

BIBLIOGRAPHY OF MATERIAL RELATED TO THE PRESERVATION OF OUTDOOR BRONZES

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CORROSION

Chilton, J.P., Principles of Metallic Corrosion, The Chemical Society Monographs for Teachers no. 4, London, 1073 (The Chemical Society Publications Sales Office, Blackhorse Road, Letchworth, Herts., SG6 1HN ENGLAND.

Evans, Ulick R., An Introduction to Metallic Corrosion, London, 1948.

Evans, Ulick R., The Corrosion and Oxidation of Metals: Scientific Principles and Practical Applications, London, 1967.

LaQue, F.L., and Copson, H.R., Corrosion Resistance of Metals and Alloys, 2nd ed., American Chemical Society Monograph Series, N.Y., 1963.

Unlig, H.H., Corrosion and Corrosion Control, N.Y. 1971.

ATMOSPHERIC CORROSION INVESTIGATIONS

1860s and following years - investigations of the Berlin Patina Commission see, e.g. Magnus, G., "Concerning the Influence of the Composition of Bronzes on the Attainment of a Beautiful Green Patina", Dinglers Polytech. J., 172, pp. 370-6, 1864.

1908 - Looock found basic copper sulfate in the patina of the Jan Willem monument, but this was thought to be a special case (Lewin-Alexander bibliography, ATTA, VI, 4; and VII, 1, 1967-68)

1923-24 - Vernon, W.H.J., "First Experimental Report to the Atmospheric Corrosion Committee of the British Non-Ferrous Metals Research Association", Transactions of the Faraday Society, XIX, 1923-24, pp. 839-934.

1927 - Vernon, W.H.J., "Second Experimental Report to the Atmospheric Corrosion Committee, British Non-Ferrous Metals Research Association", Transactions of the Faraday Society, XXIII, 1927, pp. 113-204.

1929 - Vernon and Whitby, "The Open-Air Corrosion of Copper. A Chemical Study of the Surface Patina", J. Inst. Metals, 24, no. 2, 1929, pp. 181-95. Identified the green corrosion product of bronze exposed to the open air as primarily basic copper sulfate.

1930 - Vernon and Whitby, "The Open-Air Corrosion of Copper, Part II, The Mineralogical Relationships of Corrosion Products", J. Inst. Metals, 44, no. 2 1930, pp. 389-96.

1931 - Vernon, W.H.J., "A Laboratory Study of the Atmospheric Corrosion of Metals, I. The Corrosion of Copper in Certain Synthetic Atmospheres with Particular Reference to the Influence of Sulphur Dioxide in Air of Various Relative Humidities", Transactions of the Faraday Society, 27, 1931, pp. 255-277.

1932 - Vernon, W.H.J., "The Open-Air Corrosion of Copper, Part III, Artificial Production of Green Patina", J. Inst. Metals, 49, 1932, pp. 153-61.

1953-54 - May, R., "Some Observations on the Mechanism of Pitting Corrosion", J. Inst. Metals, 82, 1953-54, pp. 65-74.

1956 - Atmospheric Corrosion of Non-Ferrous Metals, ASTM StP 175, Philadelphia, 1956. Articles by: Thompson, Tracy and Freeman, "The Atmospheric Corrosion of Copper--Results of 20-year Tests", pp. 77-87; and Tracy, "Effect of Natural Atmospheres on Copper Alloys--20-year Test", pp. 67-76.

1968 - Metal Corrosion in the Atmosphere, ASTM StP 435, 1968. Articles by E. Wattsson and R. Holm, "Copper and Copper Alloys", pp. 187-210; and D.H. Thompson, "Atmospheric Corrosion of Copper Alloys", pp. 129-140.

1971 - Leidheiser, H. The Corrosion of Copper, Tin, and their Alloys, Corrosion Monograph Series, N.Y., 1971. See Ch. I on Atmospheric Testing, literature survey up to 1970.

CONSERVATION

1933 - Gettens, R.J., "The Composition of the Patina on a Modern Bronze Statue", Technical Studies in the Field of the Fine Arts, II, 1, July 1933, pp. 31-33.

1950s - Bearzi, B., "S. Ludovico is Given Back his Golden Glory", in Poggi, Planiscig, and Bearzi, Donatello, S. Ludovico, N.Y., n.d. (Scientific analysis in R. Baistrocchi, "Orientative spectrochemical research on some Italian antique bronzes", Spectrochim. Acta, V, 1952, pp. 24-29.

1951 - Jack, J.F.S., "The Cleaning and Preservation of Bronze Statues", Museums Journal, 50, no. 10, Jan. 1951, pp. 231-236.

1964 - I° Convegno Internazionale sui problemi della conservazione delle opera d'arte: Il bronzo e I metallic antichi non ferrosi, Spoleto, 5-12 Ottobre 1964 (mimeographed pre-prints). Especially the papers by: B. Bearzi, "Restauro, corrosione, autoprotezione del bronzo"; S. Liberti, "An enquiry into the state of preservation of the bronze horses from St. Mark's Basilica in Venice"; Panseri and Leoni, "Metallographic examination of the horses from St. Mark's Basilica, Venice".

1965 - P. Rotondi, "Allarme per i cavalla della Basilica di S. Marco a Venezia", Bollettino del Istituto Centrale del Restauro, Rome, 1965, pp. 6-20.

1967 - R.J. Gettens, "Preservation and Restoration of Out-door Metal Sculptures" (mimeographed), 6° Reunion Mixte du Comite de l'ICOM. Study begun by Murray Pease in 1964, preliminary report underlining the need for further study.

1967-68 - S.Z. Lewin and S. M. Alexander, "The Composition and Structure of Natural Patinas, Part I. Copper and Copper Alloys, Section A. Antiquity to 1929; Section B, 1930 to 1967", AATA, VI, 4, 1967; VII, 1, 1968.

1968 - M. Leoni and C. Panseri, "Influenza delle condizioni ambientali sulla corrosione delle opere d'arte metalliche e problemi relative alla loro conservazione", Storia della Metallurgia, Atti notizie, no. 3, pp. 79-86.

1971 - J. Riederer, "Die Zerstörung von Kunstwerken durch luftverunreinigende Stoffe", Schönere Heimat, 2, pp. 44-47.

1972 - J. Ternback, "Restoration of Bronzes Ancient and Modern", paper presented at meetings of IIC-AG, June 1972, abstract in IIC-AG Bulletin, vol. 12, no. 2, pp. 110-116.

J. Riederer, "Korrosionsschäden an den Bronzen der Münchner Residenz", Deutsche Kunst und Denkmalpflege, 30, H.1, pp. 49-56.

ICOM Committee for Conservation, Madrid Conference, October 1972, papers presented to the Working Group on Metals chaired by R. Organ, especially:

F. Ogburn, E. Passaglia, H. Burnett, J. Kruger, and M. Picklesimer (National Bureau of Standards, Washington, D.C.), "Structural Repair and Surface Restoration of Four Twentieth-Century Gilded Bronze Equestrian Statues" (published in Technical News Bulletin, National Bureau of Standards, vol. 56, no. 11, Nov. 1972, "A Horse of Another Color", pp. 256-57)

J. Riederer (Doerner Institut, Munich), "Corrosion Damage on Bronze Sculptures"

J. Lehmann (National Museum, Poznan, Poland), "Corrosion of Monuments and Antiquities made of Copper and Copper Alloy in Outdoor Exhibits"

M. Leoni, "Il danneggiamento delle opera d'arte metalliche per corrosione atmosferica", Metallurgia Italiana, n. 6, pp. 1-3.

1973 - M. Marabelli, "Bronzo--leghe del rame", pp. 91-103; "Esami chimici e fisici di bronzi esposti all 'aperto", pp. 472-485; "Conservazione di bronzi corrosi", pp. 487-499; Problemi di Conservazione, G. Urbani, ed., Bologna, 1973.

1974 - P. Weil, "Problems of Preservation of Outdoor Bronze Sculpture: Examination and Treatment of The Meeting of the Waters in St. Louis, Missouri", AIC Bulletin, vol. 14, no. 2, pp. 84-92.

P. Weil, "The Use of Glass Bead Peening to Clean Large-Scale Outdoor Bronze Sculpture", AIC Bulletin, vol. 15, no. 1, pp. 55-58.

1975 - P. Weil, "The Approximate Two-Year Lifetime of Inctalac on Outdoor Bronze Sculpture", ICOM Committee for Conservation, 4th Triennial Meeting, Venice, 1975. (preprint no. 75/22/2)

1976 - P. Gaspar, L. Gulbransen, K. Morris, P. Weil and D. Zimmerman, "Conservation of Outdoor Bronze Monuments", Archaeometry Symposium, Edinburgh, March, 1976 (papers to be printed)

P. Weil, "A Review of the History and Practice of Patination" Symposium on Corrosion and Metal Artifacts, National Bureau of Standards, March 1976 (papers available from Supt. of Documents, U.S. Govt Printing Office, Wash. DC 20402)

P. Weil, "The Conservation of Outdoor Bronze Sculpture", National Sculpture Review, November, 1976.

GENERAL INFORMATION ON THE FIELD OF ART CONSERVATION

1. **Basic requirements** for entering the field include interest in and aptitude for: (a) fine arts, including practical experience in sculpture, painting, drawing or crafts, with demonstration of good manual dexterity; (b) art history; (c) science, especially Chemistry and Physics. An ability to write good, clear prose is as important to being a good Art Conservator as it is to being successful in most other fields.
2. **Art Conservation Training Programs:**
 - a. Conservation of Historic and Artistic Works
Cooperstown, New York 13326
 - b. Conservation Center/Institute of Fine Arts
New York University
1 East 78th Street
New York, N.Y. 10021
 - c. Winterthur Conservation Program
309 Old College
University of Delaware 19711
 - d. Queen's University Conservation Program
Queens University
Kingston, Ontario
Canada
3. **Professional organizations:**
 - a. International Institute for Conservation of Historic and Artistic Works (IIC)
6 Buckingham Street
London WC2N 6BA
England
periodicals: Studies in Conservation
Art and Archaeology Technical Abstracts
 - b. American Institute for Conservation (AIC)
1522 K Street, N.W., Ste. 804
Washington, D.C. 20005
(202) 638-1444
periodical: Journal of the AIC
4. **Code of Ethics:** "Code of Ethics and Standards of Practice" 1979 (available from the AIC office)
5. **Basic Bibliography:** H.J. Plenderleith and A.E.A. Werner, The Conservation of Antiquities and Works of Art, 2nd ed, 1971, Oxford University Press, London, 1974.

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August 1979

CONSERVATION JOURNALS AND ORGANIZATIONS:

AATA	Art & Archeology Technical Abstracts	ICOM	International Council of Museum Papers
AIC	Journal of the American Institute for Conservation	IIC	International Institute for Conservation of Historic and Artistic Works
ASTM	American Society for Testing and Materials	IIC-AG	International Institute for Conservation of Historic and Artistic Works - American Group
CCI	Canadian Conservation Institute Publications and Notes	TC	Technology and Conservation (published erratically, now defunct)
GCI	Getty Conservation Institute		