Association of Medical Advisors to British Orchestra

Research in performing arts medicine has grown from case reports and prevalence studies to sophisticated projects using advanced technology. New treatments, mo responsive to the artists' specific needs, are being developed and the emphasis is beginning to shift to prevention and education.

Susan Harman

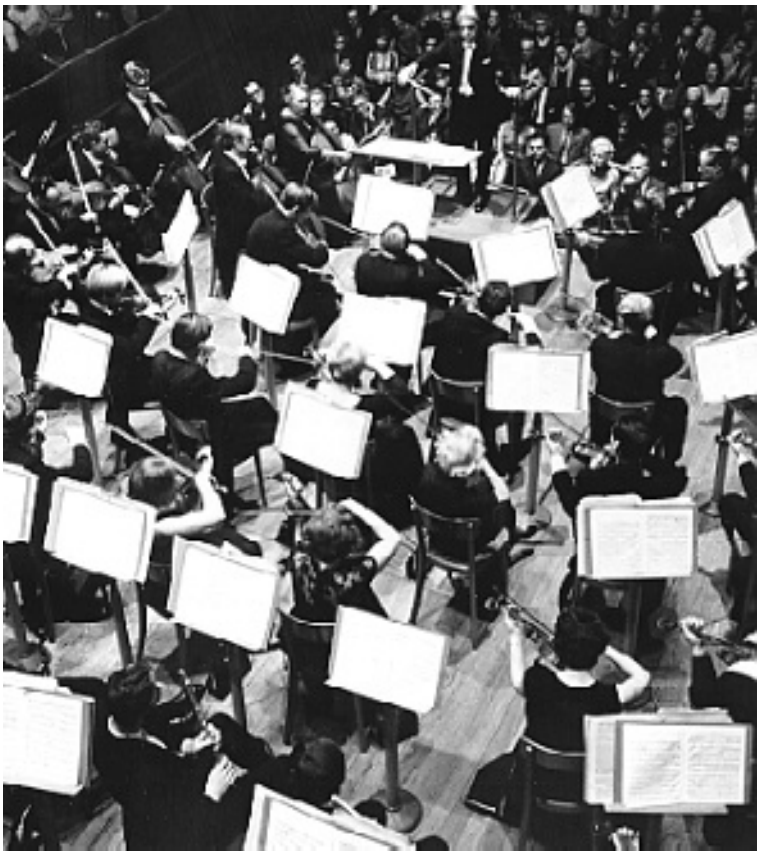
MUSICIANS

John P. Chong

The musician relies on the skilled use of the muscles, nerves and bones (neuromusculoskeletal system). Playing an instrument requires finely controlled repetitive motions and often entails working in unnatural postures for extended periods of practice and performance (figure 96.13). These demands on the body can result in specific types of health problems. In addition, adverse working conditions, such as excessive sound exposure levels, prolonged periods of

performance without rest, and inadequate preparation for new and difficult repertoire or instruments may affect the health of musicians in all age groups and at all levels of performing ability. Recognition of these hazards, accurate diagnosis and early treatment will prevent occupational disabilities that may interfere with, interrupt or end careers.

Figure 96.13 Orchestra



Neuromusculoskeletal Problems

Studies from the United States, Australia and Canada suggest that around 60% of musicians will face career-threatening injuries during their working lifetime. Clinical cross-sectional studies have examined the prevalence of muscle-tendon disorders, of peripheral nerve entrapment syndromes and motor control problems. These studies have revealed several common diagnoses, which include various overuse syndromes, including strain of the muscles and connective tissue which control the bending and extending motions in the wrist and fingers. These syndromes result from the repetitive forceful movement of the muscle-tendon units. Other common diagnoses relate to pain in body parts which are involved in prolonged strain from awkward and imbalanced postures while playing musical instruments. Playing the instruments in the groups described below involves putting pressure on the branches of the nerves in the wrist and forearm, the shoulders, arm and neck. Occupational cramp or muscle spasms (focal dystonia) are also common problems which often can affect performers at the pinnacle of their careers.

String instruments: Violin, viola, cello, bass, harp, classical guitar and electric

guitar

Health problems in musicians who play string instruments often are caused by the manner in which the musician supports the instrument and the posture assumed while sitting or standing and playing. For example, most violinists and violists support their instruments between the left shoulder and chin. Often the musician's left shoulder will be elevated and the left chin and jaw will bear down in order to allow the left hand to move over the fingerboard. Elevating a joint and bearing down at the same time leads to a state of static contraction which promotes neck and shoulder pain, temporomandibular joint disorders involving the nerves and muscles of the jaw, and thoracic outlet syndrome, which can include pain or numbness in the neck, shoulder and upper chest area. Prolonged static sitting postures, particularly while assuming a bent posture, promote pain in the large muscle groups which support posture. Static twisting rotation of the spine is often required to play the string bass, harp and classical guitar. Heavy electric guitars are usually supported by a strap over the left neck and shoulder, contributing to pressure on the nerves of the shoulder and upper arm (the brachial plexus) and thus to pain. These problems of posture and support contribute to the development of strain and pressure of the nerves and muscles of the wrist and fingers by promoting their faulty alignment. For example, the left wrist may be used for excessive repetitive bending motions which result in strain of the extensor muscles of the wrist and fingers and the development of carpal tunnel syndrome. Pressure on the nerves of the shoulder and arm (lower trunks of the brachial plexus) may contribute to problems with the elbow, such as a double crush syndrome and ulnar neuropathy.

Keyboard instruments: Piano, harpsichord, organ, synthesizers and electronic keyboards

Playing a keyboard instrument requires assuming a similar posture to that of typing. Often the forward and downward orientation of the head to look at the keys and hands and repetitive upward movement to look at the music causes pain in the nerves and muscles of the neck and back. The shoulders will often be rounded, combined with a forward head poking posture and a shallow breathing pattern. A condition known as thoracic outlet syndrome can develop from chronic compression of the nerves and blood vessels that pass between the muscles in the neck, shoulder and rib cage. In addition, a musician's tendency to bend the wrists and curl the fingers while keeping the hand/finger joints flat places excessive strain on the wrist and finger muscles in the forearm. Additionally, the repeated use of the thumb kept in a position under the hand strains the thumb muscles which extend and binds the finger extensor muscles across the back of the hand. The high repetitive force needed to play large chords or octaves may strain the capsule of the wrist joint and result in ganglion formation. Prolonged co-contraction of the muscles that turn and move the arms up and down can lead to nerve entrapment syndromes. Muscle spasms and

cramps (focal dystonia) are common among this group of instrumentalists, sometimes requiring long periods of neuromuscular retraining to correct movement patterns which can lead to these difficulties.

Wind and brass instruments: Flute, clarinet, oboe, saxophone, bassoon, trumpet, french horn, trombone, tuba and bagpipes

A musician who plays one of these instruments will vary his or her posture according to the need to control airflow since posture will control the area from which diaphragmatic and intercostal breath is drawn. Playing these instruments depends on the way the mouthpiece is held (the embouchure) which is controlled by the facial and pharyngeal muscles. The embouchure controls sound production of vibrating reeds or the mouthpiece. Posture also affects how the musician supports the instrument while sitting or standing and in operating the keys or valves of the instrument that govern the pitch of the note played by the fingers. For example, the traditional French open-holed flute requires sustained adduction and flexion (bending forward) of the left shoulder, sustained abduction (drawing away) of the right shoulder and rotation of the head and neck to the left in slight movement. The left wrist is often held in an extremely bent position while the hand is also extended in order to support the instrument by the curled left index finger and both thumbs, counter balanced by the right little finger. This promotes strain of the forearm muscles and the muscles which permit extension of the fingers and thumbs. The tendency to project the head and neck forward and use shallow breathing increases the chances of developing thoracic outlet syndrome.

Percussion instruments: Drums, timpani, cymbals, xylophone, marimba, tabla and taiko

The use of sticks, mallets and bare hands to strike various percussion instruments results in rapid pulling back of the wrists and fingers at impact. The impulse vibration caused by striking the instrument is transmitted up the hand and arm and contributes to repetitive strain injuries of the muscle-tendon units and the peripheral nerves. Biomechanical factors, such as the amount of force used, the repetitive nature of the playing and static load placed on the muscles can add to the injuries. Carpal tunnel syndrome and nodule formation in tendon sheaths are common in this group of musicians.

Hearing Loss

The risk of hearing loss from music exposure depends on the intensity and duration of exposure. It is not uncommon to have exposure levels of 100 dB during a quiet passage of orchestral music, with peak values of 126 dB measured at the shoulder of an instrumentalist in the middle of the orchestra. At the position of the conductor or teacher, levels of 110 dB in an orchestra or band are

common. Exposure levels for pop/rock and jazz musicians may be significantly higher, depending on the physical acoustics of the stage or pit, amplification system and placement of speakers or other instruments. The average duration of exposure may be approximately 40 hours per week, but many professional musicians will perform 60 to 80 hours per week on occasion. Hearing loss among musicians is far more common than expected, with approximately 89% of professional musicians who were found to have suffered musculoskeletal injuries also showing an abnormal hearing test result, with a hearing loss in the 3 to 6 KHz region.

Personal ear protection can be used but it must be adapted for each instrument type (Chasin and Chong 1992). By inserting an acoustic attenuator or filter into custom-moulded earplugs, the intensity of higher frequency sounds transmitted by ordinary earplugs is reduced to a flat attenuation as measured at the eardrum, which should be less damaging to the ear. The use of a tuned or adjustable vent in a custom earplug will allow the lower frequencies and some harmonic energy to pass through the earplug unattenuated. Earplugs can be designed to provide a slight amplification to alter perception of the singer's voice, thus allowing the artist to reduce the risk of vocal strain. Depending on the psycho-acoustical nature of the instrument and surrounding music exposures, substantial reduction in risk for the development of hearing loss can be obtained. Improvement in the perception of the relative intensity of the musician's own performance may reduce the risk of repetitive strain injuries by a relative reduction of the force of repetitive movements.

There are practical strategies for reducing the exposure of musicians that do not interfere with music production (Chasin and Chong 1995). Loudspeaker enclosures can be elevated above floor level, which results in minimal loss of low-frequency sound energy, while preserving sufficient loudness for the musician to perform at a lower intensity level. Musicians who play high-intensity, highly directional instruments such as trumpets and trombones should be on risers so that the sound passes above the other musicians, thereby lowering its impact. There should be 2 m of unobstructed floor space in front of the orchestra. Small stringed instruments should always have at least 2 m of unobstructed space above them.

SINGERS

Anat Keidar

The term singer applies to any person whose career, avocation or livelihood relies heavily on the use of his or her voice in a musical context rather than ordinary speech. Unlike percussionists, pianists or violinists, the singer is the instrument. Hence, the well-being of a singer depends not only on the health of his or her larynx (where the sound originates) or vocal tract (where the sound is modified),

but also on proper functioning and maximal coordination of most mind and body systems.

Of the many styles of singing documented throughout the world, some reflect a unique liturgical, cultural, linguistic, ethnic or geo-political heritage, while others are more universal in nature. Among the common styles of singing in the United States and Western world are: traditional classical (including oratorio, opera, art songs and so on), barbershop, jazz, musical theatre (Broadway), choral, gospel, folk, country (and western), popular, rhythm and blues, rock 'n' roll (including heavy metal, alternative rock and so on) and others. Each style of delivery has its typical settings, patterns, habits and associated risk factors.

Vocal Problems

Unlike non-singers, who may not be significantly hindered by vocal problems, for the classical singer, the effect of subtle vocal impairment can be devastating. Even within that category of trained singers, vocal impairment is much more debilitating for the higher voice classifications (sopranos and tenors) than for lower classifications (mezzo sopranos, altos, baritones and basses). On the other hand, some vocal performers (pop, gospel or rock, for example) go to great lengths to achieve a unique trademark and enhance their marketability by inducing vocal pathologies which often yield a breathy, husky, muffled diplophonic (simultaneous multiple pitches) quality. Owing, in part, to their impairment, they tend to sing with great effort, struggling particularly to produce the high notes. To many listeners, this struggle adds a dramatic effect, as if the singer is sacrificing his or her self while engaging in the artistic process.

The prevalence of occupation-related injuries in general, and voice disorders in particular, among singers is not well documented in the literature. This author estimates that on the average, between 10 and 20% of singers in the United States sustain some form of chronic voice disorder. However, the incidence of vocal injury varies significantly with many factors. Because many singers must adhere to specific artistic/aesthetic criteria, performance practices, popular (consumer) demands, financial constraints and social pressures, they often stretch their vocal capabilities and endurance to the limits. Furthermore, singers generally tend to deny, trivialize or ignore warning signs and even diagnoses of vocal injury (Bastian, Keidar and Verdolini-Marston 1990).

The most common problems among singers are benign mucosal disorders. The mucosa is the outer layer, or cover, of the vocal folds (commonly called vocal cords) (Zeitels 1995). Acute problems can include laryngitis and transient vocal fold swelling (oedema). Chronic mucosal lesions include vocal fold swellings, nodules ("calluses"), polyps, cysts, sub-mucosal haemorrhage (bleeding), capillary ectasia (widening), chronic laryngitis, leukoplakia (white spots or patches), mucosal tears and glottic sulci (deep furrows in the tissue). Although these disorders can be exacerbated by smoking and excessive alcohol consumption, it is

important to note that these benign mucosal lesions are typically related to the amount and manner of voice use, and are the product of vibratory trauma (Bastian 1993).

Causes of Vocal Problems

In looking at the causes of vocal problems in singers, one should distinguish between intrinsic and extrinsic factors. Intrinsic factors are those related to personality, vocal behaviour (including speaking) on and off stage, vocal technique, and intake habits (primarily if substance abuse, improper medication, malnutrition and/or dehydration is involved). Extrinsic factors are related to environmental pollutants, allergies and so on. Based on clinical experience, intrinsic factors tend to be most important.

Vocal injury is usually a cumulative process of misuse and/or overuse during the singer's productive (performance-related) and/or non-productive (domestic, social) activities. It is difficult to ascertain how much of the damage is attributable directly to the former versus the latter. Performance risk factors can include unreasonably long dress rehearsals requiring full-voice singing, performing with an upper-respiratory infection in the absence of a replacement and excessive singing. Most vocalists are advised not to sing for more than about 1.5 hours (net) per day. Unfortunately, many singers do not respect the limitations of their apparatus. Some tend to get caught up in the exploratory excitement of new technical skills, new means of artistic expression, new repertoire and so on, and practice 4, 5 or 6 hours daily. Even worse is the beating of the voice into shape when distress signals of injury (such as loss of high notes, inability to sing softly, breathy delay in sound initiation, unstable vibrato and increased phonatory effort) are manifested. The culpability of vocal overtaxing is shared with other taskmasters such as the booking agent who squeezes multiple performances into an impossible time frame, and the recording agent who leases the studio for 12 consecutive hours during which the singer is expected to record a complete CD sound track from start to finish.

Although every singer may encounter acute episodes of voice problems at some point in his or her career, it is generally believed that those singers who are musically literate and can adjust the musical score to their voice limitations, and those who have had proper voice training, are less likely to encounter severe problems of a chronic nature than their untrained peers, who often learn their repertoire by rote, repeatedly imitating or singing along with demo tapes or recordings of other performers. In doing so, they frequently sing in a key, range or style unsuitable for their voices. Singers who lend themselves to periodic tutelage and maintenance by proficient voice experts are less likely to resort to faulty compensatory vocal manoeuvres if confronted by physical impairment, and are more inclined to establish a reasonable balance between artistic demands and vocal longevity. A good teacher is aware of the normal (expected) capabilities of each instrument, can usually distinguish between technical and physical

limitations, and often is the first to detect warning signs of vocal impairment.

Sound amplification can also create problems for singers. Many rock groups, for example, amplify not only the singer, but the entire band. When the noise level interferes with auditory feedback, the singer is often unaware that he or she is singing too loudly and using faulty technique. This may contribute significantly to the development and exacerbation of vocal pathology.

Non-performance factors can also be important. Singers must realize that they do not have separate laryngeal mechanisms for singing and speaking. Although most professional singers spend much more time talking than singing, speaking technique is commonly discarded or rejected, which can adversely affect their singing.

Many of today's singers must travel regularly from one performance venue to another, on trains, tour buses or airplanes. Ongoing touring requires not only psychological adaptation, but also physical adjustments on many levels. In order for singers to function optimally, they must receive adequate quality and quantity of sleep. Radical rapid changes in time zones causes jet lag, which forces singers to remain awake and alert when their internal clock is cueing various body systems to shut down for sleep, and conversely, to sleep when their brain systems are aroused to plan and execute normal daytime activities. Such interruption may result in a host of debilitating symptoms, including chronic insomnia, headaches, sluggishness, dizziness, irritability and forgetfulness (Monk 1994). Aberrant sleep patterns are also a common problem among those singers who perform late at night. These abnormal sleep patterns are all too often mismanaged with alcohol or recreational, prescription or over-the-counter (OTC) drugs (most of which adversely affect the voice). Frequent and/or prolonged confinement to a closed cabin of a motor vehicle, train or aircraft may create additional problems. Inhalation of poorly filtered (often recycled), contaminated, dehumidified (dry) air (Feder 1984), according to many singers, can cause respiratory discomfort, tracheitis, bronchitis or laryngitis that may linger on for hours or even days following a trip.

Owing to environmental instability and hectic scheduling, many singers develop erratic, unhealthful eating habits. In addition to reliance on restaurant food and unpredictable changes in meal times, many singers eat the main meal of the day after their performance, usually late at night. Particularly for the overweight singer, and especially if spicy, greasy or acidic foods, alcohol or coffee were consumed, lying down soon after having filled the stomach is likely to result in gastroesophageal reflux. Reflux is the retrograde flow of acids from the stomach up the oesophagus and into the throat and larynx. The resulting symptoms can be devastating to the singer. Eating disorders are quite common among singers. In the operatic and classical realm, overeating and obesity are quite common. In the musical theatre and pop domain, particularly among young females, reportedly one-fifth of all singers have encountered some form of eating disorder, such as

anorexia or bulimia. The latter involves various purging methods, of which vomiting is thought to be particularly hazardous to the voice.

A detrimental factor to voice production is exposure to pollutants, such as formaldehyde, solvents, paints and dusts, and allergens, such as tree, grass or weed pollens, dust, mould spores, animal danders and perfumes (Sataloff 1996). Such exposure may occur on and off stage. In their work milieu, singers can be exposed to these and other pollutants associated with vocal symptoms, including cigarette smoke and theatrical smoke and fog effects. Singers use a greater percentage of their vital capacity than ordinary speakers. Furthermore, during intense aerobic activity (such as dancing), the number of breathing cycles per minute increases, and mouth breathing prevails. This results in the inhalation of larger amounts of cigarette smoke and fogs during performances.

Treatment of Vocal Problems

Two major issues in the treatment of vocal problems of singers are self-medication and improper treatment by physicians who are not knowledgeable about the voice and its problems. Sataloff (1991, 1995) surveyed the potential side effects associated with medications commonly used by singers. Whether recreational, prescription, over the counter or food supplements, most drugs are likely to have some effect on phonatory function. In an attempt to control “allergies”, “phlegm” or “sinus congestion”, the self-medicating singer will ultimately ingest something that will damage the vocal system. Likewise, the physician who keeps prescribing steroids to reduce chronic inflammation caused by abusive vocal habits and ignores the underlying causes will eventually hurt the singer. Vocal dysfunction resulting from poorly indicated or ill-performed phonosurgery has been documented (Bastian 1996). To avoid injuries secondary to treatment, singers are advised to know their instruments, and consult only with health care professionals who understand and have experience and expertise managing the vocal problems of singers, and who possess the patience to educate and empower singers.

PERFORMANCE ANXIETY

Performance anxiety is, like fear, joy or grief, an emotion which includes physical a psychological components. Motor responses, autonomic reactions, memories, ide and thoughts continuously interact. Performance anxiety is no longer thought of a an isolated symptom but rather as a syndrome comprising attitudes, traits and unconscious conflicts that become activated in particular circumstances.

Nearly every person must deal with performance anxiety in one form or another at one time or another. By the nature of their profession, however, performing artists or those for whom public performance is an important part of their profession, ha to deal with performance anxiety more frequently and often more intensely than d

others. Even those with years of experience may still have a performance anxiety problem.

Performance anxiety is mainly characterized by an irrational situational anxiety accompanied by unwanted physical symptoms which can lead to dysfunction and/or uncontrolled behaviour. It occurs especially in those situations in which a task has to be done that could subject the performer to possible criticism from others. Examples of such situations include public speaking, giving a concert, writing exams, sexual performance, etc. Performance anxiety can cause a broad ra of possible physical symptoms of distress, such as trembling hands, trembling lips diarrhoea, sweating hands and palpitations of the heart. These symptoms can not only affect the quality of a performance but may also negatively influence the sufferer's future and career.

Some experts believe that the causes of performance anxiety include improper practice and preparation habits, insufficient performance experience, having an inappropriate repertoire and so on. Other theories view performance anxiety as mainly caused by negative thoughts and poor self-esteem. Still others are of the opinion that the stress and fear of performance anxiety is closely related to so-calle career stress, which includes feelings of inadequacy, anticipation of punishment o criticism and loss of status. Although there is no agreement as to the cause of performance anxiety, and the explanation cannot be simple, it is clear that the problem is widespread and that even world-famous artists such as Yehudi Menuh or Pablo Casals are known to have suffered from performance anxiety and fear all their lives.

Personal traits are undoubtedly related to performance anxiety. A challenge for on person can be a catastrophe for another. The experience of performance anxiety depends to a great extent on the personal perception of a fearful situation. Some introverted individuals may, for example, be more prone to stressful events and th more likely to suffer performance anxiety than others. For some people, success ca also cause fear and performance anxiety. This in turn reduces and undermines the communicative and creative aspects of the performer.

To achieve an optimum performance a bit of fear and stress and a certain amount nervousness may be unavoidable. The margin between the degree of (still) acceptable performance anxiety and the necessity of therapeutic intervention, however, can be set only by the performer.

Performance anxiety is a complex phenomenon; its various components lead to variable and changing reactions depending on the situation. Individual aspects, work situations, social factors, personal development and so on play a considerabl role, making it difficult to give general rules.

Methods for diminishing performance anxiety include developing personal copin strategies or learning relaxation techniques such as biofeedback. Such approaches

are directed towards transforming task-irrelevant negative thoughts and worrisom anticipations into task-relevant demands and the positive task-orientated self. Medical interventions, such as beta-blockers and tranquillizers are also commonly used (Nubé 1995). The taking of drugs however, remains controversial and should done only under medical supervision due to possible side effects and contra-indications.

Jacqueline Nubé

ACTORS

Sandra Karen Richman

Acting involves placing your mind in the world of fantasy and bringing forth a character for a performance. Actors are involved in many arts and entertainment areas, including theatre, film, television, amusement and theme parks and so on. Hazards faced by actors include stress, physical hazards and chemical hazards. Stage fright (performance anxiety) is considered in a separate article.

Stress

Causes of stress include the fierce competition for scarce jobs, the pressure of performing shows daily or even more frequently (e.g., theme parks and matinee days), working at night, touring shows, filming deadlines, frequent retakes (especially while filming television commercials) and so on. There are also psychological pressures involved in adopting and maintaining a character role, including the pressure to express certain emotions upon demand, and the tactics often used by directors to obtain a given reaction from an actor. As a result, actors have higher rates of alcoholism and suicide. The solution to many of these causes of stress involves improved working and living conditions, especially when touring and on location. In addition, personal measures such as therapy and relaxation techniques can also help.

Costumes

Many costumes are a fire hazard near open flames or other ignition sources. Special effects costumes and masks can create problems of heat stress and excess weight.

The costumes of all actors working near open flames must be treated with an approved fire retardant. Actors wearing heavy costumes or costumes not suitable to the climate should be given adequate work breaks. With heavy metal or wood framework costumes, supplying cool air inside the costume might be necessary. Provision should also be made for easy escape from such costumes in case of

emergency.

Theatrical Makeup

Theatrical makeup can cause allergic skin and eye reactions and irritation in some people. The widespread practice of sharing makeup or applying it to many people from the same container can create risks of transmitting bacterial infections. According to medical experts, transmission of the HIV and other viruses is not likely through shared makeup. The use of hair sprays and other spray products in unventilated dressing rooms is also a problem. Special effects makeup can involve the use of more hazardous materials such as polyurethane and silicone rubber resins and a variety of solvents.

Basic precautions when applying makeup include washing hands before and after; not using old makeup; no smoking, eating or drinking during application; using potable water and not saliva for moistening brushes; avoiding creation of airborne dust; and using pump sprays instead of aerosol sprays. Each performer should have his or her own makeup kit when practical. When applying makeup to several individuals, disposable sponges, brushes and individual applicators, individual lipsticks (or sliced and labelled lipsticks) and so on should be used. The least toxic materials possible should be used for special effects makeup. The dressing room should have a mirror, good lighting and comfortable chairs.

Stunts

A stunt can be defined as any action sequence that involves a greater than normal risk of injury to performers or others on the set. In many such situations, actors are doubled by stunt performers who have extensive experience and training in carrying out such action sequences. Examples of potentially hazardous stunts include falls, fights, helicopter scenes, car chases, fires and explosions. Careful preplanning and written safety procedures are necessary. See the article “Motion picture and television production” for detailed information on stunts.

Other Hazards

Other hazards to actors, especially on location, include environmental conditions (heat, cold, polluted water, etc.), water scenes with possible risk of hypothermia and special effects (fogs and smoke, pyrotechnics, etc.). Special consideration must be given to these factors before filming starts. In theatres, scenes with dirt, gravel, artificial snow and so on can create eye and respiratory irritation problems when hazardous materials are used, or when materials are swept up and reused, resulting in possible biological contamination. An additional hazard is the growing phenomenon of stalking of well-known actors, actresses and other celebrities, with resultant threats or actuality of violence.

Child Actors

The use of children in theatre and motion picture production can lead to exploitation unless careful procedures are enforced to ensure that children do not work long hours, are not placed in hazardous situations and receive adequate education. Concern has also been expressed about the psychological effects on children participating in theatre or motion picture scenes involving simulated violence. Child labour laws in many countries do not adequately protect child actors.

THEATRE AND OPERA

Claes W Englund

Occupational safety and health in the theatre and opera comprises diverse aspects, including all the problems of industry in general plus specific artistic and cultural aspects. More than 125 different professions are involved in the process of making theatre or opera performances; these performances can take place in classrooms and small theatres, as well as large opera houses or convention halls. Very often theatre and opera companies tour around the country and abroad, performing in diverse buildings.

There are the artistic professions—artists, actors, singers (soloists and choirs), musicians, dancers, coaches, choreographers, conductors and directors; the technical and production professions—technical directors and managers, lighting manager, chief electrician, sound engineer, chief machinist, armourer, wigmaster, dyeing and wardrobe director, property maker, costume maker and others; and the administrative professions—chief accountant, personnel managers, house managers, catering managers, contracts managers, marketing personnel, box office personnel, advertising managers and so on.

The theatre and opera involve general industrial safety hazards such as lifting of heavy objects and accident risks as a result of irregular working hours, combined with factors specific to the theatre, such as the layout of the premises, complex technical arrangements, bad lighting, extreme temperatures and the need to work to tight schedules and meet deadlines. These risks are the same for artists and technical personnel.

A serious attitude towards occupational safety and health demands taking care of the hand of a violinist or the wrist of a ballet dancer, as well as a broader view of the situation of theatre employees as a whole, including both physical and psychological risks. Theatre buildings are also open to the public, and this aspect of safety and health must be taken care of.

Fire Safety

There are many types of potential fire hazards in theatres and opera houses. These include: general hazards such as blocked or locked exits, inadequate number and size of exits, lack of training in procedures in the event of fire; backstage hazards such as improper storage of paints and solvents, unsafe storage of scenery and other combustibles, welding in close proximity to combustible materials and lack of proper exits for dressing rooms; on-stage hazards such as pyrotechnics and open flames, lack of fireproofing of drapes, decorations, props and scenery, and lack of stage exits and sprinkler systems; and audience hazards such as permitting smoking, blocked aisles and exceeding the legal number of occupants. In case of a fire in the theatre building all aisles, passages and staircases must be kept entirely free from chairs or any other obstructions, to help evacuation. Fire escapes and emergency exits must be marked. The alarm bells, fire alarms, fire extinguishers, sprinkler systems, heat and smoke detectors and emergency lights must function. The fire curtain must be lowered and raised in the presence of each audience, unless a deluge sprinkler system is installed. When the audience must leave, whether in an emergency or at the end of a performance, all exit doors must be open.

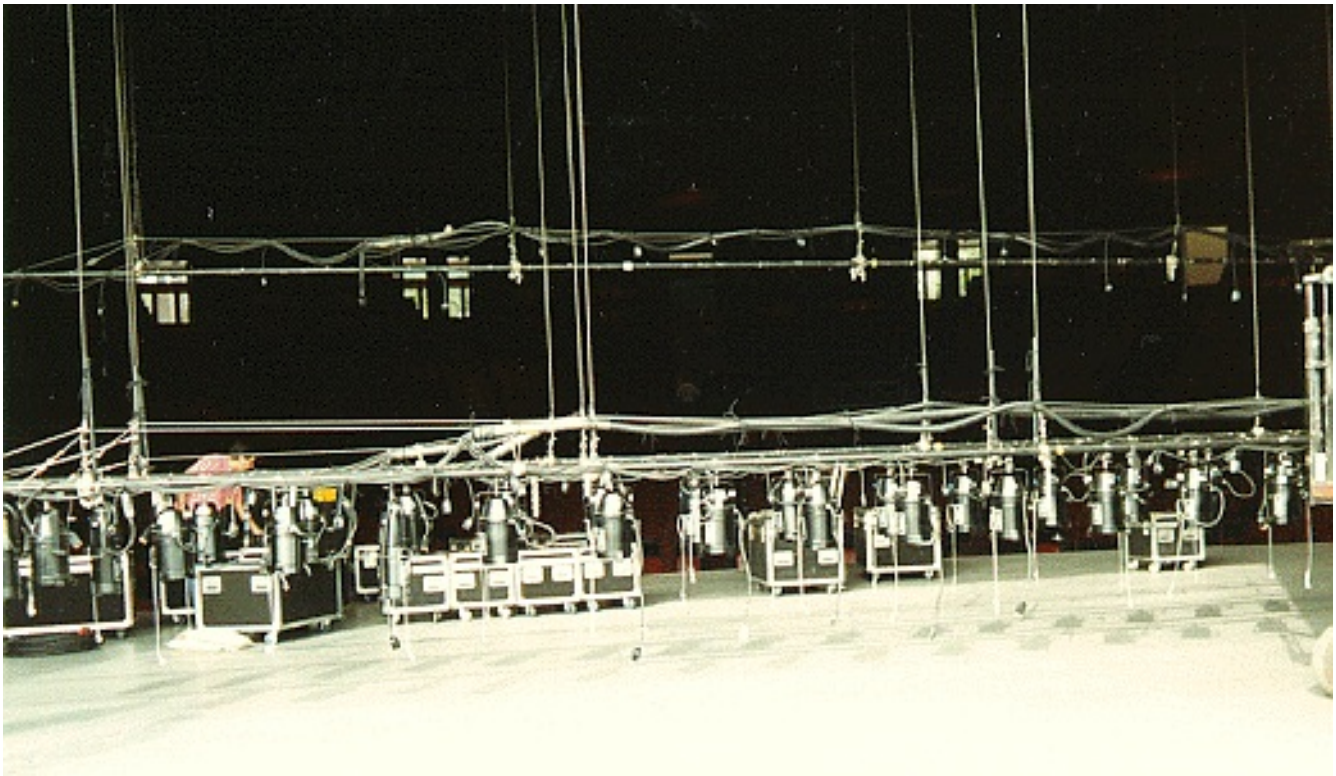
Fire safety procedures must be established and fire drills held. One or more trained fire guards must be present at all performances unless the fire department assigns firefighters. All scenery, props, drapes and other combustible materials present on the stage must be fireproofed. If pyrotechnics or open flames are present, fire permits must be obtained when required and safe procedures established for their use. Stage and backstage lighting equipment and electrical systems must meet standards and be properly maintained. Combustible materials and other fire hazards should be removed. Smoking should not be allowed in any theatre except in properly designated areas.

Grids and Rigging

Theatre and opera stages have overhead grids from which lights are hung, and rigging systems to fly (raise and lower) scenery and sometimes performers. There are ladders and overhead catwalks for lighting technicians and others to work overhead. On the stage, discipline is required from both the artists and the technical staff because of all the hanging equipment above. Theatre scenery can be moved vertically and horizontally. Horizontal movement of scenery at the side of the stage can be done manually or mechanically through the ropes from the grids in the rope house. Safety routines are very important in rope and counterweight flying. There are different kinds of rigging systems, using hydraulic and electric power. Rigging should be done by trained and qualified personnel. Safety procedures for rigging include: inspection of all rigging equipment before use and after alterations; ensuring load capacities are not exceeded; following safe procedures when loading, unloading or operating rigging systems; maintaining visual contact with a moving piece at all times; warning everyone before moving any rigged object; and ensuring no one is underneath when moving scenery. The

lighting crew must take appropriate safety measures while mounting, connecting and directing spotlights (figure 96.14). Lights should be fastened to the grid with safety chains. Safety shoes and helmets should be worn by personnel working on stage when any work is proceeding overhead.

Figure 96.14 Arranging lights in a lowered lighting grid



William Avery

Costumes and Makeup

Costumes

Costumes can be made in the theatres' own ateliers by the wardrobe attendants. It is a heavy job, especially the handling and transportation of old classical costumes. Body aches, headaches, musculoskeletal strains and sprains and other injuries can result from operating sewing machines, dryers, irons, ironing boards and electrical equipment; dust from textiles is a health hazard. Cleaning and dying of costumes, wigs and shoes can use a variety of hazardous liquid solvents and aerosol sprays.

Wearing heavy costumes can be hot under stage lights. Frequent costume changes between scenes can be a source of stress. If flames are present, fireproofing of costumes is essential.

Precautions for wardrobe attendants include proper electrical safety; adequate lighting and ventilation for solvents and spraying; adequate adjustable chairs, work tables and ironing boards; and knowledge of textiles health hazards.

Makeup

Performers usually have to wear heavy layers of makeup for several hours for every performance. Application of makeup and hair styling is usually done by makeup and hair artists in commercial theatre and opera. Often the makeup artist has to work on several performers in a short period of time. Makeup can contain a wide variety of solvents, dyes and pigments, oils, waxes and other ingredients, many of which can cause skin or eye irritation or allergies. Special effects makeup can involve the use of hazardous adhesives and solvents. Eye injuries can result from abrasions during application of eye makeup. Shared makeup is a concern for transmission of bacterial contamination (but not hepatitis or HIV). The use of aerosol hair sprays in enclosed dressing rooms is an inhalation hazard. For makeup removal, large quantities of cold creams are used; solvents are also used for removing special effects makeup.

Precautions include washing off the makeup with soap after every performance, cleaning of brushes and sponges or using disposable ones, using individual applicators for makeup and keeping all makeup cold. The makeup room must have mirrors, flexible lighting and adequate chairs.

Setting Up and Striking Sets

Scenery at a theatre may require one standing set, which can be constructed of heavy materials; more frequently there can be several changes of scenery during a performance, requiring movability. Similarly, for a repertory theatre, changeable scenery can be constructed which is easily transportable. Scenery can be built on wheels, for mobility.

Stage crews risk injury when building, disassembling and moving scenery, and when moving counterbalances. Hazards include back, leg and arm injuries. Accidents often occur when breaking down (striking) the set when a show's run is over, due to fatigue. Precautions include wearing hard hats and safety shoes, safe lifting procedures and equipment, banning of unnecessary personnel and not working when fatigued.

For scene decorators or painters painting, nailing and laying out backdrops, paint and other chemicals are also health hazards. For carpenters, unsafe worksites, noise and vibration as well as air contamination are all problems. Wig and mask makers generally have problems with working postures as well as health risks associated with the use of resins—for example, when working on bald heads and false noses. Health risks include toxic chemicals and possible allergies, skin irritation and asthmatic complaints.

Regulations

There are often national laws, for example, building codes, and local regulations

for fire safety. For grids and rigging, directives from the European Economic Commission—for instance, on machinery (89/392 EEC) and on lifting appliances for persons—may influence national legislation. Other countries also have safety and health legislation that can affect theatres and opera houses.

SCENERY SHOPS

Theatres, motion pictures, television, theme and amusement parks and similar entertainment enterprises all build and paint scenery and make props for their presentations. In many cases, these are made in-house. There are also commercial scenic shops that specialize in making large scenery which is then transported to t site. The major difference between making scenery backstage in a small theatre an building huge sets or even houses for a motion picture, for example, is the scale of the work and who does the work. In small theatres, there is little division of tasks, whereas in larger facilities, there would be a division of labour among carpenters, scenic painters, welders, prop makers and so on.

The scenery for a theatre play, motion picture set or television studio might look realistic, but is often an illusion. The walls of a room are usually not solid but are composed of lightweight flats (panels of painted canvas stretched on wooden frames). Background scenery often consists of backdrops (huge curtains painted t represent the background) which can be lowered and raised for different scenes. Other solid-looking props, such as trees, rocks, vases, mouldings, sculptures and s forth, might be made out of papier mâché, plaster, polyurethane foam or other materials. Today, a wide variety of materials are used to make scenery, including wood, metal, plastics, synthetic fabrics, paper and other modern industrial produ For scenery which performers will walk or climb on, the structures must be solid a meet proper safety standards.

The basic processes and chemicals used for making sets and props tend to be sim for the various types of entertainment facilities. Outdoor sets, however, can often u heavy construction materials such as cement on a large scale, which would be impractical inside due to smaller load-bearing capacities. The degree of hazard depends on the types and amounts of chemicals used, and the precautions taken. theatre might use quarts of polyurethane foam resin for making small props, while the inside of a tunnel in a theme park set might use hundreds of gallons of the resi Small in-house shops tend to have less awareness of the hazards, and overcrowdin often creates additional hazards due to the proximity of incompatible processes such as welding and use of flammable solvents.

Woodworking

Wood, plywood, particle board and Plexiglas are commonly used in constructing sets. Hazards include: accidents with woodworking machinery, power tools and hand tools; electrical shock; fire from combustible wood dust; and toxic effects fro

inhalation of wood dust, formaldehyde and methyl methacrylate decomposition products from machining plywood, particle board and Plexiglas, and solvents used with contact adhesives.

Precautions include machine guards, proper electrical safety, housekeeping and adequate storage to reduce fire hazards, dust collectors, adequate ventilation and e protection.

Welding, Cutting and Brazing

Steel and aluminium frameworks are commonly used for the construction of sets. These are often welded using oxyacetylene torches and arc welders of various types Injury hazards include fire from flying sparks, fire and explosion from compressed gases, and electrical shock from arc welders; health hazards include metal fumes, fluxes, welding gases (ozone, nitrogen oxides, carbon monoxide) and ultraviolet radiation.

Precautions include removal or protection of combustible materials, proper storag and handling of compressed gas cylinders, electrical safety, adequate ventilation an personal protective equipment.

Scenic Painting

Paints, lacquers, varnishes, dye solutions and other coatings are used for painting scenery flats and fabric drops. The paints and dye solutions can be either solvent based or water based. Powdered pigments and dyes are usually mixed in the shop, with the use of lead chromate pigments still being common. Large flats and drops are often sprayed. Solvents are used for dissolving dyes and resins, thinning, removing paint and other coatings and for cleaning tools, brushes and even hands Hazards include skin contact with solvents and inhalation of solvent vapours, spra mists and powdered dyes and pigments. Solvents are also fire hazards, particularly when sprayed.

Precautions include elimination of lead pigments, using water-based paints and dyes, adequate ventilation for use of solvents, respiratory protection for spraying, proper storage and handling of flammable liquids and proper disposal of waste solvents and paints.

Plastic Resins

Polyurethane foam resins, epoxy resins, polyester resins and other resins are commonly used to make large sets and props. Spraying of polyurethane foam resin containing diphenylmethane diisocyanate (MDI) is particularly dangerous, with hazards of chemical pneumonia and asthma. Epoxy resins, polyester resins and solvents have skin, eye and inhalation hazards, and are fire hazards.

Precautions include substitution of safer materials (such as cement or celastic instead of spray polyurethane foams, or water-based materials to replace solvent-based types), local exhaust ventilation, proper storage and handling, proper dispos of waste materials and adequate personal protective equipment.

Props and Models

Plastic resins are also used to make body armour, face masks, breakaway glass and other props and models, as are wood, plaster, metal, plastics and so on. A variety o water-based and solvent-based adhesives are also used. Solvents are used in cleanu Precautions are similar to those already discussed.

Michael McCann

MOTION PICTURE AND TELEVISION PRODUCTION

Michael McCann

The motion picture and television industry is found throughout the world. Motion picture production can take place in fixed studios, on large commercial studio lots or on location anywhere. Film production companies range in size from large corporations' own studios to small companies that rent space in commercial studios. The production of television shows, soap operas, videos and commercials has much in common with motion picture production.

Motion picture production involves many stages and a crew of interacting specialists. The planning stages include obtaining a finished script, determining the budget and schedule, choosing types of location and studios, designing the scene-by-scene appearance of the film, selecting costumes, planning sequence of action and camera locations and lighting schemes.

Once the planning is completed, the detailed process of choosing the location, building sets, gathering the props, arranging the lighting and hiring the actors, stunt performers, special effects operators and other needed support personnel begins. Filming follows the preproduction stage. The final step is film processing and editing, which is not discussed in this article.

Motion picture and television production can involve a wide variety of chemical, electrical and other hazards, many of which are unique to the film industry.

Hazards and Precautions

Filming location

Filming in a studio or on a studio lot has the advantage of permanent facilities and equipment, including ventilation systems, power, lighting, scene shops, costume shops and more control over environmental conditions. Studios can be very large in order to accommodate a variety of filming situations.

Filming on location, especially outdoors in remote locations, is more difficult and hazardous than in a studio because transportation, communications, power, food, water, medical services, living quarters and so on must be provided. Filming on location can expose the film crew and actors to a wide variety of hazardous conditions, including wild animals, poisonous reptiles and plants, civil unrest, climate extremes and adverse local weather conditions, communicable diseases, contaminated food and water, structurally unsafe buildings, and buildings contaminated with asbestos, lead, biological hazards and so on. Filming on water, in the mountains, in deserts and other dangerous locales poses obvious hazards.

The initial survey of possible filming locations should involve evaluating these and other potential hazards to determine the need for special precautions or alternative locations.

Fabricating scenery for motion pictures can involve constructing or modifying a building or buildings, building of indoor and outdoor sets and so on. These can be full size or scaled down. Stages and scenery should be strong enough to bear the loads under consideration (see “Scenery shops” in this chapter).

Life safety

Basic life safety includes ensuring adequate exits, keeping access routes and exits marked and clear of equipment and electrical cables and removal or proper storage and handling of combustible materials, flammable liquids and compressed gases. Dry vegetation around outdoor locations and combustible materials used in filming such as sawdust and tents must be removed or flame-proofed.

Automobiles, boats, helicopters and other means of transportation are common on film locations and a cause of many accidents and fatalities, both when used for transportation and while filming. It is essential that all drivers of vehicles and aircraft be fully qualified and obey all relevant laws and regulations.

Scaffolding and rigging

On location and in studios, lights are rigged to sets, scaffolding or permanent overhead grids, or are free standing. Rigging is also used to fly scenery or people for special effects. Hazards include collapsing scaffolds, falling lights and other equipment and failures of rigging systems.

Precautions for scaffolds include safe construction, guardrails and toeboards,

proper supporting of rolling scaffolds and securing of all equipment. Construction, operation, maintenance, inspection and repair of rigging systems should be done only by properly trained and qualified persons. Only assigned personnel should have access to work areas such as scaffolds and catwalks.

Electrical and lighting equipment

Large amounts of power are usually needed for camera lights and everyday electrical needs on a set. In the past direct current (DC) power was used, but alternating current (AC) power is common today. Often, and especially on location, independent sources of power are used. Examples of electrical hazards include shorting of electrical wiring or equipment, inadequate wiring, deteriorated wiring or equipment, inadequate grounding of equipment and working in wet locations. Tie-ins to the power sources and un-ties at the end of filming are two of the most dangerous activities.

All electrical work should be done by licensed electricians and should follow standard electrical safety practices and codes. Safer direct current should be used around water when possible, or ground fault circuit interrupters installed.

Lighting can pose both electrical and health hazards. High-voltage gas discharge lamps such as neons, metal halide lamps and carbon arc lamps are especially hazardous and can pose electrical, ultraviolet radiation and toxic fume hazards.

Lighting equipment should be kept in good condition, regularly inspected and adequately secured to prevent lights from tipping or falling. It is particularly important to check high-voltage discharge lamps for lens cracks that could leak ultraviolet radiation.

Cameras

Camera crews can film in many hazardous situations, including shooting from a helicopter, moving vehicle, camera crane or side of a mountain. Basic types of camera mountings include fixed tripods, dollies for mobile cameras, camera cranes for high shots and insert camera cars for shots of moving vehicles. There have been several fatalities among camera operators while filming under unsafe conditions or near stunts and special effects.

Basic precautions for camera cranes include testing of lift controls, ensuring a stable surface for the crane base and pedestal; properly laid tracking surfaces, ensuring safe distances from high-tension electrical wires; and body harnesses where required.

Insert camera cars that have been engineered for mounting of cameras and towing of the vehicle to be filmed are recommended instead of mounting cameras on the outside of the vehicle being filmed. Special precautions include having a

safety checklist, limiting the number of personnel on the car, rigging done by experts, abort procedures and having a dedicated radio communications procedure.

Actors, extras and stand-ins

See the article “Actors” in this chapter.

Costumes

Costumes are made and cared for by wardrobe attendants, who may be exposed to a wide variety of dyes and paints, hazardous solvents, aerosol sprays and so on, often without ventilation.

Hazardous chlorinated cleaning solvents should be replaced with safer solvents such as mineral spirits. Adequate local exhaust ventilation should be used when spraying dyes or using solvent-containing materials. Mixing of powders should be done in an enclosed glove box.

Special effects

A wide variety of special effects are used in motion picture production to simulate real events that would otherwise be too dangerous, impractical or expensive to execute. These include fogs, smoke, fire, pyrotechnics, firearms, snow, rain, wind, computer-generated effects and miniature or scaled-down sets. Many of these have significant hazards. Other hazardous special effects can involve the use of lasers, toxic chemicals such as mercury to give silvery effects, flying objects or people with rigging and electric hazards associated with rain and other water effects. Appropriate precautions would need to be taken with such special effects.

General precautions for hazardous special effects include adequate preplanning, having written safety procedures, using adequately trained and experienced operators and the least hazardous special effects possible, coordinating with the fire department and other emergency services, making everyone aware of the intended use of special effects (and being able to refuse to participate), not allowing children in the vicinity, running detailed rehearsals with testing of the effects, clearing the set of all but essential personnel, having a dedicated emergency communications system, minimizing the number of retakes and having procedures ready to abort production.

Pyrotechnics are used to create effects involving explosions, fires, light, smoke and sound concussions. Pyrotechnics materials are usually low explosives (mostly Class B), including flash powder, flash paper, gun cotton, black powder and smokeless powder. They are used in bullet hits (squibs), blank cartridges, flash pots, fuses, mortars, smoke pots and many more. Class A high explosives, such as

dynamite, should not be used, although detonating cord is sometimes used. The major problems associated with pyrotechnics include premature triggering of the pyrotechnic effect; causing a fire by using larger quantities than needed; lack of adequate fire extinguishing capabilities; and having inadequately trained and experienced pyrotechnics operators.

In addition to the general precautions, special precautions for explosives used in pyrotechnics include proper storage, the use of appropriate type and in smallest amounts necessary to achieve the effect, and testing them in the absence of spectators. When pyrotechnics are used smoking should be banned and firefighting equipment and trained personnel should be on hand. The materials should be set off by electronic firing controls and adequate ventilation is needed.

The uses of fire effects range from ordinary gas stoves and fireplaces to the destructive fires involved in burning cars, houses, forests and even people (figure 96.15). In some cases, fires can be simulated by flickering lights and other electronic effects. Materials used to create fire effects include propane gas burners, rubber cement, gasoline and kerosene. They are often used in conjunction with pyrotechnic special effects. Hazards are directly related to the fire getting out of control and the heat they generate. Poor maintenance of fire generating equipment and the excessive use of flammable materials or the presence of other unintended combustible materials, and improper storage of combustible and flammable liquids and gases are all risks. Inexperienced special effects operators can also be a cause of accidents as well.

Figure 96.15 Fire special effect

Special precautions are similar to those needed for pyrotechnics, such as replacing gasoline, rubber cement and other flammable substances with the safer combustible gels and liquid fuels which have been developed in recent years. All materials in the fire area should be non-combustible or flame-proofed. This precaution includes flame-proofed costumes for actors in the vicinity.

Fogs and smoke effects are common in filming. Dry ice (carbon dioxide), liquid nitrogen, petroleum distillates, zinc chloride smoke generators (which might also contain chlorinated hydrocarbons), ammonium chloride, mineral oil, glycol fogs and water mists are common fog-generating substances. Some materials used, such as petroleum distillates and zinc chloride, are severe respiratory irritants and can cause chemical pneumonia. Dry ice, liquid nitrogen and water mists represent the least chemical hazards, although they can displace oxygen in enclosed areas, possibly making the air unfit for supporting life, especially in enclosed areas. Microbiological contamination can be a problem associated with water-mist generating systems. Some evidence is forthcoming that respiratory irritation is possible from those fogs and smokes that were thought to be safest, such as mineral oil and glycols.

Special precautions include eliminating the most hazardous fogs and smoke; using a fog with the machine designed for it; limiting duration of use, including limiting the number of retakes; and avoiding use in enclosed spaces. Fogs should be exhausted as soon as possible. Respiratory protection for the camera crew should be provided.

Firearms are common in films. All types of firearms are used, ranging from antique firearms to shotguns and machine guns. In many countries (not including the United States) live ammunition is banned. However, blank ammunition, which is commonly used in conjunction with live bullet hits in order to simulate actual bullet impacts, has caused many injuries and fatalities. Blank ammunition used to consist of a metal casing with a percussion primer and smokeless powder topped with a paper wad, which could be ejected at high velocity when fired. Some modern safety blanks use special plastic inserts with a primer and flash powder, giving only a flash and noise. Blank ammunition is commonly used in conjunction with bullet hits (squibs), consisting of a plastic-cased detonator imbedded in the object to be struck by the bullet to simulate actual bullet impacts. Hazards, besides the use of live ammunition, include the effects of use of blanks at close range, mixing up live and blank ammunition or using the wrong ammunition in a firearm. Improperly modified firearms can be dangerous, as can the lack of adequate training in the use of blank-firing firearms.

Live ammunition and unmodified firearms should be banned from a set and non-firing facsimile weapons used whenever possible. Firearms that can actually fire a bullet should not be used, only proper safety blanks. Firearms should be checked

regularly by the property master or other firearms expert. Firearms should be locked away, as should all ammunition. Guns should never be pointed at actors in a scene, and the camera crew and others in close proximity to the set should be protected with shields from blanks fired from weapons.

Stunts

A stunt can be defined as any action sequence that involves a greater than normal risk of injury to performers or others on the set. With increasing demands for realism in films, stunts have become very common. Examples of potentially hazardous stunts include high falls, fights, helicopter scenes, car chases, fires and explosions. About half the fatalities occurring during filming are stunt-related, often also involving special effects.

Stunts can endanger not only the stunt performer but often the camera crew and other performers may be injured as well. Most of the general precautions described for special effects also apply to stunts. In addition, the stunt performer should be experienced in the type of stunt being filmed. A stunt coordinator should be in charge of all stunts since a person cannot perform a stunt and be in adequate control of safety, especially when there are several stunt performers.

Aircraft, especially helicopters, have been involved in the most serious multiple fatality accidents in motion picture production. Pilots are often not adequately qualified for stunt flying. Acrobatic manoeuvres, hovering close to the ground, flying too close to sets using pyrotechnics and filming from helicopters with open doors or from the pontoons without adequate fall protection are some of the most dangerous situations. See the article “Helicopters” elsewhere in the Encyclopaedia.

One precaution is to employ an independent aviation consultant, in addition to the pilot, to recommend and oversee safety procedures. Restriction of personnel within 50 feet of grounded aircraft and clear written procedures for filming on ground near aircraft with their engines running or during aircraft landings or takeoffs are other safety measures. Coordination with any pyrotechnics or other hazardous special effects operators is essential, as are procedures to ensure the safety of camera operators filming from aircraft. Procedures for aborting an operation are needed.

Vehicle action sequences have also been a source of many accidents and fatalities. Special effects, such as explosions, crashes, driving into rivers and car chase scenes with multiple cars, are the most common cause of accidents. Motorcycle scenes can be even more hazardous than automobiles because the operator of the motorcycle suffers from the lack of personal protection.

Special precautions include using camera cars. Using stunt drivers for all cars in a stunt scene can lower the accident rate, as can special training for non-stunt

passengers. Other safety rules include proper safety equipment, inspection of all ramps and other equipment to be used during a stunt, using dummies in cars during crashes, explosions and other extremely high risk sequences and not driving cars directly towards cameras if there is a camera operator behind the camera. See figure 96.16 for an example of using dummies in a roller coaster stunt. Adequate ventilation is needed for automobiles that are being filmed indoors with engines running. Stunt motorcycles should be equipped with a deadman switch so that the motor shuts off when the rider separates from the motorcycle.

Figure 96.16 Using dummies for a roller coaster stunt

William Avery

Stunts using fire and explosion place performers at higher risk and require special precautions beyond those used just for the special effects. Protection for stunt performers directly exposed to flames includes wearing a protective barrier gel (e.g., Zel Jel) on the hair, the skin, clothing and so on. Proper protective clothing, including fireproof suits under costumes; flame-resistant gloves and boots; and sometimes hidden oxygen tanks, should be supplied. Specially trained personnel equipped with carbon dioxide fire extinguishers should be on hand in case of an emergency.

Fight scenes can involve performers in fistfights or other unarmed combat or the use of knives, swords, firearms and other combat equipment. Many film and stage fights do not involve the use of stunt performers, thus increasing the risk of injury because of the lack of training.

Simulated weapons, such as knives and swords with retractable blades, are one safeguard. Weapons should be stored carefully. Training is key. The performer should know how to fall and how to use specific weapons. Adequate choreography and rehearsals of the fights is needed, as is proper protective clothing and equipment. A blow should never be aimed directly at an actor. If a fight involves a high degree of hazard, such as falling down a flight of stairs or crashing through a window, a professional stunt double should be used.

Falls in stunts can range from falling down a flight of stairs to falling off a horse, being thrown through the air by a trampoline or ratchet catapult system, or a high fall off a cliff or building (figure 96.17). There have been many injuries and fatalities from poorly prepared falls.

Figure 96.17 High fall stunt

William Avery

Only experienced stunt performers should attempt fall stunts. When possible, the fall should be simulated. For example, falling down a flight of stairs can be filmed a few stairs at a time so the stunt performer is never out of control, or a fall off a tall building simulated by a fall of a few feet onto a net and using a dummy for the rest of the fall. Precautions for high falls involve a high fall coordinator and a specialized fall/arrest system for safe deceleration. Falls of more than 15 feet require two safety spotters. Other precautions for falls include airbags, crash pads of canvas filled with sponge rubber, sand pits and so on, depending on the type of fall. Testing of all equipment is crucial.

Animal scenes are potentially very hazardous because of the unpredictability of

animals. Some animals, such as large cats, can attack if startled. Large animals like horses can be a hazard just because of their size. Dangerous, untrained or unhealthy animals should not be used on sets. Venomous reptiles such as rattlesnakes are particularly hazardous. In addition to the hazards to personnel, the health and safety of the animals should be considered.

Only trained animal handlers should be allowed to work with animals. Adequate conditions for the animals are needed, as is basic animal safety equipment, such as fire extinguishers, fire hoses, nets and tranquilizing equipment. Animals should be allowed adequate time to become familiar with the set, and only required personnel should be permitted on the set. Conditions that could upset animals should be eliminated and animals kept from exposure to loud noises or light flashes whenever possible, thus ensuring the animals will not be injured and will not become unmanageable. Certain situations—for example, those using venomous reptiles or large numbers of horses—will require special precautions.

Water stunts can include diving, filming in fast-moving water, speedboat stunts and sea battles. Hazards include drowning, hypothermia in cold water, underwater obstructions and contaminated water. Emergency teams, including certified safety divers, should be on hand for all water stunts. Diver certification for all performers or camera operators using self-contained underwater breathing apparatus (SCUBA) and provision of standby breathing equipment are other precautions. Emergency decompression procedures for dives over 10 m should be in place. Safety pickup boats for rescue and proper safety equipment, such as use of nets and ropes in fast-moving water, are needed.

Health and Safety Programmes

Most major film studios have a full-time health and safety officer to oversee the health and safety programme. Problems of responsibility and authority can occur, however, when a studio rents facilities to a production company, as is increasingly common. Most production companies do not have a health and safety programme. A health and safety officer, with authority to establish safety procedures and to ensure they are carried out, is essential. There is a need to coordinate the activities of others charged with production planning, such as stunt coordinators, special effects operators, firearms experts and the key grip (who is usually the individual most responsible for the safety of sets, cameras, scaffolding, etc.), each of whom has specialized safety knowledge and experience. A health and safety committee that meets regularly with representatives from all departments and unions can provide a conduit between the management and employees. Many unions have an independent health and safety committee which can be a source of health and safety expertise.

Medical services

Both non-emergency and emergency medical services are essential during film production. Many film studios have a permanent medical department, but most production companies do not. The first step in determining the degree of on-location medical services to be provided is a needs assessment, to identify potential medical risks, including the need for vaccination in certain countries, possible local endemic diseases, evaluation of local environmental and climate conditions, and an evaluation of the quality of local medical resources. The second, pre-planning stage involves a detailed analysis of major risks and availability of adequate emergency and other medical care in order to determine what type of emergency planning is essential. In situations where there are high risks and/or remote locations, trained emergency physicians would be needed on location. Where there is quick access to adequate emergency facilities, paramedics or emergency medical technicians with advanced training would suffice. In addition, adequate emergency transportation should be arranged beforehand. There have been several fatalities due to the lack of adequate emergency transportation (Carlson 1989; McCann 1989).

Standards

There are few occupational safety and health regulations aimed specifically at the film production industry. However, many general regulations, such as those affecting fire safety, electrical hazards, scaffolding, lifts, welding and so on, are applicable. Local fire departments generally require special fire permits for filming and may require that standby fire personnel be present on filming sites.

Many productions have special requirements for the licensing of certain special effects operators, such as pyrotechnicians, laser operators and firearms users. There can be regulations and permits required for specific situations, such as the sale, storage and use of pyrotechnics, and the use of firearms.

RADIO AND TELEVISION BROADCASTING

Nancy Clark

The production of television and radio broadcasts involves camera shoots and recordings on location and in the studio, video- and audiotape editing, transmitting and receiving broadcasts, managing electronic information and graphics, and maintenance of equipment and tape. Broadcast engineers and technicians produce pre-taped and live broadcasts for major network and cable companies, local stations and production companies. Major occupations include: camera operator, sound person, tape editor, computer operator, maintenance engineer, news broadcaster and other television and radio artists.

Broadcasting and its support activities can take place in remote locations, in the studio or in various maintenance and specialty shops. Employees can be exposed

to many hazards typical of the technological workplace, including poor indoor air quality, poor workplace design and low-frequency electromagnetic radiation (since microwave technology is used to transmit and receive broadcasts, and the density of electronic equipment produces relatively high levels of low-frequency energy fields). Proper shielding and placement of equipment are prudent measures to protect operators from these fields.

Hazards and Precautions

Remote locations

Roving camera and audio crews cover news and special events for networks and local stations. Crews carry to the site everything needed for the broadcast, including camera, sound recorder, lights, tripod and electrical cords. Since the advent of lightweight cameras equipped with sound recorders, a single person may be assigned to operate the equipment. The hazards can include trips, slips and falls and musculoskeletal stress. Violence in riots and wars can lead to injuries and fatalities. Bad weather, crowds, environmental disasters and rough terrain increase the potential for serious injuries and illnesses among the crew.

The danger can be reduced through assessing the location for the potential for violence and the securing of safe operating locations. Personal protective equipment, such as bullet-proof vests and helmets, may also be needed. Adequate staffing and material-handling equipment and safe lifting practices can reduce musculoskeletal stresses.

News and traffic reports are frequently recorded or aired from helicopters. Broadcast personnel have been killed and injured in crashes and unplanned landings. Strict adherence to proper training and certification of pilots, preventive maintenance of equipment and prohibition of unsafe flying practices (such as flying too close to other helicopters or to structures) are crucial for protecting these employees. See the article “Heliocopters” elsewhere in this volume.

Sporting events, such as golf tournaments and car races, and other special events are often shot from elevated platforms and scaffolds. Motorized lifts and cranes are also used to position equipment and personnel. These structures and machines are typical of those used in general building construction and motion picture production, and one may encounter the same hazards, such as falling off the structure, being struck by falling objects, being struck by lightning in open areas and being electrocuted from contact with overhead power lines and live electrical equipment.

Proper inspection and erection of platforms, full guardrails with toe boards to prevent objects from falling, access ladders, grounding and guarding of electrical equipment and observance of weather alerts, as in construction work, are some appropriate precautions to be taken.

Studio productions

Studio productions have the advantages of familiar surroundings where employees operate cameras, sound equipment and special effects equipment. The hazards are similar to those described in motion picture production and include: musculoskeletal stresses, electrical hazards, noise (especially in rock radio studios) and exposure to theatrical smokes and fogs. Appropriate ergonomic design of work spaces and equipment, electrical safeguards, control of sound levels, careful selection of smokes and fogs and adequate ventilation are all possible preventive measures.

Film editing, handling and storage

Before being broadcast, video- and audiotapes must be edited. The conditions will depend on the size of the facility, but it is not uncommon for several editing operations to be going on at the same time. Editing work requires close attention to the material, and editing rooms can be noisy, overcrowded and poorly lit, with poor indoor air quality and electrical hazards. The space and the equipment can have poor ergonomic design; tasks may be repetitive. There may be noise and fire hazards. Proper workspace design including space, lighting and ventilation, soundproofing and electrical safeguards are all necessary. Special inspection and handling procedures are required for old film storage. Some production companies have libraries that contain old cellulose nitrate (nitrocellulose) films. These films are no longer made, but those that are in storage are severe fire and life hazards. Nitrocellulose can combust and explode readily.

Computer graphics are common in taped programmes and require long hours at visual display units. Working conditions vary based on the size and layout of the facility. Workspace design requirements are similar to other computer workstations.

Maintenance Shops

Technicians and engineers maintain cameras, recorders, editing machines and other broadcasting equipment, and their working conditions resemble those of their industrial counterparts. Low-residue organic solvents, such as freons, acetone, methanol, methyl ethyl ketone and methylene chloride are used to clean electronic parts and electrical contacts. Metal components are repaired using welding, soldering and power tools. The hazards can include inhalation of solvent vapours and metal fumes, skin contact with solvents, fire and machine hazards. The substitution of safer materials, local exhaust ventilation for solvent vapours and fumes from welding and soldering, as well as machine guards, are all possible safeguards.

JOURNALISM

Aidan White

Journalism is one of the romantic professions, but it is also one of the most dangerous. Between 1990 and 1997 more than 500 journalists and media workers were killed, many the victims of gangsters, paramilitary groups and terrorists. Each year, hundreds of reporters and writers are injured, both physically and psychologically, by the horrors of war and social conflict. See figure 96.18 .

Figure 96.18 Algiers, Algeria, 11 February 1996: The devastated offices of Le Soir, one of three newspapers hit by a terrorist car bomb.

Le Soir

The tendency to try to manipulate or control information is becoming more evident as the speed and range of communication increases. Today information speeds around the world in seconds thanks to satellite technology. News and information can be beamed into people's homes as it happens.

Consequently, journalists and their visible helpers—camera and technical staff, for instance—pose a threat to any group, official or otherwise, that wants to avoid public scrutiny. This leads to specific and targeted attacks on journalists and media organizations.

The problem of "censorship by violence" is exacerbated by the nature of commercial competition in the media industry and by unregulated patterns of employment. Media networks compete vigorously for market share, and this is leading to greater pressure on journalists to provide ever more dramatic and

sensationalist images and reportage. Many media people are taking greater risks than before.

The situation is made worse because few media organizations provide training for their staff in how to deal with situations of violence and conflict. Such training is essential. Media staff need to be able to make coherent and sensible “risk assessment” judgements about fast-moving reporting situations. They need a basic knowledge of first aid and advice from media veterans on how to report from dangerous scenes.

The most vulnerable group of media workers—freelance journalists and casual staff—are the ones least likely to receive training even where it is available. More freelance staff are employed than ever before and many of them are hired from the regions where the reported action is taking place. Sometimes they are hired without any life or health insurance. If they get hurt, they are not entitled to compensation.

Because they often work in very unpredictable circumstances, some journalists will always be at risk. Often it will be impossible to avoid injury, even death. But much more can be done to minimize the levels of risk. For instance, in Algeria, where some 60 journalists were assassinated between June 1994 and March 1996, journalists’ unions, employers and the authorities have combined their efforts to minimize risks.

Much more needs to be done by media organizations and representatives of media workers and journalists to provide protections for media personnel. In particular there is a need for:

· Adequate preparation by journalists and media before going on assignment. Media organizations should provide technical assistance and establish training programmes specifically designed to improve levels of personal safety and to carry out risk assessment related to specific assignments.

· Health and life insurance for everyone reporting in the field, with established procedures to ensure that anyone who is likely to be at risk, including freelance staff or stringers, is covered.

In addition, media organizations must reverse recent trends that undermine the social and professional conditions in which journalists work. There should be increased investment in professional training and journalistic ethics to emphasize the importance of investigative journalism to the good health of democratic society.

Journalists themselves have a key role to play. All journalists must take responsibility to exercise the highest standards of personal safety and minimize risks to themselves and their colleagues. Journalists need to maintain the highest professional standards and conduct and should not compromise the ethics of

journalism in any aspect of the gathering, production or dissemination of news and information.

But it is not only the professionals that need to take practical steps to address the issue. Governments, which have a responsibility to protect the lives and security of citizens, must ensure that journalists and media organizations are provided with the maximum security and protection from violence.

Government and public authorities must not regard journalists as part of the state security apparatus and must not demand information or materials from media organizations in order to assist inquiries which are the responsibility of official agencies.

One of the worrying features of journalism has always been that governments are prepared to use the cover of journalistic activity in order to carry out surveillance and espionage. It is a practice which exposes all travelling journalists to suspicion and intimidation.

The key is to reduce the risk. There are no absolute guarantees of safety, but governments, journalists and media organizations need to avoid creating the conditions which make it easier to commit violence against media. A starting point would be recognition that no single story, no matter how dramatic, is worth a life.

MUSEUMS AND ART GALLERIES

Kathryn A. Makos

Museums and art galleries are a popular source of entertainment and education for the general public. There are many different types of museums, such as art, history, science, natural history and children's museums. The exhibits, lectures and publications offered to the public by museums, however, are only one part of the function of museums. The broad mission of museums and art galleries is to collect, conserve, study and display items of artistic, historical, scientific or cultural importance. Supportive research (fieldwork, literary and laboratory) and behind-the-scenes collection care typically represent the largest proportion of work activities. Collections on display generally represent a small fraction of the total acquisitions of the museum or gallery, with the remainder in on-site storage or on loan to other exhibits or research projects. Museums and galleries may be stand-alone entities or affiliated with larger institutions such as universities, government agencies, armed services installations, park service historic sites or even specific industries.

A museum's operations can be divided into several main functions: general building operations, exhibit and display production, educational activities, collection management (including field studies) and conservation. Occupations,

which may overlap depending on size of staff, include building maintenance trades and custodians, carpenters, curators, illustrators and artists, librarians and educators, scientific researchers, specialized shipping and receiving and security.

General Building Operations

The operation of museums and galleries poses potential safety and health hazards both common to other occupations and unique to museums. As buildings, museums are subject to poor indoor air quality and to risks associated with maintenance, repair, custodial and security activities of large public buildings. Fire prevention systems are critical to protect the lives of staff and a multitude of visitors, as well as the priceless collections.

General tasks involve custodians; heating, ventilation and air-conditioning (HVAC) specialists and boiler engineers; painters; electricians; plumbers; welders; and machinists. Safety hazards include slips, trips and falls; back and limb strains; electrical shock; and fires and explosions from compressed gas cylinders or hot work. Health hazards include exposures to hazardous materials, noise, metal fumes, flux fumes and gases, and ultraviolet radiation; and dermatitis from cutting oils, solvents, epoxies and plasticizers. Custodial staff are exposed to splash hazards from diluting cleaning chemicals, chemical reactions from improperly mixed chemicals, dermatitis, inhalation hazards from dry sweeping of lead paint chips or residual preservative chemicals in collection storage areas, injury from broken laboratory glassware or working around sensitive laboratory chemicals and equipment, and biological hazards from cleaning building exteriors of bird debris.

Older buildings are prone to mould and mildew growth and poor indoor air quality. They often lack exterior wall vapour barriers and have air handling systems which are old and difficult to maintain. Renovation may lead to uncovering material hazards in both centuries-old buildings and modern ones. Lead paints, mercury linings on old mirrored surfaces and asbestos in decorative finishes and insulation are some examples. With historic buildings, the need to preserve historic integrity must be balanced against design requirements of life safety codes and accommodations for persons with disabilities. Exhaust ventilation system installations should not destroy historic facades. Rooflines or skyline restrictions in historic districts may pose serious challenges to construction of exhaust stacks with sufficient height. Barriers used to separate construction areas often must be free-standing units that cannot be attached to walls that have historic features. Renovation should not mar underlying supports which may consist of valuable wood or finishes. These restrictions may lead to increased dangers. Fire detection and suppression systems and fire-rated construction are essential.

Precautions include the use of personal protective equipment (PPE) for eyes, face, head, hearing and respiration; electrical safety; machine guards and lock-out/tag-

out programmes; good housekeeping; compatible hazardous material storage and secure compressed gas cylinders; fire detection and suppression systems; dust collectors, local exhaust and use of high efficiency particulate air (HEPA) filtered vacuum cleaners; safe lifting and material handling training; fork-lift safety; use of hoists, slings and hydraulic lifts; chemical spill control; safety showers and eye washes; first aid kits; and hazard communication and employee training programmes in hazards of materials and jobs (particularly for custodians in laboratories) and means for protection.

Exhibit and Display Production

The production and installation of museum exhibits and displays can involve a wide range of activities. For example, an animal exhibit in a natural history museum could involve the production of display cases; the construction of a reproduction of the animal's natural habitat; the fabrication of the animal model itself; written, oral and illustrated materials to accompany the exhibit; appropriate lighting; and more. Processes involved in the exhibit production can include: carpentry; metalworking; working with plastics, plastics resins and many other materials; graphic arts; and photography.

Exhibit fabrication and graphics shops share similar risks with general woodworkers, sculptors, graphic artists, metalworkers and photographers. Specific health or safety risks may arise from installation of exhibits in halls without adequate ventilation, cleaning of display cases containing residues of hazardous treatment materials, formaldehyde exposure during photography set-up of fluid collection specimens and high-speed cutting of wood treated with fire retardant, which may liberate irritating acid gases (oxides of sulphur, phosphorus).

Precautions include appropriate personal protective equipment, acoustic treatment and local exhaust controls on woodworking machinery; adequate ventilation for graphics tables, silkscreen wash booths, paint-mixing areas, plastics resin areas, and photo development; and use of water-based ink systems.

Educational Activities

Museum educational activities can include lectures, distribution of publications, hands-on arts and science activities and more. These can be directed either towards adults or children. Arts and science activities can often involve use of toxic chemicals in rooms not equipped with proper ventilation and other precautions, handling arsenic-preserved stuffed birds and animals, electrical equipment and more. Safety risks may exist for both museum education staff and participants, particularly children. Such programmes should be evaluated to determine what types of precautions are needed and whether they can be done safely in the museum setting.

Art and Artefact Collections Management

Collections management involves field collection or acquisition, inventory control, proper storage techniques, preservation and pest management. Fieldwork can involve digging on archaeological expeditions, preserving botanical, insect and other specimens, making casts of specimens, drilling fossil rocks and more. The duties of curatorial staff in the museum include handling the specimens, examining them with a variety of techniques (e.g., microscopy, x ray), pest management, preparing them for exhibits and handling travelling exhibitions.

Hazards can occur at all stages of collections management, including those associated with field work, hazards inherent in the handling of the object or specimen itself, residues of old preservation or fumigation methods (which may not have been well documented by the original collector) and hazards associated with pesticide and fumigant application. Table 96.8 gives the hazards and precautions associated with some of these operations.

Table 96.8 Hazards and precautions of collection management processes

Process	Hazards and precautions
Field work and handling of specimens	Ergonomic injuries from repetitive drilling on fo lifting; biohazards from surface cleaning of bird response (pulmonary and dermal) from insect fr living and dead specimens, particularly birds an (plaque, Hanta virus) and other diseased tissues hazards from preserving media.
	Precautions include ergonomic controls; HEPA control of detritus allergens, insect eggs, larvae; u precautions for avoiding staff exposure to anima agents;.and adequate ventilation or respiratory p handling hazardous preserving agents.
Taxidermy and osteological preparation	Health hazards in the preparation of skins, whol skeletal specimens, and in the cleaning and rest mounts, arise from exposure to solvents and deg clean skins and skeletal remains (after maceratic preservatives, especially arsenic (internal and ex applications); osteological preparation (ammoni solvents, degreasers); formaldehyde for preservin autopsy (or necropsy); frass allergens; contact wi specimens; asbestos-plaster in old mounts. Safe include heavy lifting strains; injury from use of p or sharps on specimens; and use of flammable o mixtures.
	Precautions include local exhaust ventilation; re

	Precautions include local exhaust ventilation; re aprons; use of brushes and HEPA vacuums to cl rearrange nap instead of low-pressure compress brushing alone; and use of disinfectants in necr handling areas. Check with local environmental current approval status for taxidermy and prese applications.
Illustrators and microscopic examinations by curators and their technicians	Exposure to hazardous storage media at close ra alcohols, formaldehyde/glutaraldehyde and osm used in histology (sectioning, staining, slide mo scanning and transmission electron microscopy
	See laboratory research for appropriate precauti
Fumigant and pesticide use	Insect damage to collections cannot be tolerated indiscriminate use of chemicals can have advers staff health and collections. Integrated pest man programmes are now utilized as practical means while reducing health and collection risks. Com chemical pesticides and fumigants (many now b restricted) include(d): DDT, naphthalene, PDB, ethylene oxide, carbon tetrachloride, ethylene di bromide and sulphuryl fluoride. Many have poo properties, are extremely toxic or lethal to huma concentrations and should be applied by profes exterminators or fumigators offsite or outside oc require complete airing in a well-ventilated area gassing products from porous collection materia
	Precautions include PPE, respirator, ventilation, medical surveillance, HEPA vacuums, regulatory applicators and air sampling before reentry into
Laboratory research	Hazardous tasks involve molecular systematics; general storage of living cells and tissue cultures DMSO, radioactive isotopes, a wide variety of so ether; cryogenic liquids for freeze-drying (nitrog of benzidine-based dyes.
	Precautions include cryogenic protection (glove aprons, well-ventilated areas, safety relief valves, pressure transport and storage), biosafety cabin laboratory hoods and respirators, local exhaust e weighing and microscope stations; clean benche grade filters, gloves and lab coats, eye protection for control of detritus allergens, insect eggs, larva precautions for avoiding laboratory and custodi animal disease agents.

Shipping, receiving and preparing of loaned collections for exhibitions	Exposure to unknown storage media and potent shipping material (e.g., crates lined with asbesto countries without stringent environmental repo requirements.
	Precautions include appropriate hazard warning loaned exhibitions, and ensuring that incoming documents stipulate contents.

There are also hazards associated with the collection objects themselves. Wet collections in general have the following risks: exposure to formaldehyde used for field-fixing and permanent storage; sorting specimens from formaldehyde to alcohol storage (usually ethanol or isopropanol); and “mystery liquids” on incoming loans. Dry collections in general have the following risks: residual particulate preservatives, such as arsenic trioxide, mercuric chloride, strychnine and DDT; and vaporizing compounds leaving residues or recrystallization, such as dichlorvos/vapona pest strips, paradichlorobenzene (PDB) and naphthalene. See table 96.9 for a list of many of the particular hazards found in collection management. This table also includes hazards associated with conservation of these specimens.

Table 96.9 Hazards of collection objects

Source of hazard	Hazard
Botanicals, vertebrates and invertebrates	Storage media containing formaldehyde, acetic formaldehyde used in field fixing, sorting to alco mercuric chloride on dry-mounted plant specin mercury-preserved birds and mammals, dry-mo insect frass allergens.
Decorative arts, ceramics, stone and metal	Pigments or preservatives may contain mercury plated objects may have cyanide bound into fin liberated by water-washing). Celluloid objects (F fire hazards. Fiesta-ware and enamel jewellery m radioactive uranium pigments.
Entomology	Naphthalene, paradichlorobenzene (PDB) expos replenishing storage drawers or observing specir collection bottle preparations using cyanide salt
Furniture	The furniture may have been treated with penta containing wood preservatives, lead and other to Cleaning and restoration may involve treatment spirits, methylene chloride paint strippers, varn
Minerals	Radioactive specimens, natural ores of high-toxi minerals (lead/asbestiform), noise from section

	epoxies for slide/section preparation.
Miscellaneous hazards	Old pharmaceuticals in medical, dental and vete (which may have degraded, are illegal substance converted into reactive or explosive compounds firearms; carbon tetrachloride in nineteenth- an century fire-extinguishing devices; vehicle batte transformers, capacitors and other electrical coll felts in static generators, lighthouses and scienc asbestos from plasters in trophy mounts, casts a household appliances, ceramic glazes, wiring an
Paintings, print and paper	These may contain high-toxicity pigments of lea white lead, chrome yellow), cadmium, chromiu chromate form), cobalt (particularly cobalt viole arsenate), manganese and mercury. Cyanide ma some printers' inks and in old (nineteenth centu mercury was added to some paintings and fabri prevention; lampblack and coal tar dyes are carc and restoration of these materials can involve th varnishes, lacquers, chlorine dioxide bleaches ar
Paleobiological specimens	Ergonomic and health risks from fossil preparati drilling or chipping rock matrix containing free asbestos or radioactive ore; epoxies and liquid p casts; noise; solvents and acids for rock digestio most hazardous).
Photographs	Nitrocellulose film has the risk of spontaneous c nitric acid burns from decomposing film. It sho modern film. Selenium toning restoration can in selenium and sulphur dioxide exposure, and rec ventilation.
Storage cases	Lead and cadmium surface paint, arsenic-treate asbestos insulation render cases difficult to disp and chips containing these substances pose haz interior and exterior case cleaning; vacuum debi considered hazardous waste.
Textiles, clothing	Hazards include dyes (particularly benzidine ba arsenic for lace and other component preservati felt treatment; poisonous plant materials used fo decorations; mould, mildew, allergens from inse excrement (frass).

Occupational health and safety considerations are similar to those of general industry. Precautions include occupational maintenance of a good inventory of

collection treatment methods, personal protective equipment, including vinyl (not latex) gloves for dry specimen handling, and impervious gloves and splash protection for liquids. Medical surveillance with regard to general and reproductive hazards; good hygiene practices—lab coats and work clothes laundered separately from family clothes (or best at work in a dedicated washer); avoidance of dry sweeping (use HEPA vacuum cleaners); avoiding water-trap vacuum cleaners on suspect collections; proper hazardous waste disposal methods; and chemical hazard information training for staff are some examples.

Conservation Laboratories

Conservation work, often in full-scale laboratories, involves the cleaning and restoration (by chemical or physical means) of items such as paintings, paper, photographs, books, manuscripts, stamps, furniture, textiles, ceramics and glass, metals, stone, musical instruments, uniforms and costumes, leather, baskets, masks and other ethnographic objects. Hazards unique to conservation range from highly intermittent exposures to dropper-size amounts of restoration chemicals, to potentially heavy exposures when using large quantities of chemicals to treat statuary or large vertebrate specimens. Ergonomic injuries are possible from awkward hand-and-brush positions over painting or statuary restoration work, and heavy lifting. A wide variety of solvents and other chemicals are used in cleaning and restoration of collection objects. Many of the techniques used for the restoration of damaged artwork, for example, are the same, and involve the same hazards and precautions as those of the original art process. Hazards also arise from the composition and finish of the object itself, as described in table 96.9 . For precautions see the previous section.

ZOOS AND AQUARIUMS

Ken Sims

Zoological gardens, wildlife parks, safari parks, bird parks and collections of aquatic wildlife share similar methods for the maintenance and handling of exotic species. Animals are held for exhibition, as an educational resource, for conservation and for scientific study. Traditional methods of caging animals and preparing aviaries for birds and tanks for water creatures remain common, but more modern, progressive collections have adopted different enclosures designed to meet more of the needs of particular species. The quality of space accorded to an animal is more important than the quantity, however, which has consequential beneficial effects on keeper safety. The danger to keepers is often related to the size and natural ferocity of the species attended, but many other factors can affect the danger.

The main animal groupings are mammals, birds, reptiles, amphibians, fish and invertebrates. Problem areas that are common to all the animal groups are toxins,

diseases that are contractible from animals (zoonoses) and changing animal moods.

Mammals

Mammals' varied forms and habits require a wide range of husbandry techniques. The largest land forms are herbivorous, such as elephants, and are limited in their ability to climb, jump, burrow or gnaw, so their control is similar to domestic forms. Remote control of gates can offer high degrees of safety. Large predators such as big cats and bears require enclosures with wide margins of safety, double entry doors and in-built catch-ups and crushes. Agile climbing and jumping species pose special problems to keepers, who lack comparable mobility. The use of electric shock fence wiring is now widespread. Capture and handling methods include corralling, nets, crushing, roping, sedation and immobilization with drugs injected by dart.

Birds

Few birds are too large to be restrained by gloved hands and nets. The largest flightless birds—ostriches and cassowaries—are strong and have a very dangerous kick; they require crating for restraint.

Reptiles

Large carnivorous reptile species have violent strike attack capability; many snakes do too. Captive specimens may seem docile and induce keeper complacency. An attacking large constricting snake can overwhelm and suffocate a panicking keeper of much greater weight. A few venomous snakes can "spit"; thus eye protection against them should be mandatory. Restraint and handling methods include nets, bags, hooks, grabs, nooses and drugs.

Amphibians

Only a large giant salamander or big toad can give an unpleasant bite; otherwise risks from amphibians are from toxin excretion.

Fish

Few fish specimens are hazardous except for venomous species, electric eels and bigger predatory forms. Careful netting minimizes risk. Electric and chemical stunning may be occasionally appropriate.

Invertebrates

Some lethal invertebrate species are kept which require indirect handling. Mis-identification and specimens hidden by camouflage and small size can endanger the unwary.

Toxins

Many animal species have evolved complex poisons for feeding or defence, and deliver them by biting, stinging, spitting and secretion. Delivered quantities may vary from the inconsequential to lethal doses. Worst case scenarios should be the model for accident anticipation procedures. Single keeper exposure to lethal species should not be practised. Husbandry must include risk evaluation, unambiguous warning signs, restriction of handling to those trained, maintenance of stocks of antidotes (if any) in close liaison with local trained medical practitioners, predetermination of handler reaction to antidotes and an efficient alarm system.

Zoonoses

A good animal health programme and personal hygiene will keep the risk from zoonoses very low. However, there are many which are potentially lethal, such as rabies, which is untreatable in later stages. Almost all are avoidable, and treatable if diagnosed correctly early enough. As with work elsewhere, the incidence of allergy-related illness is rising and it is best treated by non-exposure to the irritant when identified.

“Non-venomous” bites and scratches require careful attention, as even a bite which appears not to break skin can lead to rapid blood poisoning (septicaemia). Carnivore and monkey bites should be especially suspect. An extreme example is the bite of a komodo dragon; the microflora in its saliva are so virulent that bitten large prey that escapes an initial attack will rapidly die from shock and septicaemia.

Routine prophylaxis against tetanus and hepatitis may be appropriate for many staff.

Moods

Animals can give an infinite variety of responses, some very dangerous, to close human presence. Observable mood changes can alert keepers to danger, but few animals show signs readable by humans. Moods can be influenced by a combination of seen and unseen stimuli such as season, day length, time of day, sexual rhythms, upbringing, hierarchy, barometric pressure and high-frequency noise from electrical equipment. Animals are not production line machines; they may have predictable patterns of behaviour but all have the capacity to do the unexpected, against which even the most skilled attendant must guard.

Personal safety

Risk appreciation should be taught by the skilled to the inexperienced. An undiminishing high level of caution will enhance personal safety, particularly, for example, when food is offered to larger carnivores. Animal responses will vary to different keepers, especially to those of different sex. An animal submissive to one person may attack another. The understanding and use of body language can enhance safety; animals naturally understand it better than humans. Voice tone and volume can calm or cause chaos (figure 96.19).

Figure 96.19 Handling animals with voice and body language

Ken Sims

Clothing should be chosen with special care, avoiding bright, flapping material. Gloves may protect and reduce handling stress but are inappropriate for handling snakes because tactile sensitivity is reduced.

If keepers and other staff are expected to manage trespassing, violent or other problem visitors, they should be schooled in people management and have back-up on call to minimize risks to themselves.

Regulations

Despite the variety of potential risks from exotic species, the greater workplace hazards are conventional ones arising from plant and machinery, chemicals, surfaces, electricity and so on, so standard health and safety regulations must be

applied with common sense and regard for the unusual nature of the work.

PARKS AND BOTANICAL GARDENS

Paul V. Lynch

The occupational safety and health hazards for those who work in parks and botanical gardens fall in the following general categories: environmental, mechanical, biological or chemical, vegetation, wildlife and caused by human beings. The risks differ depending on where the site is located. Urban, suburban, developed or undeveloped wildland will differ.

Environmental Hazards

As parks and garden personnel are found in all geographical areas and generally spend a great deal, if not all, of their working time outdoors, they are exposed to the widest variety and extremes of temperature and climatic conditions, with the resultant risks ranging from heat stroke and exhaustion to hypothermia and frostbite.

Those who work in urban areas may be in facilities where vehicular traffic is significant and may be exposed to toxic exhaust emissions such as carbon monoxide, unburned carbon particles, nitrous oxide, sulphuric acid, carbon dioxide and palladium (from the breakdown of catalytic converters).

Because some facilities are located in the higher elevations of mountainous regions, altitude sickness may be a risk if an employee is new to the area or is prone to high or low blood pressure.

Park area workers are usually called upon to perform search and rescue and disaster control activities during and following natural disasters such as earthquakes, hurricanes, flooding, volcanic eruptions and the like affecting their area, with all of the risks inherent in such events.

It is essential that all personnel be thoroughly trained in the potential environmental risks inherent in their areas and be provided with the proper clothing and equipment, such as adequate cold- or hot-weather gear, water and rations.

Mechanical Hazards

Personnel in parks and gardens are called upon to be thoroughly familiar with and operate an extremely wide variety of mechanical equipment, ranging from small hand tools and power tools and powered lawn and garden equipment (mowers, thatchers, rototillers, chainsaws, etc.) to heavy equipment such as small tractors,

snow ploughs, trucks and heavy construction equipment. Additionally, most facilities have their own shops equipped with heavy power tools such as table saws, lathes, drill presses, air pressure pumps and so on.

Employees must be thoroughly trained in the operation, hazards and safety devices for all types of equipment they could potentially operate, and be provided and trained in the use of the appropriate personal protection equipment. Since some personnel may also be required to operate or ride the full range of motor vehicles, and fixed- or rotary-wing aircraft, they must be thoroughly trained and licensed, and regularly tested. Those that ride as passengers must have knowledge of the risks and training in safe operation of such equipment.

Biological and Chemical Hazards

Continuous, close contact with the general public is inherent in almost every occupation in park and garden work. The risk of contracting viral or bacterial diseases is always present. Additionally, the risk of contact with infected wildlife that carry rabies, psitticosis, Lyme disease and so on is present.

Park and botanical garden workers are exposed to various amounts and concentrations of pesticides, herbicides, fungicides, fertilizers and other agricultural chemicals, as well as toxic paints, thinners, varnishes, lubricants and so on used in maintenance and transport work and equipment.

With the proliferation of illegal drugs, it is becoming common for personnel in national parks and forests to come across illegal drug-manufacturing laboratories. The chemicals found in these can cause death or permanent neurological damage. Personnel in urban and rural areas may also encounter discarded drug paraphernalia such as used hypodermic syringes, needles, spoons and pipes. If any of these punctures the skin or enters the body, illness ranging from hepatitis to HIV could result.

Thorough training in the risks and preventive measures is essential; regular physical examinations should be provided and immediate medical attention sought if a person is so exposed. It is essential that the type and duration of exposure be recorded, if possible, to be given to the treating physician. Whenever illegal drug paraphernalia is encountered personnel should not touch it but rather should secure the area and refer the matter to trained law enforcement personnel.

Vegetation Hazards

Most types of vegetation pose no health risk. However, in wildland areas (and some urban and suburban park areas) poisonous plants such as poison ivy, poison oak and poison sumac can be found. Health problems ranging from a minor rash to a severe allergic reaction can result, depending on the susceptibility of the individual and the nature of the exposure.

It should be noted that roughly 22% of the total population suffers from allergic reactions of one form or another, ranging from mild to severe; an allergic individual may respond to only a few substances, or to many hundreds of different types of vegetation and animal life. Such reactions can result in death, in extreme cases, if immediate treatment is not found.

Prior to working in any environment with plant life, it should be determined whether an employee has any allergies to potential allergens and should take or carry appropriate medication.

Personnel should also be cognizant of plant life that is not safe to ingest, and should know the signs of ingestion illness and the antidotes.

Wildlife Hazards

Parks workers will encounter the full spectrum of wildlife that exists around the world. They must be familiar with the types of animals, their habits, the risks and, where necessary, the safe handling of the wildlife expected to be encountered. Wildlife ranges from urban domestic animals, such as dogs and cats, to rodents, insects and snakes, to wildland animals and bird species including bears, mountain lions, poisonous snakes and spiders, and so on.

Proper training in the recognition and handling of wildlife, including the diseases affecting such wildlife, should be provided. Appropriate medical response kits for poisonous snakes and insects should be available, along with training in how to use them. In remote wildland areas, it may be necessary to have personnel trained in the use of, and be equipped with, firearms for personal protection.

Human-caused Hazards

In addition to the aforementioned risk of contact with a visitor having a contagious illness, a major share of the risks faced by personnel who work in the parks, and to a lesser degree botanical gardens, are the result of either accidental or deliberate action of facilities visitors. Those risks range from the need of park employees to perform search and rescue activities for lost or injured visitors (some in the most remote and dangerous environments) to responding to acts of vandalism, drunkenness, fighting and other disruptive activities, including assault on park or garden employees. Additionally, the park or garden employee is at risk of vehicular accidents caused by visitors or others who are driving by or in the vicinity of the employee.

Approximately 50% of all wildland fires have a human cause, attributable to either arson or negligence, to which the park employee may be required to respond.

Wilful damage or destruction of public property is also, unfortunately, a risk the park or garden employee may well be required to respond to and repair, and,

depending on the type of property and degree of damage, a significant safety risk may be present (i.e., damage to wilderness trails, foot bridges, interior doors, plumbing equipment and so on).

Personnel who work with the environment are, generally, sensitive and attuned to the outdoors and to preservation. As a result, many such personnel suffer from varying degrees of stress and related illnesses because of the unfortunate actions of some of those who visit their facilities. It is important, therefore, to be aware of the onset of stress and take remedial action. Classes in stress management are helpful for all such personnel.

Violence

Violence in the workplace is, unfortunately, becoming an increasing common risk and cause of injury. There are two general classes of violence: physical and psychological. The types of violence range from simple verbal threats to mass murder, as evidenced by the 1995 bombing of the US federal office building, Oklahoma City, Oklahoma. In 1997 a tribal police officer was killed while trying to serve a warrant on a Southwest Indian reservation. There is also a less discussed, but common, psychological violence that has been classed euphemistically as “office politics” that can have equally debilitating effects.

Physical. In the United States, attacks on federal, state and local governmental personnel who work in remote and semi-remote parks and recreation areas are not uncommon. The majority of these result in injury only, but some involve assaults with dangerous weapons. There have been instances where disgruntled members of the public have entered federal land-managing agencies’ offices brandishing firearms, threatened the employees and had to be restrained.

Such violence can result in injury ranging from minor to fatal. It can be inflicted by unarmed assault or the use of the widest variety of weapons, ranging from simple club and stick to handguns, rifles, knives, explosives and chemicals. It is not uncommon for such violence to be inflicted upon the vehicles and structures owned or used by the governmental agency that operates the park or recreational facility.

It is also not uncommon for disgruntled or dismissed employees to seek retaliation against current or former supervisors. It is also becoming common for outdoor recreation, forest and park employees to encounter persons growing and/or manufacturing illegal drugs in remote areas. Such persons do not hesitate to resort to violence to protect their perceived territory. Park and recreation personnel, particularly those involved in law enforcement, are required to deal with persons under the influence of drugs or alcohol who break the law and become violent when apprehended.

Psychological. Not as well publicized, but in some instances equally damaging, is

psychological violence. Commonly called “office politics”, it has been in use probably since the beginning of civilization to gain status over co-workers, gain an advantage in the workplace and/or weaken a perceived opponent. It consists of destroying the credibility of another person or group, usually without that other person or group being aware that it is being done.

In some instances, it is done openly, through the media, legislative bodies and so on, in an attempt to gain political advantage (for example, destroying the credibility of a governmental agency in order to cut its funding).

This usually has a significant negative result on the morale of the individual or group involved and, in rare, extreme instances, can cause a recipient of the violence to take his or her own life.

It is not uncommon for victims of violence to suffer from post-traumatic stress disorder, which may affect them for years. It has the same effect as “shell shock” among military personnel who have experienced prolonged and intense combat. It may require extensive psychological counselling.

Protective measures. Because of the constantly increased risk of encountering violence in the workplace, it is essential that employees receive extensive training in the recognition and avoidance of potentially dangerous situations, including training in how to deal with persons who are violent or out of control.

· Where possible, additional security needs to be added to high-density occupancy areas.

· Employees who work away from a standard office or shop location should be provided with two-way radio communication to be able to summon help when needed.

· In some instances, it may be necessary to train employees in the use of firearms and arm them for self-protection.

· Each agency responsible for managing park or outdoor recreation areas should conduct an annual security survey of all its facilities to determine current risk and what measures are necessary to protect employees.

· Management at all levels needs to exercise extra vigilance to counter the psychological risk whenever it occurs, seek out and correct unfounded rumours and assure that all employees have accurate facts concerning the operation and future plans of their agency and workplace.

Post-incidence assistance. It is equally essential, not only for the affected employees or employers, but all agency employees as well, that any employee subjected to on-the-job violence be given not only prompt medical attention, but equally prompt psychological assistance and stress counselling. The effects of

such violence can remain with the employee long after the physical wounds heal and can have a significant negative effect on his or her ability to function in the workplace.

As the population increases, the incidence of violence will increase. Preparation and prompt and effective response are, at present, the only remedies open to those at risk.

Conclusion

Because personnel are required to work in all types of environments, good health and physical fitness is essential. A consistent regimen of moderate physical training should be adhered to. Regular physical examinations, geared to the type of work to be performed, should be obtained. All personnel should be completely trained in types of work to be performed, the hazards involved and hazard avoidance.

Equipment should be maintained in sound operating condition.

All personnel expected to work in remote areas should carry two-way radio communication equipment and be in regular contact with a base station.

All personnel should have basic—and if possible, advanced—first aid training, including cardio-pulmonary resuscitation, in the event a visitor or co-worker is injured and medical help is not immediately available.

CIRCUSES AND AMUSEMENT AND THEME PARKS

William Avery

The common product shared between circuses and amusement and theme parks is creating and providing entertainment for the public's enjoyment. Circuses can take place in a large temporary tent equipped with bleachers or in permanent buildings. Attending a circus is a passive activity in which the customer views the various animal, clown and acrobatic acts from a seated position. Amusement and theme parks, on the other hand, are locations where customers actively walk around the park and can participate in a wide variety of activities. Amusement parks can have many different types of rides, exhibits, games of skill, sales booths and stores, grandstand shows and other types of entertainment. Theme parks have exhibits, buildings and even small villages that illustrate the particular theme. Costume characters, who are actors dressed in costumes illustrating the theme—for example, historical costumes in historic villages or cartoon costumes for parks with a cartoon theme—will participate in shows or walk around among the visiting crowds. Local country fairs are another type of event where activities can include rides, animal and other side shows, such as fire-eating, and agricultural and farm animal exhibitions and competitions. The size of the

operation can be as small as one person running a pony cart ride in a parking lot, or as large as a major theme park employing thousands. The larger the operation, the more background services that can be present, including parking lots, sanitation facilities, security and other emergency services and even hotels.

Occupations vary widely as do the levels of skills required for individual tasks. People employed in these activities include ticket sellers, acrobatic performers, animal handlers, food service workers, engineers, costume characters and ride operators, among a long list of other workers. The occupational safety and health risks include many of those found in general industry and others that are unique to circuses and amusement and theme park operations. The following information provides a review of entertainment-related hazards and precautions found within this segment of the industry.

Acrobatics and Stunts

Circuses, in particular, have many acrobatic and stunt acts, including high-wire tightrope walking and other aerial acts, gymnastic acts, fire-juggling acts and displays of horsemanship. Amusement and theme parks can also have similar activities. Hazards include falls, misjudged clearances, improperly inspected equipment and physical fatigue due to multiple daily shows. Typical accidents involve muscular, tendon and skeletal injuries.

Precautions include the following: Performers should receive comprehensive physical conditioning, proper rest and a good diet, and show schedules should be rotated. All equipment, props, rigging, safety devices and blocking should be carefully reviewed before each performance. Show personnel should not perform when they are ill, injured or taking medication which may affect required abilities to safely meet the needs of the show.

Animal Handling

Animals are most commonly found in circuses and county fairs, although they can also be found in activities such as pony rides in amusement parks. Animals are found in circuses in wild-animal training acts, for example, with lions and tigers, horse riding acts and other trained animal acts. Elephants are used as show performers, rides, exhibits and work animals. In country fairs, farm animals such as pigs, cattle and horses are exhibited in competitions. In some places, exotic animals are displayed in cages and in such acts as snake handling. Hazards include the unpredictable characteristics of animals combined with the potential for animal handlers to become overly confident and let their guard down. Serious injury and death are possible in this occupation. Elephant handling is considered one of the most dangerous professions. Some estimates indicate there are approximately 600 keepers in the United States and Canada. During the course of an average year there will be one elephant handler killed. Venomous snakes, if

used in snake-handling acts, can also be very dangerous, with possible fatalities from snake bites.

Precautions include intense and ongoing animal-handling training. It must be instilled in employees to remain on their guard at all times. The use of protected contact systems is recommended where keepers work alongside animals capable of causing serious injury or death. Protected contact systems always separate the animal handler and the animal by means of bars or closed-off areas. When animals perform on stage to live audiences, noise and other stimuli conditioning must be a part of the required safety training. With venomous reptiles, proper anti-venom antidotes and protective equipment such as gloves, leg guards, snake pincers and carbon dioxide bottles should be available. Care and feeding of animals when they are not being exhibited also requires careful attention on the part of the animal caretakers to prevent injury.

Costume Characters

Costume characters acting the role of cartoon figures or historical period characters often wear heavy and bulky costumes. They can act on stages or mingle with the crowds. Hazards are back and neck injuries associated with wearing such costumes with uneven weight distribution (figure 96.20). Other exposures are fatigue, heat-related problems, crowd pushing and hitting. See also “Actors”.

Figure 96.20 Worker wearing a heavy costume

William Avery

Precautions include the following: Costumes should be correctly fitted to the individual. The weight load, especially above the shoulders, should be kept at a minimum. Costume characters should drink plenty of water during periods of warm weather. Interaction with the public should be of short duration because of the stress of such work. Character duties should be rotated, and non-costumed escorts should be with characters at all times to manage crowds.

Fireworks

Fireworks displays and pyrotechnics special effects can be a common activity (figure 96.21). Hazards can involve accidental discharge, non-planned explosions and fire.

Figure 96.21 Loading pyrotechnics for fireworks show

William Avery

Precautions include the following: Only appropriately trained and licensed pyrotechnicians should detonate explosives. Storage, transportation and detonation procedures must be followed (figure 96.22). Applicable codes, laws and ordinances in the jurisdiction where operating must be adhered to. Pre-approved personal safety equipment and fire extinguishing equipment must be at the detonation site where there is immediate access.

Figure 96.22 Bunker storage for fireworks

William Avery

Food Service

Food can be bought at circuses and amusement and theme parks from individuals with trays of food, at vendor carts, booths, or even restaurants. Hazards common to food service operations at these events involve serving large captive audiences during high periods of demand in a very short period of time. Falls, burns, cuts and repetitive motion trauma are not uncommon in this occupational classification. Carrying food around on trays can involve back injuries. The risks are increased during periods of high volume. A common example of injury occurring in high-volume food service areas is repetitive motion trauma that can result in tendinitis and carpal tunnel syndrome. One example of a job description where such injuries occur is an ice-cream scooper.

Precautions include the following: Increased staffing during high-volume periods is essential to the safety of the operation. Specific duties such as mopping, sweeping and cleaning should be addressed. Precautions for repetitive motion trauma: regarding the example given above, using softer ice cream can make scooping less strenuous, employees can be regularly rotated, scoops can be warmed to promote easier penetration of the ice cream and the use of ergonomically designed handles should be considered.

Scenery, Props and Exhibits

Stage shows, exhibits, booths, artificial scenery and buildings must be built. Hazards include many of the same hazards as found in construction, including

electrocution, severe lacerations, and eye and other injuries associated with the use of power tools and equipment. The outdoor building and use of props, scenery and exhibits increases the potential hazards such as collapse if construction is inadequate. Handling of these components can result in falls and back and neck injuries (see also “Scenery shops” in this chapter).

Precautions include the following: The manufacturer’s warnings, safety equipment recommendations and safe operating instructions for power tools and machinery must be followed. The weight of props and their sections should be minimized to reduce the possibility of lifting-associated injuries. Props, scenery and exhibits designed for outdoor use must be reviewed for wind load ratings and other outdoor exposures. Props designed for use with live loads should be appropriately rated and the built-in safety factor verified. Fire rating of the material should be considered based on the intended use, and any fire regulations that may be applicable must be followed.

Ride Operators and Maintenance Personnel

There are a wide variety of amusement park rides, including Ferris wheels, roller coasters, water flume rides, looping boats and aerial tramways. Ride operators and maintenance personnel work in areas and under conditions where there are increased risks of serious injury. The exposures include electrocution, being struck by equipment and caught in or between equipment and machinery. Besides the rides, ride and maintenance personnel must also operate and maintain the associated electrical power plants and transformers.

Precautions include an effective programme that can reduce the potential for serious injury in a lock out, tag out and block out procedure. This programme should include: personally assigned padlocks with single keys; written procedures for working on electrical circuitry, machinery, hydraulics, compressed air, water and other sources of possible energy release; and tests to ensure that the energy supply has been shut off. When more than one person is working on the same piece of equipment, each person should have and use his or her own lock.

Travelling Shows

Circuses and many amusement rides can travel from one location to another. This can be by truck for small operations, or by train for large circuses. Hazards include falls, severed body parts and possible death during erection, dismantling or transportation of equipment (figure 96.23). A particular problem is expedited work procedures, resulting in skipping time-consuming safety procedures, in an effort to meet play date deadlines.

Figure 96.23 Erecting an amusement park ride with a crane

William Avery

Precautions include the following: Employees must be well trained, exercise caution and follow manufacturer's safety instructions for assembly, dismantling, loading, unloading and transportation of the equipment. When animals are used, such as an elephant to pull or push heavy equipment, additional safety precautions are required. Equipment such as cables, ropes, hoists, cranes and fork-lifts should be inspected before each use. Over-the-road drivers must follow highway transportation safety guidelines. Employees will require additional training in safety and emergency procedures for train operations where animals, personnel and equipment travel together.

BULLFIGHTING AND RODEOS

Michael McCann

Bullfighting, or the corrida as it is commonly called, is popular in Spain, Spanish-speaking countries in Latin America (especially Mexico), southern France and Portugal. It is highly ritualized, with pageants, well-defined ceremonies and colourful traditional costumes. Matadors are highly respected and often begin their training at an early age in an informal apprenticeship system.

Rodeos, on the other hand, are a more recent sports event. They are an outgrowth of skills contests between cowboys illustrating their everyday activities. Today, rodeos are formalized sports events popular in the western United States, western Canada and Mexico. Professional rodeo cowboys (and some cowgirls) travel the rodeo circuit from one rodeo to another. The most common rodeo events are

bronco riding, bull riding, steer wrestling (bulldogging) and calf roping.

Bullfights. Participants in a bullfight include the matadors, their assistants (the banderilleros and picadors) and the bulls. When the bull first enters the arena from the bull pen gate, the matador attracts its attention with a series of passes with his large cape. The bull is attracted by the movement of the cape, not the colour, since bulls are colour-blind. The matador's reputation is based on how close he gets to the horns of the bull. These fighting bulls have been bred and trained for centuries for their aggressiveness. The next part of the bullfight involves the weakening of the bull by mounted picadors placing lances in the bull, and then banderilleros, working on foot, placing barbed sticks called banderillas in the bull's shoulder in order to lower the bull's head for the kill.

The final stage of the fight involves the matador trying to kill the bull by inserting his sword blade between the shoulder blades of the bull into the aorta. This stage involves many formalized passes with the cape before the final kill. The greater the risks taken by the matador, the greater the acclaim, and of course the greater the risk of being gored (see figure 96.24). Bullfighters generally receive at least one goring per season, which could involve as many as 100 bullfights per year per matador.

Figure 96.24 Bullfighting

El País

The primary hazard facing the matadors and their assistants is being gored or even killed by the bull. Another potential hazard is tetanus from being gored. One

epidemiological study in Madrid, Spain, indicated that only 14.9% of bullfighting professionals had complete anti-tetanus vaccination, while 52.5% had suffered occupational injuries (Dominguez et al. 1987). Few precautions are taken. The mounted picadors wear steel leg armour. Otherwise, the bullfighting professionals depend on the training and skills of themselves and their horses. One essential precaution is adequate planning for onsite emergency medical care (see “Motion picture and television production” in this chapter).

Rodeos. The most hazardous common rodeo events are bronco or bull riding and steer wrestling. In bronco or bull riding, the purpose is to stay on the bucking animal for a predetermined time. Bronco riding can be either bareback or with a saddle. In steer wrestling, a rider on horseback attempts to throw the steer to the ground by diving off the horse, grabbing the bull by its horns and wrenching it to the ground. Calf roping involves roping a calf from horseback, jumping off the horse and then hog-tying the front and back legs of the calf together in the shortest possible time.

Besides the rodeo contestants, those at risk include the pickup riders or outriders, whose role is to rescue the thrown rider and capture the animal, and the rodeo clowns, whose job is to distract the animal, especially bulls, to give the thrown rider a chance to escape (figure 96.25). They do this while on foot and dressed in a colourful costume to attract the animal’s attention. Hazards include being trampled, being gored by the bull’s horns, injuries from being bucked off, knee injuries from jumping off the horse, elbow injuries in bronco and bull riders from holding on to the animal with one hand and facial injuries from bulls tossing their heads back. Injuries also occur from bronco or bull riders being smashed against the sides of the chute while waiting for the gate to open and the animal to be released. Severe injuries and fatalities are not infrequent. Bull riders sustain 37% of all rodeo-related injuries (Griffin et al. 1989). In particular, brain and spinal cord injuries are of concern (MMWR 1996). One study of 39 professional rodeo cowboys showed a total of 76 elbow abnormalities in 29 bronco and bull riders (Griffin et al. 1989). They concluded that the injuries were a result of constant hyperextension of the arm gripping the animal, as well as injuries in falls.

Figure 96.25 Rodeo clown distracting a bull from a fallen rider

Dan Hubbell

The main way of preventing injuries lies in the skills of the rodeo cowboys, pickup riders and rodeo clowns. Well-trained horses are also essential. Taping elbows and wearing elbow pads has also been recommended for bronco and bull riding. Safety vests, mouth guards and safety helmets are rare, but becoming more accepted. Face masks have occasionally been used for bull riding. As in bullfighting, an essential precaution is adequate planning for on-site emergency medical care.

In both rodeos and bullfighting, of course, the animal keepers, feeders and so on are also at risk. For more information on this aspect, see “Zoos and aquariums” in this chapter.

PROFESSIONAL SPORTS

Gordon Huie, Peter J. Bruno and W. Norman Scott

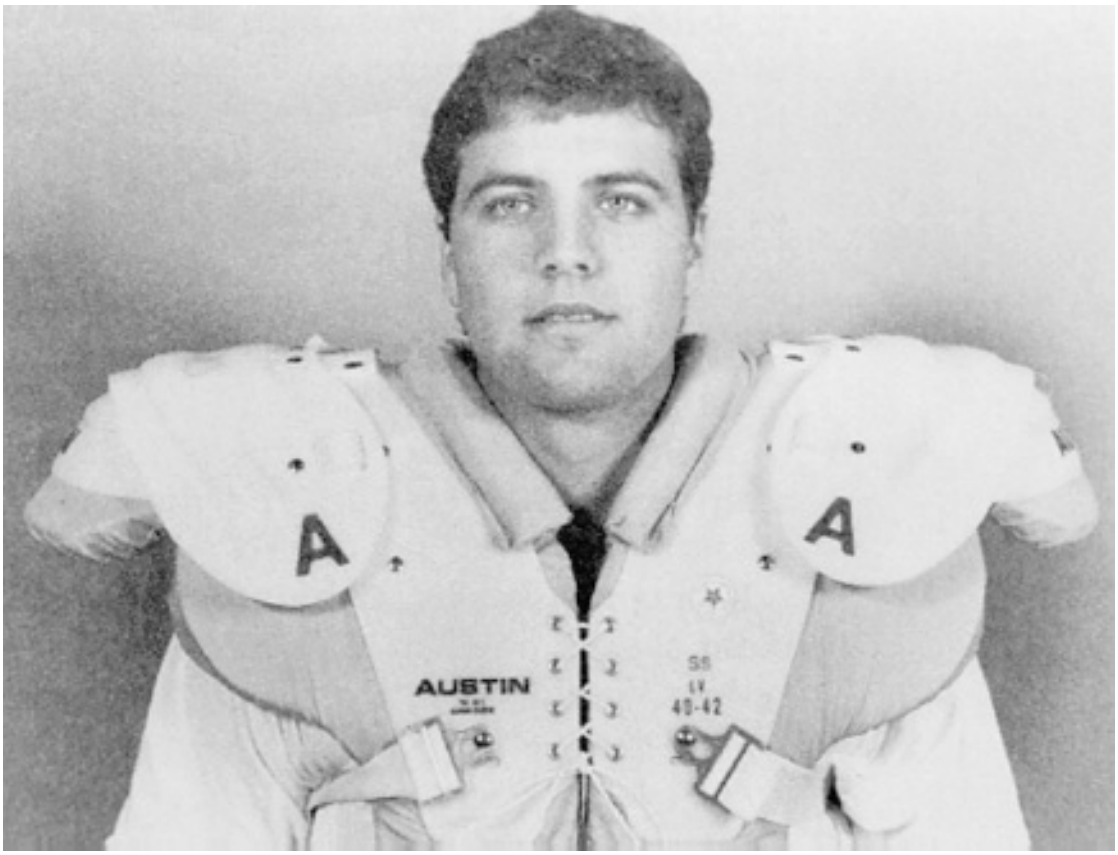
Sports activities involve a great number of injuries. Precautions, conditioning and safety equipment, when used properly, will minimize sports injuries.

In all sports, conditioning year round is encouraged. Bone, ligaments and muscles respond in a physiological fashion by gaining both size and strength (Clare 1990). This increases the athlete’s agility to avoid any injurious physical contact. All sports requiring weightlifting and strengthening should be under the supervision of a strength coach.

Contact Sports

Contact sports such as American football and hockey are particularly dangerous. The aggressive nature of football requires the player to strike or tackle the opposing player. The focus of the game is to possess the ball with the intent of physically striking anyone in one's path. The equipment should be well-fitting and offer adequate protection. (figure 96.26). The helmet with appropriate face mask is standard and is critical in this sport (figure 96.27). It should not slide or twist and the straps should be applied snugly (American Academy of Orthopedic Surgeons 1991).

Figure 96.26 Snug fitting football pads



Source: American Academy of Orthopedic Surgeons 1991

Figure 96.27 American football helmet

Source: Clare 1990

Unfortunately, the helmet is sometimes used in an unsafe manner whereby the player “spears” an opponent. This can lead to cervical spine injuries and possible paralysis. It can also lead to careless play in sports like hockey, when players feel they can be more free with the use of their stick and risk slashing the face and body of the opponent.

Knee injuries are quite common in football and basketball. In minor injuries, an elastic “sleeve” (figure 96.28) which provides compressive support may be useful. The ligaments and cartilage of the knee are prone to stress as well as impact trauma. The classic combination of cartilage and ligamentous insult was first described by O’Donoghue (1950). An audible “pop” may be heard and felt, followed by swelling, if there are ligament injuries. Surgical intervention may be needed before the player may resume activities. A derotational brace may be worn post-operatively and by players with partial tear of the anterior cruciate ligament but with enough intact fibres able to sustain their activities. These braces must be well padded to protect the injured extremity and other payers (Sachare 1994a)

Figure 96.28 Patella cut-out sleeve

Huie, Bruno and Norman Scott

In hockey, the velocity of both the players and the hard hockey puck warrants the use of protective padding and helmet (figure 96.29). The helmet should have a face shield to prevent facial and dental injuries. Even with helmets and protective padding to vital areas, severe injuries such as fractures of extremities and spine do occur in football and hockey.

Figure 96.29 Padded hockey gloves

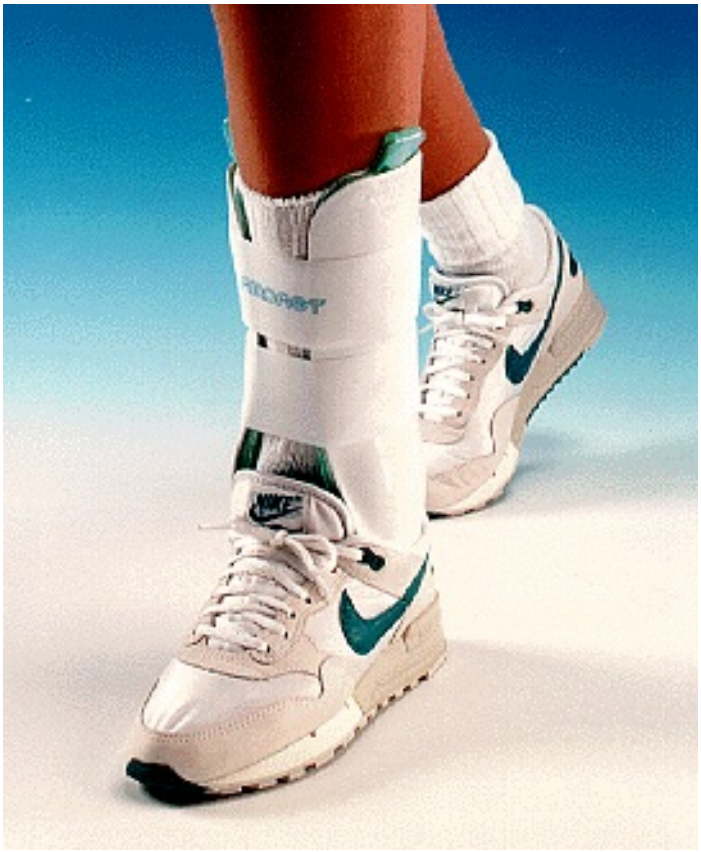
In both American football and hockey, a complete medical kit (which includes diagnostic instruments, resuscitation equipment, immobilization devices, medication, wound care supplies, spine board and stretcher) and emergency personnel should be available (Huie and Hershman 1994). If possible, all contact sports should have this available. Radiographs should be obtained of all injuries to rule out any fractures. Magnetic resonance imaging has been found to be very helpful in determining soft tissue injuries.

Basketball

Basketball is also a contact sport, but protective equipment is not worn. The focus of the player is to have possession of the ball and their intent is not to strike the opposing players. Injuries are minimized due to the player's conditioning and speed in averting any hard contact.

The most common injury to the basketball player are ankle sprains. Evidence of ankle sprains has been noted in about 45% of players (Garrick 1977; Huie and Scott 1995). The ligaments involved are the deltoid ligament medially and the anterior talofibular, posterior talofibular, and calcaneofibular ligaments laterally. X rays should be obtained to rule out any fractures which may occur. These radiographs should include the entire lower leg to rule out a Maisonneuve fracture (VanderGriend, Savoie and Hughes 1991). In the chronically sprained ankle, use of a semi-rigid ankle stirrup will minimize further insult to the ligaments (figure 96.30).

Figure 96.30 Rigid ankle stirrup



AirCast

Finger injuries may result in ruptures of the supporting ligamentous structures. This can result in a Mallet finger, Swann Neck deformity and Boutonierre deformity (Bruno, Scott and Huie 1995). These injuries are quite common and are due to direct trauma with the ball, other players and the backboard or rim. Prophylactic taping of ankles and fingers helps minimize any accidental twisting and hyperextension of the joints.

Facial injuries (lacerations) and fractures of the nose due to contact with opponents' flailing arms or bony prominences, and contact with the floor or other stationary structures have been encountered. A clear light-weight protective mask may help in minimizing this type of injury.

Baseball

Baseballs are extremely hard projectiles. The player must always be cognizant of the ball not only for safety reasons but for the strategy of the game itself. Batting helmets for the offensive player, and chest protector and catcher's mask/helmet (figure 96.31). for the defensive player are required protective equipment. The ball is hurled at times in excess of 95 mph, sometimes resulting in bone fractures. Any head injuries should have a full neurological work-up, and, if loss of consciousness is present, radiographs of the head should be taken.

Figure 96.31 Protective catcher's mask

Huie, Bruno and Norman Scott

Soccer

Soccer can be a contact sport resulting in trauma to the lower extremity. Ankle injuries are very common. The protection that would minimize this would be taping and the use of a semi-rigid ankle stirrup. It has been found that the effectiveness of the taped ankle diminishes after about 30 minutes of vigorous activities. Tears of the anterior cruciate ligament of the knee are often encountered and most likely will require a reconstructive procedure if the player wishes to continue participating in this sport. Anterior medial tibial stress syndrome (shin splints) is extremely common. The hypothesis is that there may be an inflammation to the periosteal sleeve around the tibia. In extreme situations, a stress fracture may occur. The treatment requires rest for 3 to 6 weeks and the use of non-steroidal anti-inflammatory drugs (NSAID), but high-level and professional-level players tend to compromise the treatment once the symptoms diminish as early as 1 week and thus go back to the impact activity. Hamstring pulls and groin pulls are common in the athletes who do not permit enough time to warm and stretch the musculature of the legs. Direct trauma to the lower extremities, particularly the tibia, may be minimized with the use of anterior shin guards.

Skiing

Skiing as a sport does not require any protective equipment, although goggles are encouraged to prevent eye injuries and to filter out the sun's glare off the snow. Ski boots offer a rigid support for the ankles and have a "quick-release"

mechanism in the event of a fall. These mechanisms, although helpful, are susceptible to circumstances of the fall. During the winter season, many injuries to the knee resulting in ligament and cartilage damage are encountered. This is found in the novice as well as the seasoned skier. In professional downhill skiing, helmets are required to protect the head due to the velocity of the athlete and the difficulty of stopping in the event the trajectory and direction are miscalculated.

Martial Arts and Boxing

Martial arts and boxing are hard contact sports, with little or no protective equipment. The gloves used on the professional boxing level are, however, weighted, which increases their effectiveness. Head guards at the amateur level help soften the impact of the blow. As with skiing, conditioning is extremely important. Agility, speed and strength minimize the combatant's injuries. The blocking forces are deflected more than absorbed. Fractures and soft tissue insults are very common in this sport. Similar to volleyball, the repetitive trauma to the fingers and carpal bones of the hand results in fractures, subluxation, dislocation and ligamentous disruptions. Taping and padding of the hand and wrist may provide some support and protection, but this is minimal. Studies have shown that long-term brain damage is a serious concern for boxers (Council on Scientific Affairs of the American Medical Association 1983). Half of a group of professional boxers with more than 200 fights each had neurological signs consistent with traumatic encephalopathy.

Horse Racing

Horse racing at the professional and amateur levels requires a riding helmet. These helmets offer some protection for head injuries from falls, but they offer no attachment for the neck or spine. Experience and common sense help minimize falls, but even seasoned riders can sustain serious injuries and possibly paralysis if they land on their head. Many jockeys today also wear protective vests since being trampled under horses' hooves is a major risk in falls and has resulted in fatalities. In harness racing, where horses pull two-wheeled carts called sulkies, collisions between sulkies has resulted in multiple pile-ups and serious injuries. For hazards to stable hands and others involved in handling the horses, see the chapter Livestock rearing.

First Aid

As a general rule, immediate icing (figure 96.32), compression, elevation and NSAIDs following most injuries will suffice. Pressure dressings should be applied to any open wounds, followed by an evaluation and suturing. The player should be removed from the game immediately to prevent any blood-borne contamination to other players (Sachare 1994b). Any head trauma with loss of consciousness should have a mental status and neurological work-up.

Figure 96.32 Cold compressive therapy

AirCast

Physical Fitness

Professional athletes with asymptomatic or symptomatic cardiac conditions may be hesitant in disclosing their pathology. In recent years, several professional athletes have been found to have cardiac problems that resulted in their deaths. The economic incentives of playing professional-level sports may inhibit athletes from disclosing their conditions for fear of disqualifying themselves from strenuous activities. Carefully obtained past medical and family histories followed by EKG and treadmill stress tests prove to be valuable in detecting those who are at risk. If a player is identified as a risk and still wishes to continue competing regardless of the medical-legal issues, emergency resuscitative equipment and trained personnel must be present at all practices and games.

Referees are present not only to keep the flow of the game going but to protect the players from hurting themselves and others. Referees, for the most part, are objective and have the authority to suspend any activity should an emergency condition arise. As with all competitive sports, emotion and adrenaline are flowing high; the referees are present to help the players harness these energies in a positive fashion.

Proper conditioning, warm-up and stretching prior to engaging in any competitive activity is vital to the prevention of strains and sprains. This procedure enables the muscles to perform at peak efficiency and minimizes the

possibilities of strains and sprains (micro-tears). Warm-ups may very well be a simple jog or callisthenics for about 3 to 5 minutes followed by gentle stretching out of the extremities for an additional 5 to 10 minutes. With the muscle at its peak efficiency, the athlete may be able to quickly manoeuvre away from a threatening position.

SEX INDUSTRY

Priscilla Alexander

The sex industry is a major industry both in developing countries, where it is a major source of foreign currency, and in industrialized countries. The two main divisions of the sex industry are (1) prostitution, which involves the direct exchange of a sexual service for money or other means of economic compensation and (2) pornography, which involves the performance of sex-related tasks, sometimes involving two or more people, for still photographs, in motion pictures and videotapes, or in a theatre or nightclub, but does not include direct sexual activity with the paying client. The line between prostitution and pornography is not very clear, however, as some prostitutes restrict their work to erotic acting and dance for private clients, and some workers in the pornography industry go beyond display to engaging in direct sexual contact with members of the audience, for example, in strip- and lap-dancing clubs.

The legal status of prostitution and pornography varies from one country to another, ranging from complete prohibition of the sex-money exchange and the businesses in which it takes place, as in the United States; to decriminalization of the exchange itself but prohibition of the businesses, as in many European countries; to toleration of both independent and organized prostitution, for example, in the Netherlands; to regulation of the prostitute under public health law, but prohibition for those who fail to comply, as in a number of Latin American and Asian countries. Even where the industry is legal, governments have remained ambivalent and few, if any, have attempted to use occupational safety and health regulations to protect the health of sex workers. However, since the early 1970s, both prostitutes and erotic performers have been organizing in many countries (Delacoste and Alexander 1987; Pheterson 1989), and have increasingly addressed the issue of occupational safety as they attempt to reform the legal context of their work.

A particularly controversial aspect of sex work is the involvement of young adolescents in the industry. There is not enough space to discuss this at any length here, but it is important that solutions to the problems of adolescent prostitution be developed in the context of responses to child labour and poverty, in general, and not as an isolated phenomenon. A second controversy has to do with the extent to which adult sex work is coerced or the result of individual decision. For the vast majority of sex workers, it is a temporary occupation, and

the average worklife, worldwide, is from 4 to 6 years, including some who work only for a few days or intermittently (e.g., between other jobs), and others who work for 35 years or more. The primary factor in the decision to do sex work is economics, and in all countries, work in the sex industry pays much better than other work for which extensive training is not required. Indeed, in some countries, the higher-paid prostitutes earn more than some physicians and attorneys. It is the conclusion of the sex workers' rights movement that it is difficult to establish issues like consent and coercion when the work itself is illegal and heavily stigmatized. The important thing is to support sex workers' ability to organize on their own behalf, for example, in trade unions, professional associations, self-help projects and political advocacy organizations.

Hazards and Precautions

Sexually transmitted diseases (STDs). The most obvious occupational hazard for sex workers, and the one which has received the most attention historically, is STDs, including syphilis and gonorrhoea, chlamydia, genital ulcer disease, trichomonas and herpes, and, more recently, the human immunodeficiency virus (HIV) and AIDS.

In all countries, the risk of infection with HIV and other STDs is greatest among the lowest-income sex workers, whether on the street in the industrial countries, in low-income brothels in Asia and Latin America or in residential compounds in impoverished communities in Africa.

In industrialized countries, studies have found HIV infection among female prostitutes to be associated with injecting drug use by either the prostitute or her ongoing personal partner, or with the prostitute's use of "crack", a smokeable form of cocaine—not with the number of clients or with prostitution per se. There have been few if any studies of pornography workers, but it is likely to be similar. In developing countries, the primary factors are less clear, but may include a higher prevalence of untreated conventional STDs, which some researchers think facilitate transmission of HIV, and a reliance on informal street vendors or poorly equipped clinics for treatment of STDs, if treatment involves injections with unsterile needles. Injection of recreational drugs is also associated with HIV infection in some developing countries (Estébanez, Fitch and Nájera 1993). Among male prostitutes, HIV infection is more often associated with homosexual activity, but is also associated with injecting drug use and sex in the context of drug dealing.

Precautions involve the consistent use of latex or polyurethane condoms for fellatio and vaginal or anal intercourse, where possible with lubricants (water-based for latex condoms, water or oil-based for polyurethane condoms), latex or polyurethane barriers for cunnilingus and oral-anal contact and gloves for hand-genital contact. While condom use has been increasing among prostitutes in most countries, it is still the exception in the pornography industry. Women

performers sometimes use spermicides to protect themselves. However, while the spermicide nonoxynol-9 has been shown to kill HIV in the laboratory, and reduces the incidence of conventional STD in some populations, its efficacy for HIV prevention in actual use is far less clear. Moreover, the use of nonoxynol-9 more than once a day has been associated with significant rates of vaginal epithelial disruption (which could increase the female sex worker's vulnerability to HIV infection) and sometimes an increase in vaginal yeast infections. No one has studied its use for anal sex.

Access to sex worker–sensitive health care is also important, including care for other health problems, not just STDs. Traditional public health approaches that involve mandatory licensing or registration, and regular health examinations, have not been effective in reducing the risk of infection for the workers, and are contrary to World Health Organization policies that oppose mandatory testing.

Injuries. Although there have not been any formal studies of other occupational hazards, anecdotal evidence suggests that repetitive stress injuries involving the wrist and shoulder are common among prostitutes who do "hand jobs", and jaw pain is sometimes associated with performing fellatio. In addition, street prostitutes and erotic dancers may develop foot, knee and back problems related to working in high heels. Some prostitutes have reported chronic bladder and kidney infections, due to working with a full bladder or not knowing how to position oneself to prevent deep penetration during vaginal intercourse. Finally, some groups of prostitutes are very vulnerable to violence, especially in countries where the laws against prostitution are heavily enforced. The violence includes rape and other sexual assault, physical assault and murder, and is committed by police, clients, sex work business managers and domestic partners. The risk of injury is greatest among younger, less experienced prostitutes, especially those who begin working during adolescence.

Precautions include ensuring that sex workers are trained in the least stressful way to perform different sexual acts to prevent repetitive stress injuries and bladder infections, and self-defence training to reduce vulnerability to violence. This is particularly important for young sex workers. In the case of violence, another important remedy is to increase the willingness of police and prosecuting attorneys to enforce the laws against rape and other violence when the victims are sex workers.

Alcohol and drug use. When prostitutes work in bars and nightclubs, they are often required by management to encourage clients to drink, as well as to drink with clients, which can be a serious hazard for individuals who are vulnerable to alcohol addiction. In addition, some begin to use drugs (e.g., heroin, amphetamines and cocaine) to help deal with the stress of their work, while others used drugs prior to beginning sex work, and turned to sex work in order to pay for their drugs. With injecting drug use, vulnerability to HIV infection, hepatitis and a range of bacterial infections increases if drug users share needles.

Precautions include workplace regulations to ensure that prostitutes can drink non-alcoholic beverages when with clients, the provision of sterile injection equipment and, where possible, legal drugs to sex workers who inject drugs, and increasing access to drug and alcohol addiction treatment programmes.

NIGHTLIFE ENTERTAINMENT

Angela Babin

This grouping of extremely varied and miscellaneous entertainment occupations includes work locations such as bars, nightclubs, discotheques, dancehalls, topless bars, go-go clubs, casinos, bingo and gambling parlours, and pool halls, as well as cinema theatres. Occupations include bartenders, waiters, hostess/host, card dealers, bouncers (security personnel), musicians, dancers, strippers and movie projectionists. Hotels and restaurants often have night entertainment venues within them. There are several categories of hazards common to almost all nightlife entertainment workers.

Shiftwork. Entertainment workers such as bartenders may have routine nightshifts, while musicians working in a club may have irregular shifts. Various physiological, psychological and social effects are associated with nightshift or irregular shiftwork. Often bartenders and cocktail waitresses work shifts that are 10 to 14 hours long.

Violence. Workplace violence is a major problem in establishments that serve alcohol, as well as in gambling enterprises. The United States National Institute for Occupational Safety and Health studied homicide rates among workers in the United States during 1980–1989. They found bartenders to be ranked the eighth highest occupational group, with a homicide rate of 2.1 per 100,000, compared to the average homicide rate of 0.7 homicides per 100,000 for all workers. The exchange of money with the public, often working alone or in small numbers and working late at night or early in the morning, as well as working in high-crime areas, were all found to be factors related to the high rate. Preventive measures for lowering the violence rate include increasing the visibility of the workplace, such as by installing better lighting. The amounts of cash on hand should be minimized and signs posted which clearly indicate that little or no cash in on hand. Silent alarms and hidden cameras can be installed and workers can be trained in non-violent response techniques for emergencies, such as robberies. Arrangements can be made for having routine police checks on workers' safety, and workers may even be provided bullet-proof barriers and vests if needed.

Fire Safety. Many smaller nightclubs, dancehalls, movie theatres and bars may not meet with local assembly, building or fire code requirements. There have been several high-profile fatal fires in urban clubs, which are often more crowded than permissible by law. Adherence to fire and assembly codes, a fire safety and

emergency programme and availability of fire extinguishers and training in their use, as well as other emergency procedures, can reduce risks (Malhotra 1984).

Second-hand smoke. In many locations where there is nightlife entertainment, second-hand cigarette smoke is a significant hazard. The risk of lung cancer and heart disease is increased with exposure to cigarette smoke in the workplace (NIOSH 1991). The risk of laryngeal cancer, also associated with tobacco use, is elevated in bartenders and food servers. Often, smaller bars and night entertainment clubs do not have adequate ventilation for cigarette smoke. In many countries, efforts are being made to regulate exposure to second-hand smoke; but such governmental restriction are not universal. Ventilation and air cleaning devices, such as electrostatic precipitators, as well as the restriction of smoking will decrease exposure.

Alcohol and drug abuse. Working in certain occupations has been found to be correlated to increased alcohol consumption, and one suggestive study has found that death from liver cirrhosis, a disease associated with alcohol consumption, is elevated among waiters, bartenders and musicians (Olkinuora 1984). In nightlife entertainment work there is easy access to alcohol and a social pressure to drink. Often there is isolation from a usual homelife because of working during the night shift or because of touring through different locations. Poor management and lack of supervision can contribute to the problem. Performance anxiety (in the case of musicians), or the need to stay awake during night shift, as well as the fact that patrons may be apt to abuse drugs, can also increase the risks for drug abuse among workers in the nightlife environment. The risks for alcohol and drug abuse intervention programmes can be decreased by well-designed training programmes which assist workers dealing with these problems.

Noise. Excessive noise exposure can be a problem in bars and restaurants. While the problem of noise is obvious in discotheques and music clubs which feature excessively high sound levels, noise overexposure can also be a problem in bars and other locations in which there is only pre-recorded or jukebox music, which can also be played very loudly. Sound levels of over 100 decibels (dB) are common in discos (Tan, Tsang and Wong 1990). One survey of 55 nightclubs in New Jersey in the United States revealed noise levels from 90 to 107 dB. Placement of speakers and jukeboxes away from work stations can reduce worker exposure, and acoustic baffling and barriers can also help. In some cases a general reduction in volume may be possible. If possible, wearing ear plugs can reduce worker exposure.

Dermatitis. Nightlife workers share many skin problems with food handlers. Skin infections, such as candidiasis of the hands, can arise from extensive contact with soiled glassware, washing and cleaning fluids and water. Automatic dish- and glass-washing equipment can address this problem. Food sensitivities are also known, such as contact dermatitis in a bartender with a sensitivity to lemon and lime peels (Cardullo, Ruszkowski and Deleo 1989). Bartenders have developed eczema from handling mint. Other specific sensitivities leading to dermatitis

have been reported, such as dermatitis in a professional blackjack dealer who developed a sensitivity to chromate salts used in the green dye for the felt on gaming tables (Fisher 1976).

Musculoskeletal problems. Repetitive motion injuries and other problems associated with workplace design can be found among nightlife workers. For example, musicians and dancers are prone to specific musculoskeletal problems, as discussed elsewhere in this chapter. Bartenders who continually wash glassware and card dealers who must shuffle and deal cards for games in casinos have been found to suffer from carpal tunnel syndrome. More frequent breaks during shifts, in addition to job and task redesign, may reduce these hazards. Bartenders, cocktail waitresses, casino dealers and food servers often must stand for their entire workshift, which may be 10 to 12 hours long. Excessive standing can result in back strain and other circulatory and musculoskeletal problems. Corrugated rubber floor mats and comfortable, supportive shoes can lessen the strain.

Film projection booths. Projection booths are small and problems of excessive heat can arise. Older film projection booths use a carbon arc light source to project images, while more modern booths employ xenon lamps. In either case, ultraviolet (UV) radiation and ozone gas exposure can occur. Levels of ozone that ranged from 0.01 to 0.7 parts per million have been reported. The ozone is generated by the UV radiation, which ionizes oxygen found in the air. (Maloy 1978). In addition, use of carbon arc light sources is associated with rare earth metal fumes, carbon dioxide, carbon monoxide, ozone, electromagnetic radiation (EMF) and heat exposures. Local exhaust ventilation is required.

Special effects. Many different special effects can be used in clubs and discotheques, including, various smokes and fogs, laser light shows and even pyrotechnics. Adequate training in laser operation and safety and other special effects is necessary. UV light emitted from “black” lights may pose additional hazards, especially to strippers and go-go dancers (Schall et al. 1969). It has been suggested that a glass barrier between the black light and the performers would help decrease the hazards. These effects are described in more detail in other articles in this chapter.

ENVIRONMENTAL PROTECTION AND PUBLIC HEALTH ISSUES

Michael McCann

Visual Arts

The visual arts produce a wide range of potential environmental problems and raise a number of public health issues. The visual arts use a broad range of

chemicals and techniques which can create air and water pollution problems similar to that of the comparable industrial processes, only on a much smaller scale.

Hazardous waste produced by artists can include: (1) toxic and extremely toxic wastes, including solvents, lead compounds, chromates and cyanide solutions; (2) flammable waste, including flammable and combustible liquids (e.g., rags soaked with oil and turpentine), oxidizing substances such as potassium chlorate and dichromates, and ignitable compressed gases; (3) corrosive waste, including acids with a pH less than 2 and alkalis with a pH greater than 12; and (4) reactive wastes, such as organic peroxides, cyanide solutions and sulphide solutions. Artists and artisans are less likely, however, to know how to dispose of this waste or even to know what is hazardous. The most common method of waste disposal for artists is pouring down the sink or onto the ground, tossing in the garbage or evaporation. Although the individual amounts of pollutants are small, cumulatively they can result in significant pollution.

In the United States and Canada and many other countries, artists working in their homes are usually exempted from industrial hazardous waste regulations under a household hazardous waste exemption. Many localities, however, do provide special household hazardous waste days when households can bring their hazardous waste to a central site for collection. However, even in countries which do regulate artists as small businesses, there is little enforcement of hazardous waste regulations for these cottage industries.

Types of waste management methods available include many of the same ones used by industry, including source reduction, waste separation and concentration, recycling, energy and material recovery, incineration or treatment, and secure land disposal. Some of these methods are more available to artists than others.

The best way of managing hazardous waste is to actually eliminate or minimize its production by substituting materials which are less toxic—for example, using lead-free glazes instead of leaded glazes in pottery and enamelling, and using water-based screen printing inks and other coating materials instead of solvent-based ones.

Separating hazardous materials from non-hazardous materials—for example, separating solvent-based paints and water-based paints—can be a simple method to reduce the amount of hazardous waste and prevent it from contaminating regular garbage.

Traditional industrial methods of concentration, such as evaporation of large volumes of photographic wastes, are usually not feasible for artists.

Recycling can involve the reusing of materials (such as solvents used for oil

painting cleanup) by the individual, or the passing of unwanted materials to someone else who can use them. Large printmaking facilities, which generate many solvent- or oil-soaked rags, can contract for laundering and reuse them.

Treatment can involve several processes. The most common one used by artists is neutralization of acids or alkaline solutions. Incineration is usually restricted to burning wood dust. Evaporation of solvents is also commonly done. This reduces the amount of hazardous waste potentially contaminating water supplies, although it does contaminate the atmosphere to some degree.

The least favourable option is secure land disposal in a proper hazardous waste disposal site. This is usually not a viable option for artists, especially in developing countries.

A public health issue that is common to many of the visual arts is the problem of the exposure of children to toxic chemicals found in many art materials, including those intended for use by children. Examples include solvents in permanent felt-tip markers and lead in ceramic glazes. Children and other family members can be exposed to hazardous substances and conditions in the home.

A widespread problem in many countries is lead poisoning, including fatalities from cooking and storing food in containers that have been made with lead-containing pottery glazes. In the commercial industry, the problem of lead leaching from glazed pottery has been mostly eliminated through government regulations and good quality control. The World Health Organization has standards for lead and cadmium leaching from pottery intended for food and drink use. The cost of the testing required, however, is not feasible for craft potters, and therefore craft potters should use only lead-free glazes for food and drink containers.

Performing and Media Arts

Theatres, scenery shops and motion picture and television production areas also can produce hazardous waste, since they use many of the same chemicals as are used in the visual arts. The same solutions apply. In particular, the widespread shift from solvent-based paints to water-based paints has greatly decreased the amount of solvent pollution.

One of the main public health issues for theatres (and other places of public assembly) is fire safety. Many theatres and other performance spaces, especially small, non-commercial ones, do not meet applicable fire codes and are dangerously overcrowded. There have been many disastrous fires with numerous fatalities in the performing arts. The use of fogs and smokes for special effects in theatre and opera can also pose the risk of asthma attacks in asthmatic audience members in the front of the theatre if the building does not have adequate exhaust ventilation to prevent the fog or smoke from affecting the audience.

Entertainment Industry

Entertainment industries such as amusement and theme parks can face all the solid waste and other pollution problems of a small town. Zoos, circuses and other types of entertainment involving animals can have many of the same pollution problems as livestock raising, but on a smaller scale.

A public health concern at all entertainment events where food is sold is the possibility of developing salmonella poisoning, hepatitis or other diseases if there are not adequate public health controls.

Crowd control is another major public health concern in many large entertainment events, such as certain types of popular concerts and sports events. Widespread use of drugs and alcohol, overcrowding, allowing extensive standing room (festival seating) and lack of adequate preplanning have led to many incidents involving riots and panic, with resulting multiple injuries and fatalities. In addition, lack of adequate construction standards has caused fires and collapses of seating areas in several countries. There is a need for better regulations and provision of proper crowd control measures in these situations.

Visitors to parks and zoos can also present hazards to themselves. There have been many incidents where zoo visitors have been maimed or killed after entering animal enclosures. Visitors who get too close to wild animals in the parks have also experienced attacks, many of which have been fatal. The problems of inexperienced parks visitors getting lost, caught in storms, or falling from mountains is also a constant public health risk which can use up extensive resources for rescue.

The sex industry, especially prostitution, is particularly infamous for the possibility of patrons being robbed and possibly contracting sexually transmitted diseases. This is particularly true in countries where prostitution is not legally controlled. Criminal activities are often associated with prostitution.

REFERENCES

American Academy of Orthopedic Surgeons. 1991. Protective equipment. In Athletic Training and Sports Medicine. Park Ridge, IL: APOS.

Arheim, DD. 1986. Dance Injuries: Their Prevention and Care. St. Louis, MO: CV Mosby Co.

Armstrong, RA, P Neill, and R Mossop. 1988. Asthma induced by ivory dust: A new occupational cause. Thorax 43(9):737-738.

Axelsson, A and F Lindgren. 1981. Hearing in classical musicians. Acta Oto-Larynogologica 92 Suppl. 377:3-74.

Babin, A 1996. Orchestra pit sound level measurements in Broadway shows. Presented at the 26th Annual Meeting of the American Public Health Association. New York, 20 November.

Baker, EL, WA Peterson, JL Holtz, C Coleman, and PJ Landrigan. 1979. Subacute cadmium intoxication in jewellery workers: an evaluation of diagnostic procedures. Arch Environ Health 34:173-177.

Balafrej, A, J Bellakhdar, M El Haitem, and H Khadri. 1984. Paralysis due to glue in young apprentice shoemakers in the medina of Fez. Rev Pediatrie 20(1):43-47.

Ballesteros, M, CMA Zuniga, and OA Cardenas. 1983. Lead concentrations in the blood of children from pottery-making families exposed to lead salts in a Mexican village. B Pan Am Health Organ 17(1):35-41.

Bastian, RW. 1993. Benign mucosal and saccular disorders; benign laryngeal tumors. In Otolaryngology-Head and Neck Surgery, edited by CW Cumming. St. Louis, MO: CV Mosby Co.

—. 1996. Vocal fold microsurgery in singers. Journal of Voice 10(4):389-404

Bastian, R, A Keidar, and K Verdolini-Marston. 1990. Simple vocal tasks for detecting vocal fold swelling. Journal of Voice 4(2):172-183.

Bowling, A. 1989. Injuries to dancers: Prevalence, treatment and perception of causes. British Medical Journal 6675:731-734.

Bruno, PJ, WN Scott, and G Huie. 1995. Basketball. In The Team Physicians's Handbook, edited by MB Mellion, WM Walsh and GL Shelton. Philadelphia, PA: Mosby Yearbook.

Burr, GA, TJ Van Gilder, DB Trout, TG Wilcox, and R Friscoll. 1994. Health Hazard Evaluation Report: Actors' Equity Association/The League of American Theaters and Producers, Inc. Doc. HETA 90-355-2449. Cincinnati, OH: US National Institute for Occupational Safety and Health.

Calabrese, LH, DT Kirkendal, and M Floyd. 1983. Menstrual abnormalities, nutritional patterns and body composition in female classical ballet dancers. Phys Sports Med 11:86-98.

Cardullo, AC, AM Ruszkowski, and VA DeLeo. 1989. Allergic contact dermatitis resulting from sensitivity to citrus peel, geriniol, and citral. J Am Acad Dermatol 21(2):395-397.

Carlson, T. 1989. Lights! Camera! Tragedy. TV Guide (26 August):8-11.

Chasin, M and JP Chong. 1992. A clinically efficient hearing protection program

for musicians. Med Prob Perform Artists 7(2):40-43.

—. 1995. Four environmental techniques to reduce the effect of music exposure on hearing. Med Prob Perform Artists 10(2):66-69.

Chaterjee, M. 1990. Ready-made garment workers in Ahmedabad. B Occup Health Safety 19:2-5.

Clare, PR. 1990. Football. In The Team Physicians's Handbook, edited by MB Mellion, WM Walsh, and GL Shelton. St. Louis, MO: CV Mosby Co.

Cornell, C. 1988. Potters, lead and health—Occupational safety in a Mexican village (meeting abstract). Abstr Pap Am Chem S 196:14.

Council on Scientific Affairs of the American Medical Association. 1983. Brain injury in boxing. JAMA 249:254-257.

Das, PK, KP Shukla, and FG Ory. 1992. An occupational health programme for adults and children in the carpet weaving industry, Mirzapur, India: A case study in the informal sector. Soc Sci Med 35(10):1293-1302.

Delacoste, F and P Alexander. 1987. Sex Work: Writings by Women in the Sex Industry. San Francisco, CA: Cleis Press.

Depue, RH and BT Kagey. 1985. A proportionate mortality study of the acting profession. Am J Ind Med 8:57-66.

Dominguez, R, JR DeJuanes Paardo, M Garcia Padros, and F Rodriguez Artalejo. 1987. Antitetanic vaccination in a high-risk population. Med Segur Trab 34:50-56.

Driscoll, RJ, WJ Mulligan, D Schultz, and A Candelaria. 1988. Malignant mesothelioma: a cluster in a Native American population. New Engl J Med 318:1437-1438.

Estébanez, P, K Fitch, and Nájera 1993. HIV and female sex workers. Bull WHO 71(3/4):397-412.

Evans, RW, RI Evans, S Carjaval, and S Perry. 1996. A survey of injuries among Broadway performers. Am J Public Health 86:77-80.

Feder, RJ. 1984. The professional voice and airline flight. Otolaryngology-Head and Neck Surgery, 92(3):251-254.

Feldman, R and T Sedman. 1975. Hobbyists working with lead. New Engl J Med 292:929.

Fishbein, M. 1988. Medical problems among ICSOM musicians. Med Prob Perform Artists 3:1-14.

Fisher, AA. 1976. “Blackjack disease” and other chromate puzzles. Cutis 18(1):21-22.

Frye, HJH. 1986. Incidence of overuse syndrome in the symphony orchestra. Med Prob Perform Artists 1:51-55.

Garrick, JM. 1977. The frequency of injury, mechanism of injury and epidemiology of ankle sprains. Am J Sports Med 5:241-242.

Griffin, R, KD Peterson, J Halseth, and B Reynolds. 1989. Radiographic study of elbow injuries in professional rodeo cowboys. Phys Sports Med 17:85-96.

Hamilton, LH and WG Hamilton. 1991. Classical ballet: Balancing the costs of artistry and athleticism. Med Prob Perform Artists 6:39-44.

Hamilton, WG. 1988. Foot and ankle injuries in dancers. In Sports Clinics of North America, edited by L Yokum. Philadelphia, PA: Williams and Wilkins.

Hardaker, WTJ. 1987. Medical considerations in dance training for children. Am Fam Phys 35(5):93-99.

Henao, S. 1994. Health Conditions of Latin American Workers. Washington, DC: American Public Health Association.

Huie, G and EB Hershman. 1994. The team clinician’s bag. Am Acad Phys Asst 7:403-405.

Huie, G and WN Scott. 1995. Assessment of ankle sprains in athletes. Phys Assist J 19(10):23-24.

Kipen, HM and Y Lerman. 1986. Respiratory abnormalities among photographic developers: A report of 3 cases. Am J Ind Med 9:341-347.

Knishkowy, B and EL Baker. 1986. Transmission of occupational disease to family contacts. Am J Ind Med 9:543-550.

Koplan, JP, AV Wells, HJP Diggory, EL Baker, and J Liddle. 1977. Lead absorption in a community of potters in Barbados. Int J Epidemiol 6:225-229.

Malhotra, HL. 1984. Fire safety in assembly buildings. Fire Safety J 7(3):285-291.

Maloy, E. 1978. Projection booth safety: New findings and new dangers. Int Assoc Electr Inspect News 50(4):20-21.

McCann, M. 1989. 5 dead in movie heliocopter crash. Art Hazards News 12:1.

—. 1991. Lights! Camera! Safety! A Health and Safety Manual for Motion Picture and Television Production. New York: Center for Safety in the Arts.

—. 1992a. Artist Beware. New York: Lyons and Burford.

—. 1992b. Art Safety Procedures: A Health and Safety Manual for Art Schools and Art Departments. New York: Center for Safety in the Arts.

—. 1996. Hazards in cottage industries in developing countries. Am J Ind Med 30:125-129.

McCann, M, N Hall, R Klarnet, and PA Peltz. 1986. Reproductive hazards in the arts and crafts. Presented at the Annual Conference of the Society for Occupational and Environmental Health Conference on Reproductive Hazards in the Environment and Workplace, Bethesda, MD, 26 April.

Miller, AB, DT Silverman, and A Blair. 1986. Cancer risk among artistic painters. Am J Ind Med 9:281-287.

MMWR. 1982. Chromium sensitization in an artist's workshop. Morb Mort Weekly Rep 31:111.

—. 1996. Bull riding-related brain and spinal cord injuries—Louisiana, 1994-1995. Morb and Mort Weekly Rep 45:3-5.

Monk, TH. 1994. Circadian rhythms in subjective activation, mood, and performance efficiency. In Principles and Practice of Sleep Medicine, 2nd edition, edited by M. Kryger and WC. Roth. Philadelphia, PA: WB Saunders.

National Institute for Occupational Safety and Health (NIOSH). 1991. Environmental Tobacco Smoke in the Workplace: NIOSH Current Intelligence Bulletin 54. Cincinnati, OH: NIOSH.

Norris, RN. 1990. Physical disorders of visual artists. Art Hazards News 13(2):1.

Nubé, J. 1995. Beta Blockers and Performing Musicians. Doctoral thesis. Amsterdam: University of Amsterdam.

O'Donoghue, DH. 1950. Surgical treatment of fresh injuries to major ligaments of the knee. J Bone Joint Surg 32:721-738.

Olkinuora, M. 1984. Alcoholism and occupation. Scand J Work Environ Health 10(6):511-515.

—. 1976. Injuries to the knee. In Treatment of Injuries to Athletes, edited by DH O'Donoghue. Philadelphia, PA: WB Saunders.

Pan American Health Organization, (PAHO). 1994. Health Conditions in the Americas. Vol. 1. Washington, DC: PAHO.

Pheterson, G. 1989. The Vindication of the Rights of Whores. Seattle, WA: Seal

Press.

Prockup, L. 1978. Neuropathy in an artist. Hosp Pract (November):89.

Qualley, CA. 1986. Safety in the Artroom. Worcester, MA: Davis Publications.

Ramakrishna, RS, P Muthuthamby, RR Brooks, and DE Ryan. 1982. Blood lead levels in Sri Lankan families recovering gold and silver from jewellers' waste. Arch Environ Health 37(2):118-120.

Ramazzini, B. 1713. De morbis artificum (Diseases of Workers). Chicago, IL: University of Chicago Press.

Rastogi, SK, BN Gupta, H Chandra, N Mathur, PN Mahendra, and T Husain. 1991. A study of the prevalence of respiratory morbidity among agate workers. Int Arch Occup Environ Health 63(1):21-26.

Rossol, M. 1994. The Artist's Complete Health and Safety Guide. New York: Allworth Press.

Sachare, A.(ed.). 1994a. Rule #2. Section IIC. In The Official NBA Basketball Encyclopedia. New York: Villard Books.

—. 1994b. Basic Principle P: Guidelines for infection control. In The Official NBA Basketball Encyclopedia. New York: Villard Books.

Sammarco, GJ. 1982. The foot and ankle in classical ballet and modern dance. In Disorders of the Foot, edited by MH Jahss. Philadelphia, PA: WB Saunders.

Sataloff, RT. 1991. Professional Voice: The Science and Art of Clinical Care. New York: Raven Press.

—. 1995. Medications and their effect on the voice. Journal of Singing 52(1):47-52.

—. 1996. Pollution: Consequences for singers. Journal of Singing 52(3):59-64.

Schall, EL, CH Powell, GA Gellin, and MM Key. 1969. Hazards to go-go dancers to exposures to "black" light from fluorescent bulbs. Am Ind Hyg Assoc J 30:413-416.

Schnitt, JM and D Schnitt. 1987. Psychological aspects of dance. In The Science of Dance Training, edited by P Clarkson and M Skrinar. Champaign, IL: Human Kinetics Press.

Seals, J. 1987. Dance surfaces. In Dance Medicine: A Comprehensive Guide, edited by A Ryan and RE Stephens. Chicago, IL: Pluribus Press.

Sofue, I, Y Yamamura, K Ando, M Iida, and T Takayanagi. 1968. N-hexane polyneuropathy. Clin Neurol 8:393-403.

Stewart, R and C Hake. 1976. Paint remover hazard. JAMA 235:398.

Tan, TC, HC Tsang, and LL Wong. 1990. Noise surveys in discotheques in Hong Kong. Ind Health 28(1):37-40.

Teitz, C, RM Harrington, and H Wiley. 1985. Pressure on the foot in point shoes. Foot Ankle 5:216-221.

VanderGriend, RA, FH Savoie, and JL Hughes. 1991. Fracture of the ankle. In Rockwood and Green's Fractures in Adults, edited by CA Rockwood, DP Green, and RW Bucholz. Philadelphia, PA: JB Lippincott Co.

Warren, M, J Brooks-Gunn, and L Hamilton. 1986. Scoliosis and fracture in young ballet dancers: Relationship to delayed menarcheal age and amenorrhea. New Engl J Med 314:1338-1353.

World Health Organization (WHO). 1976. Meeting on Organization of Health Care in Small Industries. Geneva: WHO.

Zeitels, S. 1995. Premalignant epithelium and microinvasive cancer of the vocal fold: the evolution of phonomicrosurgical management. Laryngoscope 105(3):1-51.

OTHER RELEVANT READINGS

Alexander, P. 1995. Sex workers fight against AIDS: An international perspective. In Women Resisting AIDS: Strategies of Empowerment, edited by BE Schneider and N Stoller. Philadelphia, PA: Temple University Press.

—. 1997. Making a living: Women who go out. In Women's Experiences with AIDS, edited by M Ankrah and L Long. New York: Columbia University Press.

American National Standards Institute (ANSI). 1993. American National Standard for Safe Use of Lasers. New York: ANSI.

Association of Systematics Collections. 1994. Guidelines for Institutional Policies and Planning in Natural History Collections. Washington, DC: Association of Systematics Collections.

Avery, B. 1992. Special Event & Show Safety Guide (Fireworks, Animal Handling, Power Tools). Orlando, FL.

Babin, A and M McCann. 1992. Waste Management and Disposal for Artists and Schools. New York: Center for Safety in the Arts.

Barnard, MA. 1993. Violence and vulnerability: Conditions of work for streetwalking prostitutes. Sociology of Health and Illness 15(5):683-705.

Bastian, RW. 1987. Vocal fold surgery in singers. Med Prob of Perform Artists 66: 49-52.

—. 1988. Factors leading to successful evaluation and management of patients with voice disorders. Ear, Nose and Throat Journal 67:411-420.

—. 1990. Prevention of voice disorders. In The Principles of Singing, 2nd edition, edited by KE Miller. Englewood Cliffs, NJ: Prentice-Hall.

Bastian, R, K. Verdolini, and A. Keidar. 1989. The team approach to management of patients with voice disorders. NATS Journal 45(5):16-19.

Bouchayer, M and G Cornut. 1988. Microsurgery for benign mucosal disorders. Ear, Nose and Throat Journal 67:446-466.

California State Fire Marshall Film Advisory Committee. 1988. Film Industry Fire/life Safety Handbook. Sacramento, CA: California State Fire Marshall.

Canadian Centre for Occupational Health and Safety (CCOHS). 1988. Infograms on Hand Tools. Hamilton, ONT: CCOHS.

—. 1988. Infograms on Powered Hand Tools. Hamilton, ONT: CCOHS.

—. 1988. Infograms on Woodworking Machines. Hamilton, ONT: CCOHS.

Chong, JP. 1996. The human performance approach to prevention. In Musicians and the Prevention of Hearing Loss, edited by M Chasin. San Diego, CA: Singular Publishing, Inc.

—. 1997. Physical therapy for physical problems. In Chronic Musculoskeletal Injuries in the Workplace, edited by D Ranney. Philadelphia, PA: WB Saunders.

Chong, JP, M Lynden, D Harvey, and M Peebles. 1989. Occupational health problems of musicians. Can Fam Phys 35:2341-2348.

Clark, N. 1990. Health and Safety Manual for Broadcast Employees. New York: National Association of Broadcast Employees and Technicians Local 16.

Colton, R and J Casper. 1990. Understanding Voice Problems: A Physiological Perspective for Diagnosis and Treatment. Baltimore, MD: Williams and Wilkins.

Critchley, M and RA Henson. 1980. Music and the Brain: Studies in the Neurology of Music. London: Heinemann.

Ford, C and D Bless. 1990. Phonosurgery: Assessment and Surgical Management of Voice Disorders. Philadelphia, PA: Raven Press.

Health and Safety Commission. 1985. Zoos—Safety, Health and Welfare Standards

for Employers and Persons at Work. London: Her Majesty's Stationery Office.

Industry Wide Labor-Management Safety Committee for the Motion Picture and Television Industry. 1986. Safety Bulletins. Hollywood, CA: Industry Wide Labor-Management Safety Committee for the Motion Picture and Television Industry.

Kleinsasser, O. 1979. Microlaryngoscopy and Endolaryngeal Microsurgery: Technique and Typical Findings, 2nd edition. Baltimore, MD: University Park Press.

Lockwood, AH. 1989. Medical problems of musicians. New Engl J Med 320:221-227.

Massachusetts Institute of Technology (MIT). 1994. Health and Safety Guidelines for Computer Use at MIT. Cambridge, MA: MIT.

Miller, PL. 1991. Arsenic, Old Lace, and Stuffed Owls May Be Dangerous to Your Health: Hazards in Museum Collections. Champaign, IL: Illinois Heritage Association.

Morrison, M and L Rammage. 1994. The Management of Voice Disorders. San Diego, CA: Singular Publishing Group, Inc.

National Institute for the Conservation of Cultural Property (reference library): Washington, DC.

National Fire Protection Association (NFPA). 1991. Protection of Museums and Museum collections. Quincy, MA: NFPA.

Ontario Film and Television Industry Section 11 Advisory Committee. 1990. Safety Guidelines for the Film and Television Industry in Ontario. Toronto: Ontario Ministry of Labor.

Pheterson G. The Prostitution Prisim. Amsterdam: University of Amsterdam Press.

Phongpaichit, P. 1982. From Peasant Girls to Bangkok Masseuses. Geneva: ILO.

Phoon, WO. 1988. Chemical hazards: Metals. In Practical Occupational Health, edited by WO Phoon. Singapore, Hong Kong and New Delhi: PG Publishing.

Reid, F. 1978. The Staging Handbook. London: AC Black.

Rose, CL. 1995. Storage of Natural History Collections. Pittsburgh, PA: Society for the Preservation of Natural History Collections.

Rossol, M. 1991. Stage Fright: Health and Safety in the Theater. New York: Allworth Press.

—. 1996. Keeping Clay Work Safe and Legal, 2nd edition. Brandon, OR: National Council on Education in the Ceramic Arts.

Sataloff, RT, AG Brandfonbrener, and RJ Lederman. 1990. Textbook of Performing Arts Medicine. Philadelphia, PA: Raven Press.

Shaver, FM. 1995. Prostitution: On the dark side of the service industry. In Post-Critical Criminology. Scarborough, ONT: Prentice Hall.

Singer, K. 1932. Diseases of the Musical Profession: A Systematic Presentation of Their Causes, Symptoms and Methods of Treatment. New York: Greenberg.

Sliney, D and M Wolbarsht. 1985. Safety with Lasers and Other Optical Sources. New York: Plenum Press.

Smith, S and HFT Holt. 1993. The Artist's Manual. New York: Mayflower Books.

Spandorfer, M, D Curtiss, and JW Snyder. 1993. Making Art Safely. New York: Van Nostrand Reinhold.

Sundberg, J. 1987. The Science of the Singing Voice. Dekalb, IL: Northern Illinois University Press.

Swedish Theatre Federation and Lund University. 1989. A Study of the Theatre's Working Environment and Its Future Development. Report of a research circle working in cooperation with the Swedish Theatre Federation and Lund University. Sweden: Swedish Theatre Federation and Lund University.

Titze, I. 1993. Principles of Voice Production. Englewood Cliffs, NJ: Prentice Hall.

Truong, T-D. 1990. Sex, Money and Morality: Prostitution and Tourism in South-East Asia. London: Zed Books.

Vanwesenbeeck, I. 1994 Prostitutes' Well-being and Risk. Amsterdam: VU University Press.

White, L. 1990. The Comforts of Home: Prostitution in Colonial Nairobi. Chicago, IL: University of Chicago Press.

Zycherman, LA and JR Schrock. 1988. A Guide to Museum Pest Control. Washington, DC: Association of Systematics Collections.

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