exhibition. As in many other fields, responses to "green" concerns must be made using declining resources.

Museum 163 no.3 (1989) is the fortieth anniversary edition. It contains a review: "Then and Now: Great pioneer museums four decades later". None of them is a natural history museum. Obviously, natural history must regain the pioneering spirit if it is to capture the interest (and resources) of public and politician alike.

ABSTRACTS

The format of the abstracts is changing slightly. In order to achieve compatability with Art and Archaeology Technical Abstracts (which covers most other aspects of conservation), each abstract is covered in author, title, source and abstract order. In addition, by popular request, the person who abstracted the source is given. If after extensive enquiries you are unable to obtain a copy of the source, most abstractors will try to help you. Where a self-contained group of abstracts have been provided, these will be listed under the name of the abstractor(s). In other cases the initials of the abstractor will be appended in curly brackets, e.g.{RRW}. The corresponding names and addresses are listed at the end of the abstract section.

General

: GARRETT, K.L.
Documentation guidelines for the preparation and conservation of biological specimens
Collection Forum 5 (1989) 47-51
A reasoned plea for improved documentation standards in this field, prepared on behalf of the Society for the Preservation of Natural History Collections. Guidelines for both minimum and "full" documentation are given. Checklists with cross-referencing is suggested as a method to reduce the paperwork involved.{CVH}

Materials and Methods

: ASTM SUBCOMMITTEE D26.02 ON VAPOR DEGREASING
MNL2/Manual on Vapor Degreasing.
Book. American Society for Testing and Materials, Philadelphia, 1989, 48 pp., ISBN 0-8031-1207-6. Price US$19.00. Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187, USA.{RRW}

5.1 *Curation Newsletter*, no.10 (Spring 1990)
A series of short useful news items on the following subjects: newly available wet label paper in various forms, suitability of laser printed labels, printer ribbons for wet labelling, glass jars and lids.{CVH}

5.2 STANSFIELD,G.
Physical methods of pest control
J.Biological Curation 1 (1989) 1-4
The use of high or low temperatures, microwave and gamma radiation.{CVH}

5.3 PETTITT,C.
The new zoology storage at Manchester Museum: an opportunity for a new curatorial strategy
J.Biological Curation 1 (1989) 27-40
The movements, rearrangement and priorities of a non-insect invertebrate restorage campaign. Discusses the uses of compact storage, packaging and labelling methods.{CVH}

5.4 WEBB, E.A., PATTERSON, C., MEANEY, C.A., & SNELLGROVE, B.
Integrated pest management at the Denver Museum of Natural History
Routine fumigation of collections was abandoned and replaced by a programme of survey and trapping. Reallocation of room use was combined with more careful maintenance in sensitive areas. Periodic monitoring was instituted to identify pest along with other potential problems. {CVH}

Mercury and Mercury Compounds in Natural History Collections:
An Annotated Bibliography

Catherine A. Hawks, The Carnegie Museum of Natural History and David W. Von Endt, Conservation Analytical Laboratory, Smithsonian Institution
This bibliography highlights the use and occurrence of mercury in natural history collections, along with information on the forms of mercury likely to be encountered in these collections. The annotations do not reflect the contents of the cited material as a whole, merely the references to mercury found in these publications. The compilers do not recommend any of the treatments given below, nor do they necessarily concur with the conclusions drawn by the authors cited here. Preparation of the bibliography was funded, in part, by a grant from the Institute of Museum Services.

5.5 ADAMS,A., BAIKIE,W. & BARRON,C.
A Manual of Natural History for the use of Travellers...
London, John van Voorst (1854). Suggested preservative preparations include:
No.1
3 lb prepared chalk
2 oz tannic acid
8 oz corrosive sublimate *[mercuric chloride]*
8 oz camphor
For use on bones to be left in bird skins, bird skins themselves, slits in the tarsi of birds, nostrils on some bird species, and the skins of turtles, tortoises, snakes, frogs, toads, rays, and fish;

No.2
1 tsp corrosive sublimate
1 pt alcohol .
for application to skins, especially bare skin of birds and mammals and large skins infested with insects, and to bills and feet of birds

5.6 ANDERSON,A.
Methods of collecting and preserving vertebrate animals,
Bulletin of the National Museums of Canada 69, Biological Series No. 18 (1965) i-vii,1-99.
Claims no poison will work through from the interior of a skin to protect hair and feathers. Old methods of spraying or brushing the outside of a specimen with corrosive sublimate in alcohol are considered to be effective, but extremely dangerous, as persons later handling specimens may suffer mercury poisoning

5.7 L. ANDÉS.
Das Conserviren von Thierhölgen, Leipzig, A. Hartleben(1894). [German]
Lists numerous preservative mixtures including a version of the first of Goadby's formulas *[Abs 5.59]*, using very different amounts of the same reagents

5.8 ANON
On the preservation of anatomical preparations
American Journal of Science and Arts 3rd Series 10 (1875) 155-157.
Reports "Dr. Sesmann's" methods for anatomical preparations, which include covering the exterior of the specimen with a cloth moistened in a concentrated aqueous solution of corrosive sublimate to prevent browning when the specimen is exposed to air

5.9 BABINGTON,C.
Report of the Committee for the Preservation of Animal and Vegetable Substances, 40-41 in
Report of the 12th Meeting of the British Association for the Advancement of Science held at Manchester June 1842 London, John Murray (1843).
States that corrosive sublimate preserves animal and vegetable substances well, but excessively hardens animal specimens

5.10 BAILEY, W. [primary author and ed.]
The Botanical Collector's Handbook Salem, Massachusetts USA, George A. Bates (1881).
Believes the best protection for herbaria specimens is 1 oz corrosive sublimate/qt 95% alcohol, although this is not permanently effective. Notes that solution should not be quite saturated or a disfiguring efflorescence will appear on the plants after the alcohol evaporates. Gives the formula used at Kew Herbarium:
1 oz corrosive sublimate
1 oz carbolic acid *[phenol]*
2 pt methylated spirit *[methanol]*
Mercuric chloride solutions can be applied by brushing or dripping, or by immersion of specimens in the poison. Use of metal implements causes the metals to corrode and the sublimate to stain plants and papers. Suggests gloves to protect hands because the cuticle of the skin is removed by the solution and the hands become rough and sensitive

5.11 BAILEY, W.
Botanizing, a Guide to Field-Collecting and Herbarium Work Providence, Rhode Island USA, Preston & Rounds Co. (1899).
Repeats formulas given in his 1881 work *[Abs 5.11]*. Notes the necessity of ventilating areas where mercuric chloride is used. Poisoning is done prior to mounting plants, but it may be necessary to repeat the process, or to treat mounted specimens acquired from others; this results in stains on the papers

5.12 BAIRD, S.
Hints for Preserving Objects of Natural History Carlisle, Pennsylvania USA, printed by Gitt & Hinckley for Dickinson College (1846).
When arsenic is not available, corrosive sublimate or various other poisonous or astringent substances can be used

5.13 BAIRD, S.
Directions for collecting, preserving and transporting specimens of natural history, 235-253 in
Annual Report of the Board of Regents of the Smithsonian Institution...for the Year 1856 U.S. Senate Miscellaneous Documents No.54, Washington DC, A.O. Nicholson (1857).
Advocates mercuric chloride as one of several substitutes for arsenic. Soak mammal skins in a solution of corrosive sublimate and alcohol to protect the hair from insects; after treatment skins must be washed in clean water, otherwise exposure to light will bleach the colors. Suggests Goadby's formulas *[Abs 5.59]* for fluid preservation where alcohol is not available. Prolonged immersion in Goadby's first formula is said to destroy bone

5.14 BALDI, F. & OLSON, G.
Effect of cinnabar on pyrite oxidation by *Thiobacillus ferrooxidans* and cinnabar mobilization by a mercury-resistant strain.
Applied Environmental Microbiology 53 (1987) 772-776.
Mercury-resistant strains oxidize pyrite in pyrite-cinnabar mixtures, while mercury-sensitive strains do not. Elemental mercury is produced by mercury-resistant strains growing in the pyrite-cinnabar mixtures. Cinnabar has little effect on pyrite oxidation at 1%, but inhibits growth of both types of strains at 10% wt/wt

5.15 BALDI,F. OLSON, G. & BRINKMAN, F.
Mercury transformations by heterotrophic bacteria isolated from cinnabar and other metal sulfide deposits in Italy.
Geomicrobiology Journal 5 (1987) 1-16. Bacterial strains resistant to 5 mg mercuric chloride/liter can reduce mercuric compounds to elemental mercury. Mercury reduction is the major mercury transformation in mercury-resistant strains isolated from the deposits examined in this study. All bacterial strains growing in the presence of 0.1 mg methylmercuric chloride/liter also grow in the presence of 2 mg mercuric chloride/liter. Mercuric ion resistance is associated with mercuric reductase enzyme, which converts the mercuric ion to elemental mercury vapor. None of the mercury-resistant strains in the study produced detectable methylmercury

5.16 BATTY, J.
Practical Taxidermy, and Home Decoration New York, Orange Judd Co. (1880).
Preservative formulas include:
Arsenical Soap

1 lb laundry soap
2 qt water
3 lb arsenic
1 oz corrosive sublimate
add a lump of potash *[possibly potassium carbonate]*, thicken with pipe-clay, heat, and stir;

Pickle for Preserving Animal Skins

2 lb salt
1 lb alum
2 oz saltpetre *[potassium nitrate]*
1 oz corrosive sublimate
1/4 oz carbolic acid
2 gal cold water

Pickle for Beetles and Other Insects

2 oz water
2 oz alcohol
1/8 oz corrosive sublimate

5.17 BEETON, S.
Birds' Nests and Eggs, and Bird Stuffing. London, Ward, Lock & Co. (1877).
Advocates arsenical soap or corrosive sublimate to coat the tow or other fibrous material wrapped around the tail wires in stuffed or mounted quadrupeds

5.18 BIDSTRUP, P.
Toxicity of Mercury and its Compounds.
Amsterdam, Elseveir Publishing Co. (1964).
The principal reaction of mercury in the body is with thiols *sulfhydryl groups in proteins*. Metallic mercury and mercurous compounds are very soluble in lipoids, permitting ready distribution throughout the body. Distribution is followed by oxidation to reactive mercuric salts which may fix and accumulate in sensitive tissues, such as the brain, or may form soluble compounds with the proteins, sodium chloride and alkalis of body fluids. Absorbed mercury is excreated in urine, feces, bile, sweat, saliva and milk. Much of the action of mercury in living systems is poorly understood, as are the safe limits of exposure. Response to any dosage varies greatly with the individual. Soluble inorganic mercurials, particularly mercuric chloride, are irritating to the skin and mucous membranes, and can lead to systemic poisoning. Symptoms include gingivitis, stomatitis, excessive salivation or a metallic taste, psychic disorders, and tremors. Careful handling prcedures, good housekeeping, and appropriate ventilation or respirator systems are essential to reduce health risks. Medical surveillance is recommended for workers exposed to mercurials

5.19 BRIGGS, D., SELL, P., BLOCK, M. & I'ONS, R.
Mercury vapor: a health hazard in herbaria.
New Phytologist 94 (1983) 453-457.
Mercury vapor readings as high as 400 micrograms/m^3 are obtained in cupboard air of herbarium specimens in the Cambridge University Herbarium. Old specimens known to have been poisoned in the 1950's yield readings of 30 micrograms of mercury vapor, while recently poisoned specimens produce 170 micrograms of volatile mercury/m^3. Increased ventilation in the herbarium reduces the concentration of mercury vapor in the atmosphere to about 10 micrograms/m^3, however, concentrations were still high inside closed cabinets. Continual monitoring is recommended for all herbaria where mercury is known to have been used on specimens

5.20 ANON
Handbook of Instructions for Collectors British Museum (Natural History). 3rd. ed., London, Hazell, Watson & Viney, Ltd. (1906).
Corrosive sublimate causes excessive embrittlement of bird skins. Recommends brushing skins of crocodiles and lizards with a solution of alum containing a few grains of mercuric chloride. Fishes collected in hot climates can be preserved in alcohol with mercuric chloride or arsenic added. Diptera should be boiled in a solution of equal parts 90% alcohol and 1:500 aqueous perchloride of mercury *[mercuric chloride]*. Invertebrates can be fixed in a saturated solution of mercuric chloride in fresh or sea water with added copper sulphate, acetic acid, or chromic acid. After fixation, invertebrates must be washed in iodized alcohol to remove the sublimate, otherwise it will recrystallize in the tissues. Numerous mercuric chloride fixatives, apparently taken from Lo Bianco *[Abs 5.85]*, are suggested for marine organisms

5.21 BROWN,L. & HILL, L.
Mercuric chloride in alcohol and chloroform used as a rapidly acting fixative for contracting muscle fibers,
Journal of Microscopy 125 (1982) 319-336.
The fixative used to preserve the alignment of filaments in tetanized muscle fibers is a modification of Carnoy's acetic alcohol/corrosive sublimate, and is composed of 3 parts ethanol to 1 part chloroform (v/v), saturated with mercuric chloride (~10 gm/50 ml of mixture). The solution fixes and dehydrates at the same time. Membranes are disrupted, but myofibrils are preserved, as is the band pattern. Cross-bridges are visible with electron microscopy, but alcoholic dehydration may alter their orientation

5.22 BROWN, T.
The Taxidermist's Manual; or the Art of Collecting, Preparing, and Preserving Objects of Natural History. 10th ed., London, A. Fullarton & Co. (1851).
Treat the hands of primates with turpentine, followed by a corrosive sublimate solution. Add tincture of musk to the sublimate solution to deodorize shew, mouse, vole, badger, wolverine, and skunk skins. Use arsenic, turpentine, or corrosive sublimate solution on the interior of bird skins and soak the rump in corrosive sublimate, even if other preservtives are used elsewhere on the skin. Notes Charles Waterton [Abs 5.126] on the use of sublimate for bird skins and for feathers. Advocates adding corrosive sublimate to flour pastes

5.23 BROWN, T.
The Taxidermist's Manual; or the Art of Collecting, Preparing, and Preserving Objects of Natural History.
12th ed., London, A. Fullarton & Co. *[c.1870]*.
Repeats the advice given in 10th ed. *[Abs 5.23]*

5.24 BROWNE, M. 2nd ed., London, UPCUTT Gill, L. *[c.1884]*
Practical Taxidermy: a Manual of Instruction to the Amateur in Collecting, Preserving, and Setting Up Natural History Specimens of all Kinds.
Only bichloride of mercury *[mercuric chloride]* will kill maggots. Gives formulas for various preservatives containing mercury, including Waterton's *[Abs 5.126]*, and suggests that after mounting, mammals can be washed with Waterton's solution, or with:

No.10 Preservative Wash

1 oz corrosive sublimate
1 qt methylated spirits
1 oz tincture of camphor (or musk)
For large collections of heads or skins which have become infested with insects, especially in private collections, recommends immersion in:

No.17 Carbolic Acid Wash No. 3

1 lb carbolic acid
3 oz corrosive sublimate
1/2 oz sal ammoniac *[ammonium chloride]*
4 oz pure tannin
4 gal hot water

Suggests the following external wash for valuable bird skins:

No.18 Preservative Wash

1 pt pure sulphuric ether *[diethyl ether]*
6 gr corrosive sublimate

Cites Goadby's formulas *[Abs 5.59]* for general fluid preservation of fish and reptiles with the note that a small amount of saturated sal ammoniac solution will help dissolve corrosive sublimate in alcohol. His own fluid preservative are:

No.26 Browne's Preservative Solution

4 oz saltpetre
2 oz alum
1/4 oz corrosive sublimate
1/8 oz sal ammoniac
1/2 gal boiling water

No.27 Saline Solution for bottling Fish and Reptiles

1 gr corrosive sublimate
90 gr sodium chloride
1 pt distilled water

Recommends preserving caterpillars by pressing out the body contents, then injecting the skin with a small amount of corrosive sublimate solution via a metal or glass blowpipe

5.25 BROWNE, M. London, ADAM & CHARLES BLACK (1896).
Artistic and Scientific Taxidermy and Modelling.
Notes that mercury solutions have superceded carbolic acid for antiseptic use in hospitals. As a fungicide and insecticide on taxidermy mounts, use 1 pt 90% methyl alcohol and 20 gr bichloride of mercury. For badly infested skins or for dried entomology specimens increase the mercuric chloride to 50 gr. Quotes various mercury compounds from Lo Bianco's *Metodi usati nella Stazione Zoologica per la conservazione degli animali marini, Mittheilungen aus der Zooolgischen Station zu Neap 9 (1890) 435-474* and cites Arthur Bowes Lee *The Microtomist's Vade Mecum*. 3rd ed. (1893) on the increased solubility of corrosive sublimate when hydrochloric acid, ammonioum chloride, camphor, or sodium chloride is added. Repeats much of the advice given in his earlier publication *[Abs 5.24]*, including a new version of the carbolic acid wash for mounted heads and skins, and a stronger ether/mercuric chloride mixture for valuable birds skins and butterflies. Notes, but does not recommend, a "dangerous soap" suggested by another taxidermist which contains both arsenic and mercuric chloride. Gives formulas for modelling waxes containing vermillion *[mercuric sulfide]* as a pigment, and several vermillion pigmented oil, water, and powder paints for use in taxidermy

5.26 BRUNNER, G.
Ein neues Insektizid in der Herbar- und Museumstechnik
Der Praparator, Zeitschrift fur Museums-technik 4 (1967) 237-240. *[German]*
Reviews methods of protecting herbaria collections from insect pests. Mercuric chloride is commonly used as a 2% solution in alcohol for immersing or brushing specimens, and is effective for about 20 years

5.27 BUDIN, O.
Taxidermia y Captura de Mammiferos. Miscelanea No. 73, San Miguel de Tucuman, Argentina, Ministerio de Cultura y Educacion, Fundacion Miguel Lillo (1982). [Spanish]
To protect against insects, expose taxidermy mounts to the vapor from an alcohol solution of bichloride of mercury

5.28 BUHLER, U. & NORHEIM, G.
The mercury content in feathers of the Sparrowhawk *Accipiter nisus* in Norway.
Fauna norvegica (Ser.C) 5 (1981) 43-46.
Total mercury content of shed and plucked feathers, determined by atomic absorption spectroscopy, varied from 2-20 micrograms, with wide variations between feathers on the same bird. Mercury concentration appeared to reflect moulting pattern in primaries

5.29 BURTT-DAVY, J. & CHALK, L.
The Collection and Preparation of Herbarium and Timber Specimens. Cambridge UK, Imperial Forestry Institute, University of Oxford (1927).
To protect against insects, recommends that herbaria specimens and the gum used to mount them be brushed with:
1 lb perchloride of mercury *[mercuric chloride]*
4 gal methylated spirit
16 oz carbolic acid
Herbaria sheets should be marked "P" in the upper right hand corner to show that they have been poisoned

5.30 CABOT. Dr.
Untitled [statement made before C.T. Jackson, Society Vice President, January 19, 1859]
Proceedings of the Boston Society of Natural History 7 (1861) 5.
Bird specimens dipped in a strong solution of corrosive sublimate or in a saturated solution of arsenious acid were attacked by the larvae of dermestes and anthreni

5.31 CASSELMAN, W.
The relative oxidizing properties of certain reagents and mixtures used for the fixation of tissues.
Quarterly Journal of Microscopical Science 96(Pt.2) (1955) 223-226.
Hydrogen ion concentration and oxidation potentials were measured for solutions of primary reagents, including 1% and 5% mercuric chloride, stages in the preparation of Zenker's and Helly's fluids *[cf Abs 5.34]*, and the final fixing mixtures. For analytical grade mercuric chloride E = 0.75 V and E^0 = 0.92 V. The pH for 1% mercuric chloride = 3.25 and for 5% = 3.75. During preparation of Zenker's and Helly's fluids the following were recorded:
Stock Solution
100 ml 2.5% potassium dichromate
1 gm sodium sulfate
10 gm mercuric chloride
pH = 3.60 E = 0.76 V
Zenker's Fluid
57 ml stock solution
3 ml glacial acetic acid
pH = 2.50 E = 0.83 V

Helly's Fluid
57 ml stock solution
3 ml neutralized (with calcium carbonate) formalin
pH = 3.70 E = 0.74 V
The pH and the oxidation potential remained stable for both fixing mixtures one day after preparation

5.32 CHAMBERLAIN, C.J.
Methods in Plant Histology. 4th ed., Chicago, University of Chicago Press (1924). *[prev. eds. 1901,1905,1915]*
Under formulas for fixing agents, lists:
Corrosive Sublimate/Acetic Acid
3 gm corrosive sublimate
5 cc glacial acetic acid
100 cc 70% alcohol (or water)
Corrosive Sublimate/Acetic Acid/Picric Acid
5 gm corrosive sublimate
5 cc glacial acetic acid
1 gm picric acid
100 cc 50% alcohol
Corrosive Sublimate/Formalin/Acetic Acid
4 gm corrosive sublimate
5 cc formalin
5 cc glacial acetic acid
100 cc water (or 50% alcohol)
use all of the above at 85°C - alcohol solutions for imbedding and aqueous solutions for material to be mounted in Venetian turpentine;
Bensley's Formula for canal system *[cf Helly's, Abs 5.33]*
2.5 gm potassium bichromate
5 gm corrosive sublimate
90 cc water
10 cc neutral formalin
Bensley's Formula for mitochondria
4 parts 2.5% corrosive sublimate in water
1 part 2% osmic acid
Gilson's Fluid
42 cc 95% alcohol
60 cc water
18 cc glacial acetic acid
2 cc conc. nitric acid
11 cc saturated solution corrosive sublimate in water
Jeffrey's Formula
3 parts saturated solution corrosive sublimate in 30% alcohol
1 part saturated solution picric acid in 30% alcohol
Under stains, lists:
Millon's Reagent
1 cc mercury
9 cc conc. nitric acid
10 cc water

5.33 CLARK G.
Staining Procedures. 4th ed., Baltimore USA, Williams & Wilkins for the Biological Stain Commission (1981).
Under general methods, lists:
Heidenhain's Fluid for animal tissue (Heidenhain, 1916)
4.5 gm mercuric chloride
0.5 gm sodium chloride
20 ml formalin
4 ml trichloroacetic acid
80 ml distilled water
Helly's Fluid for animal tissue (Helly, 1903) *[cf Abs 5.31]*
2.5 gm potassium bichromate
5-8 gm mercuric chloride, to saturation
100 ml distilled water
5% neutralized formalin
Maximow's (Spuler's) Fluid for animal tissue is the same formula as Helly's fluid, but with 10% formalin;
Lillie's Buffered Sublimate for acid soluble structures (Lillie & Fullmer, 1976)
6 gm mercuric chloride
2 gm sodium acetate
100 ml distilled water
Lillie's Acidified Sublimate for pancreatic islands (Lillie & Fullmer, 1976)
6 gm mercuric chloride
85 ml water
10 ml formalin
5 ml glacial acetic acid
Schaudinn's Fluid for animal tissue (Shaudinn, 1902)
2 parts saturated aqueous mercuric chloride
1 part absolute alcohol
Zenker's Fluid for animal tissue (Zenker, 1894) *[cf Abs 5.31]*
2.5 gm potassium bichromate
5 gm mercuric chloride
100 ml distilled water
5% glacial acetic acid

5.34 CLARK, S.
Preservation of herbarium specimens: an archive conservator's approach.
Taxon 35 (1986) 675-682.
Herbaria sheets from Kew Herbarium were damaged by mould while on loan in 1982. When returned to Kew they were treated with a solution of mercuric chloride and subjected to deep-freeze disinfestation. The author cites problems with mercuric chloride, which is routinely used on specimens at Kew, including: grey staining, embrittlement of paper, corrosion of metal paper clips, and the need to wear gloves when handling specimens. Notes that mould has been known to grow on mercuric chloride solutions

5.35 COLE, F.
A history of Comparative Anatomy from Aristotle to the Eighteenth Century. New York, Dover Publications, Inc. (1975).
Notes the 1672 use, probably by Jan Swammerdam (1637-1680), of an injection of metallic mercury in the bronchial arteries of a calf, and Swammerdam's use of quicksilver *[metallic mercury]* to fill the veins and arteries of a frog. Frederick Ruysch (1638-1731) also is said to have used mercury for anatomical injections

5.36 ANON
Recommendations for personal protective equipment for working with arsenic trioxide or mercuric chloride Commonwealth of Massachusetts. West Newton, Massachusetts USA, Executive Office of Labor, Department of Labor and Industries, Division of Occupational Hygiene (1988).
Recommends the use of impermeable (rubber) gloves, reusable half-face respirators with HEPA filters, and full-body disposable Tyvek suits. Use HEPA filtered vacuum to prevent resuspension of particulates in air

5.37 COUES, E.
Field Ornithology. Salem, Massachusetts USA, Naturalists' Agency (1874).
Believes arsenic to be the best preservative, but in its absence, a strong solution of corrosive sublimate can be brushed over the inside of bird skins

5.38 COUES, E.
Key to North American Birds, v.1. Boston USA, The Page Co. (1903).
Repeats advice given in his 1874 publication *[Abs 5.37]*

5.39 CRABB, E.
A handbook on preserving museum specimens in the field.
University of Oklahoma Bulletin New Series No.268 (1923) 1-73.
Gives W.T. Hornaday's formula for a saturated corrosive sublimate solution in an equal quantity of water

5.40 CROAT, T.
Survey of herbarium problems.
Taxon 27 (1978) 203-218.
Reviews methods of treating incoming specimens, noting that one herbarium dips newly mounted herbaria sheets in a solution of bichloride of mercury. The solution is used under a hood to protect workers

5.41 DANIELS, V.
The blackening of vermillion by light. 280-282 in
Recent Advances in the Conservation and Analysis of Artifacts J. Black, comp., London, University of London, Institute of Archaeology Summer Schools Press (1987).
Reviews literature on the blackening of the mercuric sulfide pigment, vermillion. Presents the results of experiments which show that both alkali halides (potassium iodide and sodium chloride) and high relative humidity accelerate the light induced blackening of the pigment. Glycerol accelerates blackening, possibly due to its action as a humectant. The black component probably is an amorphous form of mercuric sulfide and is not detectable by x-ray diffraction, *i.e.* amorphous metacinnabarite

5.42 DAVIE, O.
Methods in the Art of Taxidermy. Philadelphia USA, David McKay (1894).
Saturate hair and feathers of mounted specimens with a 1:1 solution of alcohol and water containing as much corrosive sublimate as can be dissolved in the alcohol. Pour solution over specimens with a small teapot or spray on with an atomizer. If a grey deposit develops upon drying, it can be removed by sponging with warm water. Quotes extensively from Walter Hough *[Abs 5.70]* on the use of mercuric chloride solutions for protecting museum collections from insects and adds that these hints are useful not only to museum staff, but to furriers and housewives. Notes the use of vermillion as one of the oil colors applied to taxidermy mounts

5.43 DAVIES, T.
A letter from Captain Davies to John Ellis, Esq. FRS, on a method of preparing birds for preservation.
Philosophical Transactions of the Royal Society of London 60 (1771) 184-187.
A "composition of sublimate mercury, tempered with some water, and rubbed gently over the feathers, will prevent insects, and other vermin, from destroying the plumage..."

5.44 DUBEAU, L., CHANDLER, L., GRALOW, J., NICHOLS, P. & JONES,P.
Southern blot analysis of DNA extracted from formalin-fixed pathology specimens.
Cancer Research 46 (1986) 2964-2969.
Because formaldehyde induced formation of cross-links between DNA and proteins is reversible in aqueous solutions, high molecular weight DNA can be recovered from formalin-fixed, paraffin-embedded pathology specimens. DNA recovered from samples in which picric acid or mercuric chloride has been used in the fixative is not intact

5.45 FABER P.
The development of taxidermy and the history of ornithology.
Isis 68 (1977) 550-566.
Discusses the importance of poisons, such as arsenic and corrosive sublimate, to the growth of systmatic collections. By the 1830's, arsenic or arsenical soap had become the standard for preserving specimens against insect attack. In a footnote on p. 561, Faber states without reference, "Unfortunately corrosive sublimate causes bird skins to disintegrate"

5.46 FEIGL, F.
Spot Tests in Inorganic Analysis. 6th ed., Amsterdam, Elsevier Publishing Co. (1972).
Classical qualitative analytical techniques for the detection of metallic mercury, organomercurials, and mercury salts. In many of the tests, other metal ions and some anions interfere

5.47 FILBY,R. & SHAH,K.
Activation analysis and applications to environmental research. 153-196 in
Analytical Aspects of Mercury and other Heavy Metals in the Environment R. Frei & O. Hutzinger, eds., London, Gordon & Breach Science Publishers (1975).
Reviews application of neutron activation analysis to air pollution studies, and marine and fresh-water trace element analysis. Compares the sensitivity of of several analytical methods for mercury in ng/gm: NAA - 6.5; photometric - 5.0; AA (flameless) - 1.0; and emission spectrography - 5000. Analysis of mercury is complicated by the volatility of the metal, disproportionation of mercurous compounds, and presence of many chemical states (i.e. inorganic and organic mercurials) in biological and environmental materials. Oven drying and ashing lead to up to 98% loss of mercury from biological material. There are significant losses of mercury from dilute mercuric solutions in polyethylene vials, but not from quartz vials. Describes methods of sample preparation to prevent mercury loss

5.48 FISH, P.
Brain preservation, with a resume of some old and new methods, 385-401 in
The Wilder Quarter-Century Book, Ithaca, New York USA, Comstock Publishing Co. (1893).
Corrosive sublimate is a useful fixative in either an aqueous or alcohol solution. Cites a method whereby the brain is dropped into a solution of 6 oz bichloride of mercury per 1/2 gal water. Also gives a formula by W. Richardson (1889) for fixing the central nervous system:

2 gm mercuric chlorid *[sic]*
90 cc alcohol
2 cc hydrochloric acid
The solution must be washed out of specimens prior to dissection or precipitates may form in tissues, tissues may become embrittled, and metal instruments will corrode. Camphor or tincture of iodine increase the solubility of the salt. Sheep brains preserved in a saturated aqueous solution of corrosive sublimate drop to 36 gm below original weight after 39 days, with a drop in girth of 2 cm. Those fixed in equal parts of saturated solutions of corrosive sublimate and potassium bichromate have a loss from original weight of 25 gm after 39 days, with a 0.6 cm loss of girth. Gives a fixative recommended by Max Flesch (1888), for brains which will then be preserved dry:
1 part water and alcohol solution of corrosive sublimate
3000 parts glycerin

5.49 FORSTER, J.
A Catalogue of the Animals of North America...to which are added Short Directions for Collecting, Preserving, and Transporting, all kinds of Natural History Curiosities London, B. White (1771).
Preservative solutions include:
1 oz sal ammoniac
1 qt water
2 oz corrosive sublimate mercury
Use to kill "half-winged insects" and beetles, wash interior of skins, dip stuffing materials and suture thread, dip nuts and seeds prior to shipping, soak shipping boxes and cork liners for insect boxes, and add to pastes. Ship small birds in alcohol, then place in the solution prior to stuffing. Mix the following into stuffing materials for mounted specimens:
4 parts tobacco-sand
4 parts pounded black pepper
1 part burnt alum
l part corrosive sublimate or arsenic

5.50 FORSTER, J.
A Catalog of the Animals of North America.... 382-433 in
Forster's Catalogue of the Animals of North America, or Faunula Americana P. Sclater, ed., London, The Willughby Society (1882).
Reprint of Forster's 1771 publication *[Abs 5.49]*

5.51 FRANKS, J.
A Guide to Herbarium Practice London, The Museums Association (1965).
Commonly used poisons for hand spraying, brushing or immersing herbaria specimens are: phenol, mercuric chloride, ammonium chloride, and silver chloride. The most widely used is:
4 oz phenol
4 oz mercuric chloride
1 gal industrial spirit

5.52 FREEMAN, B.,MOYER, E. & LASSEK, A.
The pH of fixing fluids during fixation of tissues, *Anatomical Record* 121 (1955) 593-600.
Gives the pH of 26 fixing fluids at intervals during fixation. The pH of Worcester *[Abs 5.67]*, Zenker *[Abs 5.31 & 33]* and saturated aqueous mercuric chloride solutions changes less than 0.5 pH unit with tissue added. Saturated aqueous mercuric chloride has a final pH of 2.5, which is lower than the original, and there is little difference with large or small amounts of tissue added to the solution. Helly's fluid *[Abs 5.31 & 33]* is an unstable mixture. The pH rises as the fluid stands, with or without tissue, changing from 3.5 to 4.0 over a 12 hour period. The pH of Worcester fluid ranges from 1.8 to 2.0, with the pH highest after 12 hours. Zenker's fluid changes from 2.2 to 2.5, again with pH highest after 12 hours

5.53 FRIEDMAN, M. & MASRI, M.
Interactions of mercury compounds with wool and related biopolymers, 505-530 in
American Chemical Society Symposium on Protein-Metal Interactions. Advances in Experimental Medicine and Biology, v.48 , Friedman, M. ed. New Work, Plenum Press (1974).
Wool can bind mercury to about 1/2 its weight from concentrated mercuric chloride solutions and can recover a substantial amount from solutions in the ppb range. Mercuric chloride is taken up in substantial amounts at pH's from 2-10, with best results near 2 and 9. Mercuric ion has a strong tendency to form complexes with chloride and hyroyxl ions. The latter complexes precipitate in acid. Chloride complexing decreases with increasing pH, leading to hydrolysis as Cl^- is replaced by OH^-. These effects do not vary significantly with the particular cation salt used, and the effects extend to other halides. Reduced or oxidized wool, and thiosulfate wool show greater binding capacity than native wool. As mercury concentration decreases, the rate of sorption of mercuric ion from an acid solution increases. Thiol groups are the most effective bonding sites, followed by amino and imidazole groups of histine and lysine side chains. With high mercury concentrations, more mercury is bound than is accounted for by functional groups, possibly due to protein acting as a solid solvent for mercurials, or possibly because mercuric chloride may form polymeric lattices within the wool structure. In desorption to excessive hardening and shriveling of specimens

5.54 MASRI, M. & FRIEDMAN, M.
Interactions of keratins with metal ions: uptake profiles, mode of binding, and effects on properties of wool, 551-587 in Abs 5.53
The uptake of mercury ions by native wool is compared with that of wool derivatives in which particular functional groups are modified. Tabulations of the results of previous studies on interaction sites are given. Masri and Friedman suggest that, at least in their experimental conditions, mercuric ions do not interact with disulfide functions of native wool keratin; however, mercurous ions do so interact. Formaldehyde solutions desorb significant amounts of bound mercuric ion from native wool treated with mercuric chloride solutions, but not from wool treated with mercurous solutions. This is presumed to be due to formaldehyde competition with the mercuric solution for bonding sites in amino acid residues of the wool. Color change in wool derivatives, particularly to purple, are associated with mercurous ions and with mercuric nitrate, but not with other mercuric solutions. The authors suggest that the color change observed with mercuric nitrate is due to its greater dissociation in water compared to other mercuric compounds, and some conversion of mercuric to mercurous nitrate. With mercurous nitrate, the color may be due to dismutation to mercuric ion and colloidal mercury, or to precipitation of red mercuric sulfide

5.55 GANNAL, J. translated from the French, with notes and additions, by R. Harlan.
History of Embalming and of Preparations in Anatomy, Pathology, and Natural History Philadelphia USA, Judah Dobson (1840). [French edition published in 1838]
[Gives formula for the arsenical soap devised by the French naturalist, Jean Baptiste Becoeur *[1718-1777]*, and notes that others have suggested adding a small amount of corrosive sublimate to the recipe. Mentions that some amateurs have used melted suet mixed with sublimate on the interior of skins. Gives an alum/water/salt formula attributed to Parisian taxidermists and suggests adding, in the manner of English naturalists, a small amount of corrosive sublimate in alcohol, despite the toxic dust that may result. Notes solution used on exterior of mounted specimens by Sir S. Smith of the Linnean Society of London:
2 oz corrosive sublimate
2 oz camphor
1 lb spirits of wine
and claims that in France, a dilute solution of corrosive sublimate in water is used in this way. Also suggests that mercury salts form a complex with gelatin which has an affinity for sulfuric acid and results in staining the specimens black. Gannal's formula for anatomical preparations includes an injection of a mixture of equal parts suet and rosin, colored with cinnabar *[mercuric sulfide]* for arteries. In an appendix, the translator comments that corrosive sublimate frequently fails as a preservative for both animal and vegetable matter. Cites several formulas for anatomical injections which contain vermillion for coloring, and notes that metallic mercury can be used for injections in anatomy]

5.56 GARCIA, L., SHIMIZU, R., BREWER, T. & BRUCKNER, D.
Evaluation of intestinal parasite morphology in polyvinyl alcohol preservative: comparison of copper sulfate and mercuric chloride bases for use in Schaudinn Fixative,
Journal of Clinical Microbiology 17 (1983) 1092-1095.
[Compares organism recovery and morphology in PVA/copper sulfate and PVA/mercuric chloride preservative/fixative systems. With trichrome stain, the overall morphology of the intestinal protozoa is consistently clearer and better defined in PVA/mercuric chloride than in PVA/copper sulfate]

5.57 GEORGE, S.
Specimens as bioindicators of environmental disturbance, 65-73 in
Mammal Collection Management, H. Genoways, C. Jones & O. Rossolimo, eds., Lubbock, Texas USA, Texas Tech Press (1987).
[Lists environmental contaminants and the mammalian tissues in which they are found. Methylmercury is found in liver, muscle, adipose and brain tissue, and in hair. Inorganic mercury is found in brain and kidney tissue, and there is some evidence that inorganic mercury may deposit in hair]

5.58 GETTENS, R. & STOUT, G.
Painting Materials, A Short Encyclopaedia New York, Dover Publications, Inc. (1966).
[Discusses vermillion, a red mercuric sulfide found in nature as the mineral cinnabar. Vermillion was used from the ore as a pigment in ancient times, although production of artifical vermillion by recombination of mercury and sulfur seems to have been practiced from about the 8th century onwards. There are no chemical or physical differences between natural and artificial cinnabar. Vermillion is not a permanent pigment under all conditions. It darkens when exposed to direct sunlight, especially when used with tempera or water color media. The darkening is believed to result from the formation of the metastable black sulfide. Impurities seem to be involved in the change]

5.59 GOADBY, H.
On the preservation of animal substances,
Proceedings of the American Association for the Advancement of Science 6 (1852) 335.
[Goadby's formulas include:
Formula A2
4 oz rock salt
2 oz alum
4 gr corrosive sublimate
2 imp qt water (imperial quarts = 40 oz)
Formula B
8 oz rock salt
2 gr corrosive sublimate
1 imp qt water
Goady notes that one of his earlier formulas, Formula A1, differs from A2 only in that it contains half as much water. The B fluid is for preservation of land and fresh water animals. For marine animals, recommends an additional 2 oz of salt/qt of water]

5.60 GOLDWATER, L.
Mercury: A History of Quicksilver Baltimore, York Press (1972)
[General discussion of the use, toxicology, and analysis of mercury. Reviews the "normal" levels of mercury found in human body fluids, tissues, hair and nails. Suggests that mercury may be an essential trace metal (concentrations of about 1 ppm or less) for human nutrition, possibly through enhancement of enzyme activity, but offers little recent evidence to support this idea. Notes that there are acute repiratory effects from inhalation of mercury vapor, along with the neurological symptoms commonly associated with mercury poisoning]

5.61 GOSSE, P.
The Squire of Walton Hall London, Cassell & Co., Ltd. (1940).
[Biography of the English naturalist, Charles Waterton (1782-1865). Describes Waterton's use of corrosive sublimate to harden bird, mammal, reptile, fish, and insects in order to mount them without supports or stuffing materials. Notes Waterton's use of corrosive sublimate solutions to soak top hats, trousers, carriage cushions, furs, muffs, and bonnet feathers]

5.62 HARRIS, R.
The conservation of one of the earliest known examples of a fluid-preserved injection dissection,
Museums Journal 79 (1979) 71-72.
[Emission spectroscopy analysis of the dye in the injection fluid used in a specimen of *Rhizostoma coerulea* prepared by John Hunter (1728-1793) *[Abs 5.72]*, reveals that the colorant contains mercury with traces of lead, copper and zinc. The results are consistent with injection media known to have been used by Hunter]

5.63 HAWKS, C. & WILLIAMS, S.
Arsenic in natural history collections,
Leather Conservation News 2 (1986) 1-4.
[Briefly discusses the use of mercury and mercuric chloride in the preservation of bioscience specimens from the 1770's to the present]

5.64 HAWLEY, G.
The Condensed Chemical Dictionary 9th ed., New York, Van Nostrand Reinhold (1977).
[Discusses physical properties, solubilities, health hazards, uses, and shipping regulations for 50 mercury compounds]

5.65 HENRY, J.
Directions for collecting, preserving and transporting specimens of natural history,
Smithsonian Miscellaneous Collections 2 (1859) 1-40.
[Recommends poisoning the ears, lips, orbital regions and noses of large skins with an alcohol solution of corrosive sublimate, although tincture of strychnine may give better protection against insects. Notes that arsenic is the best general preservative, but in its absence corrosive sublimate is one of several subtances that may be used. Recommends Goadby's solutions *[Abs 5.59]* for fluid preserved specimens when alcohol is not available. Prolonged immersion in the fluid containing alum will destroy bones]

5.66 HICKEY, W.,LEE, V., TROJANOWSHI, J., MCMILLAN, L., MCKEARN, T., GONATAS, J. & GONATAS, N.
Immunohistochemical application of monoclonal antibodies against myelin basic protein and neurofilament triple protein subunits: advantages over antisera and technical limitations,
Journal of Histochemistry and Cytochemistry 31 (1983) 1126-1135.
[Five fixatives are tested for preservation of antigens in rat and human brain tissue. One fixative, a saturated solution of mercuric chloride (25 gm in 500 ml water) mixed with 38% formalin to yield a 4% mercuric chloride-8% formaldehyde fixative, proves to be the best for overall immunohistological staining. The optimal method for antigen preservation in both rat and human CNS tissue is arterial perfusion of mercuric chloride. The two major disadvantages of the mercuric chloride-formalin fixative are its toxicity and the black precipitate it leaves in tissue. The precipitate can be removed after immuno-peroxidase staining by exposing the tissue to an iodine solution]

5.67 HINE, I.F.
Block staining of mammalian tissues with hematoxylin and eosin,
Stain Technology 56 (1981) 119-123.
[The choice of fixative for the tissues is important for block staining techniques. The author's preference is:

Worcester's Fluid
200 ml distilled water
14 gm mercuric chloride
22.5 ml 40% formaldehyde
25 ml glacial acetic acid

or, for tissue previously fixed in 10% formalin;

Formol Sublimate
10 ml 40% formaldehyde
90 ml saturated aqueous mercuric chloride

After fixation, the tissues are removed, using non-metallic forceps, and washed in 70% ETOH to remove excess mercuric chloride. To complete removal of the mercury salts, tissue blocks are washed three times in 70% ETOH to which Lugol's iodine (1 gm iodine, 2 gm potassium iodide, 100 ml distilled water) is added. Attributes the general lack of overstaining and excellent selectivity of the hematoxylin stain to the use of Lugol's iodine as an oxidizing agent]

5.68 HORNADAY, W.T.
Taxidermy and Zoological Collecting New York, Charles Scribner's Sons (1891).
[To finish taxidermy mounts of mammals, make the following and pour over the entire surface: 2 gal 95% alcohol with enough corrosive sublimate to make a saturated solution; decant the supernatant and dilute with an equal volume of water. Notes that from a safety standpoint, mercuric chloride never should be used in the preparation of a skin prior to mounting, but believes that with care, it can be used safely after mounting]

5.69 HORIE, C.V.
Materials for Conservation London, Butterworths (1987).
[Notes past use of trivalent *[bivalent]* mercury salts to cross-link and precipitate gum arabic, and the use of mercuric chloride to prevent mould in glues]

5.70 HOUGH, W.
The preservation of museum specimens from insects and the effects of dampness, 549-558 in
Annual Report of the Board of Regents of the Smithsonian Institution for the Year Ending June 30, 1887, Pt.2 Washington, DC, Smithsonian Institution (1889).
[Notes the use of alcohol solutions of arsenic or corrosive sublimate on feathers, fur, and dressed deer skins. Recommends pre-treatment with "benzine" vapors to destroy insect eggs and larvae. Observes that some Smithsonian furskins treated with corrosive sublimate are stiff and filled with mercuric chloride dust, but are undeniably mothproof. Suggests that as corrosive sublimate coagulates albumin, it should not be used in direct contact with skins. Because it is volatile, it has been suggested for use in preventing fungal growth on materia medica specimens. Adding a little naphtha to sublimate solutions prevents recrystallization. Dip or paint botanical specimens with 1 oz of corrosive sublimate per quart of alcohol, diluted 50%. Dip entomology specimens in solutions of from 0.1:100 sublimate:alcohol to 1:100 sublimate:alcohol]

5.71 HTAR, K.
A comparative study of three fungicides for preservation of books,
Union Burma Journal of Life Sciences 3 (1970) 87-89.
[Compares 3 fungicides for treating book bindings. One fungicide is a 5% copper sulfate solution, the others are:

10 gm thymol crystals
4 gm mercuric chloride
200 cc ether
400 cc benzene
and
80 gm mercuric chloride
2 oz creosote (BP 1953)
8 oz shellac
4 lb methylated spirit (industrial)

The solutions are applied to covers (paper, cloth, leather, half-leather). Fungi present are *Aspergillus, Penicillium,* and *Fusarium*. None of the solutions have any significant effects on the fungi]

5.72 OWEN, R. ed.
Essays and Observations on Natural History, Anatomy, Physiology, Psychology, and Geology, by John Hunter, F.R.S.; being his Posthumous Papers on those Subjects...v.1 London, John Van Voorst (1861).
[John Hunter's (1728-1793) procedures for anatomical preparations. Injection liquids must be fluid during injection and solid thereafter, thus metallic mercury is unsuitable for injections. Vermillion is used in the injection material in dry specimens, with the caution that reds will darken in oily injections, and will appear paler when mixed with water or spirits. Recommends adding corrosive sublimate dissolved in alcohol to the varnish used on the surface of dry prepartions.

5.73 JOHNELS, A.
Role of natural history museums,
Museum 25 (1973) 54-59.
[Feathers from recently collected birds and those in museums are analyzed to determine trends in environmental mercury contamination. Suggests that museum collections will have an important role in environmental monitoring in the future, but that with museum material, findings must be treated with caution due to the possibility of contamination of samples]

5.74 KINGSLEY, J.
The Naturalist's Assistant: A Handbook for the Collector and Student Boston USA, Bradlee Whidden (1892).
[Lists Goadby's solutions *[Abs 5.59]* for preserving specimens, modified by a decrease of 2 gr of mercuric chloride in Formula A1, the addition of 20 gr of arsenic to Formula B, and no mention of the use of the British imperial quart for water. Also suggests a solution of 1 oz sublimate in 1 qt of alcohol. This is stored in a glass vessel and applied with a string-wound brush, "as the presence of metal will produce a discoloration"]

5.75 KOMURA, I. & IZAKI, K.
Mechanism of mercuric chloride resistance in microorganisms: vaporization of a mercury compound from mercuric chloride by multiple drug resistant strains of *Escherichia coli*,
Journal of Biochemistry 70 (1971) 885-893.
[Multiple-drug resistant strains of *E. coli* are resistant to mercuric chloride, but not to salts of cobalt, nickel, cadmium and zinc. Mercuric chloride resistance can be transferred from resistant strains to sensitive strains of the microorganism. Resistant strains grow in the presence of 0.02 mM of mercuric chloride, while sensitive strains are inhibited in the presence of 0.01 mM. When incubated with a radioactively labeled form of mercuric chloride, cells of the resistant strain vaporize an unidentified form of radioactive mercury. The apparent decrease in the uptake of mercuric ion by the resistant strain may be due to this vaporization. The experimental results suggest that some of the mercury is converted by a mechanism other than vaporization, such as binding of mercuric chloride to other compounds, or reduction to mercurous chloride or metallic mercury]

5.76 KOMURA, I., FUNADA, T. & IZAKI, K.
Mechanism of mercuric chloride resistance in microorganisms: NADPH-dependent reduction of mercuric chloride and vaporization of mercury from mercuric chloride by a multiple drug resistant strain of *Escherichia coli*,
Journal of Biochemistry 70 (1971) 895-901.
[A cell-free extract of a mercuric chloride resistant strain of *E. coli* W2252, grown in the presence of mercuric chloride, catalyzes both the vaporization of an unidentified form of mercury from the mercuric chloride, and the mercuric chloride-dependent oxidation of NADPH. The enzymatic processes are not defined, but the vaporization occurs only after reduction of mercuric chloride by NADPH. Incubation of tagged mercuric chloride with various reducing agents fails to show non-enzymatic vaporization of metallic mercury. The fact that no clear stoichiometric relationship is shown between the NADPH oxidized and the mercuric chloride reduced in the reaction suggests that an intermediate step is required for mercury vaporization. Enzymes necessary for mercuric chloride reduction and mercury vaporization are formed in the resistant strain of the microorganism when it is grown in the presence of mercuric chloride; no vaporization activity is detected with extracts of sensitive strains. Optimum vaporization takes place at pH 7 in the presence of NADPH and the magnesium ions derived from the magnesium chloride used for NADPH generation in some of the experiments]

5.77 KNUDSEN, J.
Biological Techniques: Collecting, Preserving, and Illustrating Plants and Animals New York, Harper and Row (1966).
[In an appendix on reagents and solutions, gives the following:
Corrosive Sublimate
5 gm mercuric chloride
100 cc water
Corrosive Sublimate, Acetic
100 cc saturated corrosive sublimate
5 cc glacial acetic acid
use either hot (50-60^{o}C) or cold. Wash wet specimens after fixing and transfer to 50% alcohol. To prevent specimens from turning black, avoid metal forceps and metal containers, and add iodine, dropwise, until iodine does not lose its color. For dry specimens, do not wash to remove sublimate prior to drying]

5.78 KUCKHAN, T.
Four letters from Mr. T.S. Kuckhan to the President and Members of the Royal Society on the preservation of dead birds,
Philosophical Transactions of the Royal Society of London 59 (1770) 302-320.
[Formula for a dry preservative for use in bird skins:
1/4 lb corrosive sublimate
1/2 lb prepared saltpetre
1/4 lb prepared alum
1/2 lb flowers of sulphur
1/4 lb musk
1 lb black pepper
1 lb coarse ground tobacco]

5.79 LECOQ, H. & BOISDUVAL, A.
Taxidermie, Ensignee en Dix Lecons, ou Art d'Empailler les Oiseaux, les Quadrupedes, les Reptiles et les Poissons Paris, Terry & Audin (1826). *[French]*
[A corrosive sublimate solution often is preferable to arsenical soap for treating the skins of quadrupeds. Dissolve 1/2 oz of corrosive sublimate in just enough rectified spirit to completely dissolve the sublimate. For a more concentrated solution, add

a little sal ammoniac to keep the additional sublimate from precipitating]

5.80 LETTSOM, J.
The Naturalist's and Travellers's Companion, Containing Instructions for Collecting & Preserving Objects of Natural History... 2nd ed., London, E. & C. Dilly (1774).
[Quotes Kuckhan's *[Abs 5.78]* and Capt. Davis' *[Thomas Davies, Abs 5.44]* methods. When birds or quadrupeds must be kept for extended periods in hot climates, they shoud be placed in boxes filled with tow, oakum, or tobacco which have been sprinkled with a sublimate solution]

5.81 LEYLAND, J.
Adventures in the Far Interior of South Africa Facsimilie of the 1866 ed., Cape Town RSA, C. Struik (Pty.) Ltd. (1972).
[Recommends corrosive sublimate as a preservative for crustacea. Lists Waterton's method *[cf Abs 5.126]* as: 1 tsp of powdered corrosive sublimate in a wine bottle of alcohol, allowed to stand overnight, then drawn off in a clean bottle. Test with a black feather dipped in the solution. If too strong, it will leave a "whiteness" on the feather and should be diluted with additional alcohol]

5.82 LINDBERG, S.
Emission and deposition of atmospheric mercury vapor, 89-106 in
Lead, Mercury, Cadmium and Arsenic in the Environment T. Hutchinson & K. Meema, eds., New York, John Wiley & Sons, Ltd. (1987).
[Reviews the global geochemical cycle of mercury from anthropogenic and natural sources. Activated charcoal adsorption traps are used to collect elemental and chemically bound Hg. Data suggest that the predominant atmospheric species is elemental Hg vapor. This is conducive to long range transport and to direct uptake by flora and fauna. Organic and inorganic Hg compounds react with organic matter in soil to release elemental Hg vapor. Soil microorganisms mediate the volatilization of elemental mercury. While little is known about the reactivity of mercury vapor in the atmosphere, the authors suggest that as precipitation acidity and airborne oxidant concentrations increase, the deposition of Hg from the atmosphere also will increase]

5.83 LINDBERG, S., STOKES, P., GOLDBERG, E. & WREN, C.
Group report: mercury, 17-33 in Abs 5.82
[Discusses questions about mercury and human health, environmental systems, natural and anthropogenic sources, use, methylation, and toxicity reduction. Notes the lack of data on the effects of long-term, low-level chronic exposure to mercury in man. Environmentally, mercury is the only toxic metal consistently biomagnified by aquatic food chains and it is suggested that continued monitoring of mercury in biota is warranted. Anthropogenic releases of mercury into the atmosphere may not alter the global cycle of natural emission and deposition of mercury, however, other anthropogenic pollutants, including ozone and peroxides, could alter the cycle, possibly by increasing the rate of deposition]

5.84 LLOYD, C.
The travelling naturalist Charles Waterton,
Discovery 19 (1986) 22-27.
[As an alternative to arsenic, naturalist Charles Waterton (1782-1865) reportedly dissolved mercuric chloride in a bottle of wine and used it to preserve everything from large animal skins to insects, and to waterproof top hats, clothing, carriage upholstery, furs, and bonnet feathers]

5.85 LO BIANCO, S. (translated from the original Italian by E. Hovey, 1899)
The methods employed at the Naples Zoological Station for the preservation of marine animals, 11-70 in
Notes on Methods for the Narcotization, Killing, Fixation, and Preservation of Marine Organisms Woods Hole, H. Russell, comp., Massachusetts USA, Systematics-Ecology Program, Marine Biological Laboratory (1963).
[An aqueous solution of chromic acid is the most useful reagent next to alcohol, especially for killing and hardening gelatinous and soft animals. It is mixed with osmic, acetic, or picric acid, or with corrosive sublimate in fresh or sea water. Corrosive sublimate is much used as a fixative because it permeates tissues rapidly and hardens them greatly. It is used in concentrated solutions with fresh or sea water, hot or cold. Metallic implements cannot be used because they decompose the solution and stain the specimen. Corrosive sublimate can be mixed with acetic or chromic acid or with copper sulphate. Animals treated with corrosive sublimate must be washed before placing them in alcohol, and iodine should be added dropwise until the alcohol is permanently colored. If this is not done, the mercury will be reduced and stain the animal black. Suggests mercuric chloride containing killing or fixative solutions for specific marine taxa, usually as part of a series of treatments. Solutions include: cold, hot, or boiling saturated corrosive sublimate; 90% alcohol/sublimate; cold or boiling sublimate/acetic acid; sublimate/chromic acid; sublimate/copper sulfate; sublimate/1% osmic acid; concentrated pyroligneous acid/sublimate/chromic acid]

5.86 MACARTNEY, J.
On the means of preserving animal and vegetable substances, 99-101 in
Report of the 6th Meeting of the British Association for the Advancement of Science held at Bristol August 1836 London, John Murray (1837).
[In preparing animal skins it is customary to treat the interior with arsenical paste or corrosive sublimate solution, but these are not always effective in preventing insect attack on the exterior of skins. Recommends non-toxic substitutes]

5.87 MACGREGOR, J.T. & CLARKSON, T.W.
Distribution, tissue binding and toxicity of mercurials, 463-503 in Abs 5.54
[Brief review of the historical knowledge of the toxicity of and chemistry of mercury. Mercuric salts readily are reduced to mercurous salts and these are easily oxidized to the mercuric state. Compared with mercuric chloride, mercurous chloride is relatively insoluble. The mercurous ion forms few complexes, partly because the greater ability of mercuric ions to form stable complexes with ligands favors disproportionation of the mercurous ion. Elemental mercury in equilibrium with its vapor at 24°C is a health hazard because it results in a concentration 366 times that recommended for occupational exposure by the National Institute for Occupational Health and Safety (NIOSH-). Mercuric chloride is extremely covalent and is more soluble in organic solvents than in more polar solvents. Mercuric ion adds to olefins readily but the presence of complexing agents

can cause the reaction to reverse. Mercurials have a very high affinity for sulfydrl groups, which are found in most proteins. Reviews, in detail, current knowledge of the distribution of mercurials in body fluids and tissues, and molecular binding sites of mercury vapor, mercuric salts, and methylmercury. Also reviews the treatments for mercury poisoning, including the development of thiol chelating agents to remove mercury from binding sites]

5.88 MCAULIFFE, C.
The Chemistry of Mercury ed., London, The McMillan Press Ltd. (1977).
[General reference text on the subject, with 4 parts: history; coordination chemistry; organic chemistry; and biochemistry and toxicology. Extensive bibliographies]

5.89 L'ABBÉ MANESSE
Traité sur la Manière d'Empailler et de Conserver les Animaux, les Pelleteries et les Laines Guillot, Paris (1787). [French]
[The commonly used poisons, arsenic and corrosive sublimate, are ineffective and can lead to excessive hardening and shriveling of specimens]

5.90 MASRI, M. & FRIEDMAN, M.
Interactions of keratins with metal ions: uptake profiles, mode of binding, and effects on properties of wool, 551-587 in Abs 5.53
[The uptake of mercury ions by native wool is compared with that of wool derivatives in which particular functional groups are modified. Tabulations of the results of previous studies on interaction sites are given. Masri and Friedman suggest that, at least in their experimental conditions, mercuric ions do not interact with disulfide functions of native wool keratin; however, mercurous ions do so interact. Formaldehyde solutions desorb significant amounts of bound mercuric ion from native wool treated with mercuric chloride solutions, but not from wool treated with mercurous solutions. This is presumed to be due to formaldehyde competition with the mercuric solution for bonding sites in amino acid residues of the wool. Color change in wool derivatives, particularly to purple, are associated with mercurous ions and with mercuric nitrate, but not with other mercuric solutions. The authors suggest that the color change observed with mercuric nitrate is due to its greater dissociation in water compared to other mercuric compounds, and some conversion of mercuric to mercurous nitrate. With mercurous nitrate, the color may be due to dismutation to mercuric ion and colloidal mercury, or to precipitation of red mercuric sulfide]

5.91 WINDHOLZ, M.,BUDAVARI, S.,BLUMETTI, R.,OTTERBEIN, E. eds
The Merck Index 10th ed., Rahway New Jersey USA, Merck & Co., Inc. (1983).
Chemistry and physical properties of mercury and mercury compounds, with notes on uses, and on health and safety factors. Mercuric chloride "coagulates albumin" and is incompatible with formates, sulfites, hypophosphites, phosphates, sulfides, albumin, gelatin, alkalies, alkaloid salts, ammonia, lime water, antimony and arsenic, bromides, borax, carbonates; reduced iron; copper, iron, lead, silver salts; infusions of cinchona, columbo, oak bark; tannic acid; and vegetable astringents

5.92 METCALF, C. & FLINT, W. 4TH ed., METCALF, R. ed.
*Destructive and Useful Insects, Their Habits and Control*New York, McGraw-Hill Book Co. Inc. (1962).
Mercuric chloride can be used in bookbindings and ant tapes as a repellent to ants, cockroaches, and termites

5.93 METCALFE, J.
Taxidermy, a Complete Manual, London, Gerald Duckworth & Co., Ltd. (1981).
In a list of materials for use in taxidermy, includes corrosive sublimate mixed with wood alcohol, to be painted on the exposed (unfeathered or hairless) parts of mounted birds and mammals as an insecticide. In a listing of British 19th century preservatives, gives the following formulas:
For birdskins
1 oz nutgalls
2 drams corrosive sublimate
2 drams white arsenic
1/2 oz sal ammoniac
1/2 oz powdered capsicum *[pepper]*
For external and internal use on skins
1 dram corrosive sublimate
2 drams spirits of salt
6 oz spirits of camphor
For external use on skins
1 dram corrosive sublimate
? oz wood alcohol (to make a concentrated solution)
For preserving fish and reptiles skins before mounting
3 oz burnt alum in powder
2 oz sublimate of sulphur
1/2 oz oxymariate *[oxymuriate]* of mercury
1/2 oz camphor powder
4 oz oak or elm bark powder

5.94 MUIR, D. LOVELL, M. & PEACE, C.
Health hazards in natural history museum work,
Museums Journal 80 (1981) 205-206.
Gives results of efforts to monitor arsenic and mercury levels in the air, on gloves, and to a minor degree, on specimens, at the Bristol Museum over a 3-year period. Concludes that there is no significant risk from mercury vapor or mercury dust from storage and handling of specimens, however, just 11 specimens (all birds) were examined for mercury contamination

5.95 OSGOOD, W.
A monographic study of the American marsupial *Caenolestes*
Field Museum of Natural History Zoological Series 14 (1921) 1-162
While in Venezuela in 1911, the author preserved 4 anatomical specimens in formaldehyde and mercuric chloride

5.96 ANON
Directions for Making Anatomical Preparations, Formed on the Basis of Pole, Majolin and Breschet, and Including the New Method of Mr. Swan U. Parsons. Philadelphia USA, Carey & Lea (1831).
Inject the arteries of decaying animals with oxymuriate of mercury solution and if this does not stop putrefaction, skin the animal and immerse the body in the solution for 24 hours or more

5.97 PECK, C.
Collecting and preserving fungi. 57-70 in

The Botanical Collector's Handbook, Bailey, ed. Naturalists' Handy Series No.3, Salem Massachusetts USA, George A. Bates (1881).
Recommends the following for poisoning fleshy, coriaceous and corky botanical specimens:
4 drams corrosive sublimate
3 oz sulphuric ether mix
and add
2 oz spirits of turpentine
3 oz alcohol
The mixture must be used immediately or a greasy precipitate will form; apply with a brush

5.98 PECK, W.
A method of preserving birds and other animals, from the *Philosopical Transactions*, recommended by Dr. Lettsom in his Traveller's Companion, and method of collecting and preserving vegetables by Dr. Lettsom. 11-13 of appendix in *Collections of the Massachusetts Historical Society for the Year 1795*, Boston USA, Samuel Hall (1795).
Interior of large sea birds can be treated with a sublimate solution. Mounting paper and stalks of plants in herbaria collections should be sprinkled with a sublimate solution

5.99 PECK, W.
Methods selected from various authors by Mr. Peck of preserving animals and their skins. 10-11 of appendix in Abs 5.102
Gives the following formulas for use on the exterior of animal skins:
1/2 oz sal ammoniac powder
1 pt water
1 oz corrosive sublimate
and
1 pt rectified spirit
1/4 oz corrosive sublimate
The second formula is noted as being "very proper for birds"

5.100 PIECHOCKI, P.
Uber die Geschichte der Praparation von Vogeln
Der Falke 29 (1982) 114-122. *[German]*
General historical review of preparation methods for bird specimens from the 1600's onwards. Notes Kuckhan's dry formula *[Abs 5.78]* in detail, and discusses the methods of several other 18-19th century authors who suggested mercury compounds for preparing birds

5.101 PINEL, P.
Memoire lu a la Societe d'Histoire Naturelle, sur les moyens de preparer les quadrupedes et les oiseaux destine a former des collections d'histoire-naturelle.
Observations sur la Physique, sur l'Histoire Naturelle et sur les Arts 39 (1791) 138-151. *[French]*
Critiques the methods used by others to 1791. Suggests that arsenic be substituted for corrosive sublimate in Kuckhan's dry formula *[Abs 5.78]*. Cites another dry formula using either arsenic or corrosive sublimate:
1 part sublime corrosif ou arsenic
1 part alun calcine
1 part camphre
1 part cannelle ou tout autre aromate
Corrosive sublimate on water applied to the feathers of birds, as suggested by some English authors, will be ineffective due to the oil on the feathers

5.102 POST, G.
Methods of Sampling and Preserving Field Specimens for Laboratory Examination of Laboratory Analysis. Boulder Colorado USA, Pruett Press, Inc. (1967)
Gives the following formulae:
Saturated mercuric chloride in 0.85% sodium chloride
0.85 g sodium chloride
100 ml water
add mercuric chloride until saturated;
Saturated mercuric chloride in 5% potassium dichromate
5 g potassium dichromate
100 ml water
add mercuric chloride until saturated
Schaudinn'Fluid (fixative for protozoa and wet smears of protozoa, cf Abs 5.33)
2 parts saturated mercuric chloride in 0.85% NaCl solution
1 part 95% ethanol or propan-2-ol
add glacial acetic acid to make a 1% solution. Discard mixture after 24 hours.
Zenker's Fluid (fixative for tissue preservation, cf Abs 5.33)
95 parts saturated mercuric chloride in 5% potassium dichromate
5 parts glacial acetic acid

5.103 PRINGLE, J.
Control of mould and insect pests in museums.
SAMAB
5 (1953) 257-263.
Survey of museums used in South African museums. At the time of the survey, the South African Museum used with corrosive sublimate or paraffin (petroleum distaillate) to treat newly received ethnographical objects, if infested with with insects.

5.104 PUFFER, J.
Toxic minerals
The Mineralogical Record (Jan-Feb 1980) 5-11.
Ingestion of mercury minerals may lead to kidney poisoning, and acute calomel (mercurous chloride) intoxication causes irritation and corrosion of the contacted tissues. Minimum lethal ose of calomel is 0.35 g/ 70 kg person. Chronic exposure to vapours from mercury ores may result in central nervous system effects including tremors, and psychic and emotinoal disturbances.

5.105 RICHARDSON, E., HINDLE, B., & MILLER, L.
Charles Willson Peale and His World New York, Harry N.Adams Inc. (1983).
American artist and naturalist, C.W.Peale (1741-1827), first experimented with turpentine as a preservative, then arsenic sollutions and, for larger animals, bichloride of mercury.

5.106 RICK, A.
Use of museum specimens in toxic chemical research.
Canadian Wildlife Service Occasional Paper No.21 (1975) 1-21.
Cites examples of museum biological specimens used for analyses of environmental contaminants, including mercury. Because analyses may be compromised by past treatment of collections, the author reviews some of these treatments to alert researchers to potential problems. Specimens listed as treated with mercurials are mammal skins, bird skins, molluscs and plants.

5.107 RIDGWAY,R.
Directions for collecting birds
Bull. United States National Museum 39 (1891) 1-27.
Lists vermillion as one of the water colour pigments for colouring field sketches of birds prior to preparation. Alcohol solutions of corrosive sublimate can be used effectively as insecticides, but are dangerous to health and are not recommended unless no substitute can be obtained.

5.108 ROWLEY,J.
The Art of Taxidermy New York, D.Appleton & Co (1898)
Gives the following formula for a oison to be brushed or sprinkled on the exterior mammal skins, and to be sprayed on the exterior of bird skins:
1 qt alcohol
1 pt water
add bichloride of mercury until saturated.

5.109 ROWLEY, J.
Taxidermy and Museum Exhibition. New York, D.Appleton & Co. (1925).
Advocates the following spray poison for the exterior of mounted specimens or mounted heads infested with moths or dermestids, after spraying or painting the specimens with gasoline:

1 gal	water
2 oz	dry citric acid
4 oz	bichloride of mercury

5.110 SANDELL, E.
Colorimetric Determination of Traces of Metals. 3rd ed., New York, Interscience Publishers, Inc. (1959).
Discusses separation and extraction methods to prepare samples, as well as colorimetric techniques for mercury determination. Notes that it should be possible to isolate low concentrations of elemental mercury from an aqueous medium containing a strong reducing agent by shaking the extract with an oxidizing agent. Distillation of Hg in a stream of chlorine has been used to separate it from biomaterials. Some of the hazards in mercury determination are that due to its volatility, it is present everywhere, many laboratory reagents contain appreciable amounts of mercury, and mercury is adsorbed readily on glass, especially from neutral solutions. Divalent mercury readily forms an orange complex when reacted with excess dithizone in a 1N sulfuric or nitric acid medium. The complex is soluble in carbon tetrachloride or chloroform. The solutions are extremely light sensitive and the color will change when exposed to strong light. All interferences from other metals are believed to be eliminated in Hg determination if EDTA and potassium thiocyanate are used to form complexes in an acetate-buffered solution.

5.111 SARBHAI, K. and SAXENA, L.
The reduction of mercuric chloride by aliphatic compounds induced by peroxodisulphate ion and a free radical mechanism for the reducing action of formic acid
Journal of Inorganic Nuclear Chemistry 34 (1972) 2563-2568.
The authors ascribe the direct reduction of mercuric chloride by formic acid to the free radical CO_2^-. Potassium peroxodisulfate is used as an inductor to elucidate the reaction mechanism. In any system where the CO_2^- radical is produced, reduction to the mercurous state will occur. With formic acid this is said to involve rearrangement, with a COOH radical as a chain propagating species, furnishing the CO_2^- radical. In the presence ultraviolet light or of hydrogen peroxide, mercuric chloride reduction by formic acid increases. According to a table in the text, the reduction of mercuric chloride by 0.2M ethylamine in the presence of peroxodisulfate yields a black percipitate, with no formation of mercurous chloride

5.112 SINGER, W. & NOWAK, M.
Mercury compounds. 157-171 in
Kirk-Othmer Encyclopedia of Chemical Technology v.15 3rd ed., New York, John Wiley & Sons (1981).
Mercuric chloride is particularly dangerous due to: relatively high (compared to mercurous chloride and many other mercurials) water solubility; solubility in a number of other fluids; and high vapor pressure. Maximum atmospheric concentration for inorganic mercury is listed as 0.1 mg Hg/m^3. A threshold limit value of 0.05 mg/m^3 has been proposed. Recommends periodic medical exams, including analysis of blood and urine, for all workers exposed to contact with mercury compounds or mercury vapor. Discusses the difficulties inherent in various methods of removing mercury salts from wastewater, etc., including the use of water soluble reducing agents, for example, formaldehyde buffered to a pH of 10-12 to liberate metallic mercury

5.113 SIROIS, J. & TAYLOR, J.
The determination of arsenic and mercury in natural history specimens using radioisotope x-ray spectrometry and scanning electron microscopy
Paper presented at the IIC-CG Meeting, Toronto, Canada, 27-30 May, 1988.
Radioisotope excited x-ray spectrometry (XES) can be used to determine the presence of arsenic and mercury in museum specimens. The analysis takes 200-300 seconds, is non-destructive, and can detect large deposits inside specimens or detect the metals on the surface. SEM and or XES were used to examine surface of fur, skin and feather samples, the filter paper used to collect dust from the specimens, and gloves used to handle specimens. Analysis of 110 natural history objects with XES revealed that 68% contain arsenic, 8% contain mercury, and 7% contain both. Highest concentrations were found on the inside of skins. Only minor amounts were detected on exterior fur and feathers. No arsenic was detected on the filter paper or gloves. Arsenic is very unevenly distributed on and in the specimens. Gives excellent safety guidelines for handling contaminated specimens

5.114 SNYDER, S. and VIGO, T.
Removal of mercury from aqueous solutions by N-(2-aminoethyl)aminodeoxycellulose cotton
Environmental Science and Technology 8 (1974) 944-946.
At concentrations in the range of 3.1-0.6 ppm, 100 mg of the cotton derivative, AEAC, removes about 90% of the mercury present in 200 ml of an aqueous solution. Unmodified cotton is as effective as AEAC in removing very low concentrations of mercury, however the AEAC has a superior capacity to bind large amounts of mercury

5.115 SPEAKMAN, J. & COKE, C.
The action of mercuric chloride on wool and hair
Transactions of the Faraday Society 35 (1939) 246-262.
The extent of mercuric chloride combined with wool and hair is measured by estimating the mercuric chloride concentration of a solution before and after contact with the fibers. Fibers studied are human hair, and untreated, deaminated and

quinone-treated merino wools. Despite differing sulfur contents, human hair and merino wool do not differ significantly in their affinity for mercuric chloride at 25°C. However at 40°C, disulfide bond attack occurs with merino wool. In the case of untreated wool, combination occurs chiefly with arginine and lysine side chains at low temperatures. The authors note that mercuric chloride, and especially, mercuric acetate, are capable of using sulfhydryl and other groups in animal fibers to form cross-links between peptide chains

5.116 SPENCER, G.
Control of pests in insect and herbarium cabinets.
Proceedings of the Entomological Society of British Columbia 60 (1963) 23-26.
Solutions of mercury bichloride have long been used to combat beetles in herbaria collections, but after one year, the mercury sublimes and no longer affords protection

5.117 SPERANZA, V., SKINNER, R., BOYLSTON, E. & FROMOWITZ, F.
A disadvantage of alcoholic iodine solutions for removal of mercury pigment from tissue sections.
Journal of Histotechnology 10 (1987) 253-255.
Substantial calcium depletion occurs when alcoholic iodine solutions are used to remove black, amorphous deposits of mercury pigment from tissues treated with mercuric chloride fixatives. The pH of alcoholic iodine (0.5 gm iodine in 100 ml 80% ethanol) is 2.9, and therefore acidic enough to account for the loss of calcium. The particular mercury fixative used does not have an impact on the calcium depletion

5.118 STANSFIELD, G.
Pest control - a collection management problem.
Museums Journal 85 (1985) 97-99.
Some herbaria, including until recently the University of Leicester Herbarium, protect specimens against insects by dipping the sheet, with the specimen attached, into a mercuric chloride solution. While this is effective, the potential danger to humans has caused the treatment to be abandoned in most collections

5.119 STEEDMAN, H.F.
Miscellaneous preservation methods. 175-181 in
Zooplankton Fixation and Preservation H.F. Steedman, ed., Paris, The Unesco Press (1976).
Mercuric chloride has value as a fixative, but disadvantages as a long-term preservative because it is poisonous and corrosive

5.120 STEWARD, W., GUIRGIS, H., SANDERSON, J. & TAYLOR, W.
Urinary mercury excretion and proteinuria in pathology laboratory staff.
British Journal of Industrial Medicine 34 (1977) 26-31.
Briefly traces the use of mercuric chloride fixatives in histology and notes that this use is associated with atmospheric concentrations of mercury vapor of up to 0.5 nmol/l. Technicians working in this environment show increased urinary mercury and protein outputs. Proper ventilation and careful handling of mercuric chloride solutions reduces the level to acceptable limits and is associated with the disappearance of trace proteinuria from urine

5.121 STRZELCZYK, A.
Influence of antifungal vapors on spore germination of fungi isolated from deteriorated old books.
Canadian Journal of Microbiology 14 (1968) 901-906.
Standard preservation practices in Poland include use of a mixture of thymol and mercuric chloride in ether-benzene, either rubbed into book pages or for saturation of interleaving pages. Vapors of p-chloro-m-cresol, pentachlorophenol, mercuric chloride, and phenylmercuric acetate are assessed in terms of their effects on spores and hyphae of strains of *Fusarium*, *Penicillium*, *Sepedonium*, and *Trichothecium*. Results indicate that concentrations sufficient to inhibit spore germination also cause hyphal deformation. Low concentrations of fungicides, with the exception of phenylmercuric acetate, have a stimulatory effect on spore germination. Mercuric chloride exhibits killing effects only at a concentration of at least 100 ppm

5.122 TRAIL, T.
On the preservation of zoological specimens from the depredations of insects.
Edinburgh Philosophical Journal 14 (1826) 135-138.
Compounds containing arsenic or corrosive sublimate are known to be effective against insects, but can embrittle skins unless used with caution, and cannot be used to protect entomology collections. A strong solution of corrosive sublimate in alcohol is ineffective against mites infesting the hair on a seal skin

5.123 UTHE, J. & ARMSTRONG, F.
The microdetermination of mercury and organomercury compounds in environmental materials. 21-53 in
Analytical Aspects of Mercury and Other Heavy Metals in the Environment R. Frei & O. Hutzinger eds., London, Gordon & Beach Science Publishers (1975).
Reviews the literature on microdetermination of mercury. Notes that an AOAC recommended spectrophotometric method, based on wet digestion of tissue followed by determination of dithizone complex, is not readily adaptable where less than 1 gm of material is available as a sample. For determination of total mercury, discusses various digestion procedures; colorimetric determination with dithizone and other colorimetric methods; atomic absorbtion; NAA; and miscellaneous methods such as atomic fluorescence, x-ray fluorescence for concentrations of 2-240 ppm, emission spectrography, mass spectrometry, radiochemical methods, and microbiological assay. An example of flameless AAS, suitable for large numbers of samples, is discussed in detail. Also reviews extraction and determination procedures for organomercurials

5.124 WAGSTAFFE, R. & FIDLER, F.
The Preservation of Natural History Specimens v.1., Invertebrates. New York, Philosophical Library (1965).
In addition to Zenker's Fluid *[cf Abs 5.31 & 3]*, modified here by the addition of 1 gm sodium sulfate, lists the following reagents for use in natural history preservation/preparation:
Donisthrope's Fluid (Fixative recommended by Donisthrope for killing ants. Absolute alcohol is replaced here by industrial methylated spirit.)

5 ml	glacial acetic acid
37 ml	95% alcohol
58 ml	distilled water
0.12 gm	corrosive sublimate