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CV NEWS LETTER 27

comite technique du corpus vitrearum

ICCROM 13 VIA DI SAN MICHELE ROMA 22 JUIN 78

THIS ISSUE CONTAINS ARTICLES ON:
DIESE NUMMER ENTHÄLT FOLGENDE BEITRÄGE:
CE NUMERO CONTIENT DES ARTICLES SUR:

1 generalities
2 zur restaurierung des marienfensters aus st. patroki in soest
3 aussenschutzverglasung
4 recent work
5 discussion section
6 abstracts

1 generalities

1.1 PROCEEDINGS OF THE 10th COLLOQUIUM OF THE CVMA, HELD IN STUTTGART AND FREIBURG-I-BR. (1977)

The German Committee of the Corpus has now published the Proceedings of the Colloquium, held from 22nd to 28th May 1977 (Akten des 10 internationalen Colloquiums des Corpus Vitrearum Medii Aevi), in the form of a nicely-bound booklet, measuring 210 x 150 mm, and having a blue cover. The 72 pages of the Proceedings contain abstracts of all the communications and discussions, i.e.,

Rudiger Becksmann, "Architekturbedingte Wandlungen in der deutschen Glasmalerei des 13. Jahrhunderts" (Changes in 13th-century glass painting introduced by architectural considerations), pages 19-20.

Karl-Joachim Maercker, "Frühe thüringisch-sächsische Glasmalereien und ihr Verhältnis zu Skulptur und Malerei" (Early Thuringian-Saxon glass painting and their dependence on sculpture and paintings), page 21.

Ulf-Dietrich Korn, "Das Lohner Jesse-Fenster und die Soester Wandmalerei um 1250" (The Lohner Jesse window and the Soest wall paintings of 1250), pages 22-23.

Victor Beyer, "Le Zackenstil à Strasbourg" pages 24-25.

Louis Grodecki, "Le Style "dur" de la peinture sur verre en France" (The "hard" style of glass painting in France), pages 26-28.

Nigel Morgan, "Early grisaille windows in England", page 29.

Madeline H. Caviness, "New observations on the Channel School: A French glass-painter in Canterbury", pages 30-31.

Eva Frodl-Kraft, "Zum Werden der "gotischen" Farbsprache in der Glasmalerei" (On the change in colour-expression by "Gothic" glass-painters), pages 32-34.

Bruno Mühlethaler, "Kennen wir die Grenzen und Möglichkeiten fur die Erhaltung mittelalterlicher Glasmalerei?" (Do we know the limits and possibilities for the preservation of medieval painted glass?), pages 37-46.

M. Perez y Jorba and R. Collongues, "Recherches récentes sur le processus de corrosion des vitraux", page 47.

Jean-Marie Bettembourg, "Les problèmes de la conservation des vitraux de la cathédrale de Bourges", page 48.

Ulf-Dietrich Korn, "Zur Restaurierung der Chorfenster der Stiftskirche zu Bücken" (On the restoration of the Choir window of the convent church at Bücken), page 49.

Dennis King, "Problems with the Ely Glass", page 50.

Gottfreid Frenzel, "Bericht über die Erstellung eines Glasmalerei-schadensatlas fur die Bundesrepublik Deutschland" (Report on the preparation of an atlas of damage to stained glass for the Federal Republic of Germany), page 51.

Ernst Bacher, "Zu aktuellen Fragen der Konservierung mittelalterlicher Glasgemälde" (Timely questions concerning the conservation of medieval stained glass), pages 52-53.

The Minutes of the CVMA Meeting are reported on pages 55-58, and the Closing Session is on pages 59-60. The booklet also includes names and addresses of the delegates to the Colloquium, and of the National Committees.

These abstracts have not been included in Section 6 of this News Letter because they are available in this booklet which is obtainable, free-of-charge, from Arbeitstelle Corpus Vitrearum Medii Aevi Deutschland, Urbanstrasse 84, D-7000 STUTTGART 1.

1.2 THE THIRD GERMAN CORPUS VOLUME

The end of the year will see the publication of the third German Corpus Volume (Vol II, 1, Die mittelalterlichen Glasmalereien in Baden und der Pfalz ohne Freiburg i. Br., by Rudiger Becksmann). The publishers are the Deutscher Verlag für Kunstwissenschaft, Berlin, and the volume will consist of 460 pages (308 of text), including 171 figures and 40 illustrations in the text as well as 500 monochrome plates and 14 in colour. The published price is expected to be considerable and hence the editor and the publisher have agreed to offer

the volumes, on a personal basis only, to Members of the Corpus at an advantageous pre-publication price. The figure has not yet been fixed but reservations for the Volume may be sent immediately to the Arbeitstelle in Stuttgart (at the address given at the end of Section 1.1).

1.3 MEETING OF THE PROJEKTGRUPPE GLAS IN BONN ON 13th MARCH 1978

1.3.1 New Chairman - Dr J.C. Ferrazzini

During the meeting Professor Dr Horst Scholze resigned from the position of leader of the Projektgruppe and the members unanimously elected Dr Jean-Claude Ferrazzini (from the Institut für Denkmalpflage of the E.T.H., Zürich) to take his place. The next meeting is likely to take place at the end of February or the beginning of March, 1979 and we can send our good wishes to Dr Ferrazzini for a happy term of office and the organisation of many successful meetings. Any suggestions for topics to be discussed at future meetings should be sent to Dr Ferrazzini at The Institut, CH-8092, ZÜRICH.

1.3.2 Papers read at the meeting

The following papers were read at the meeting; copies were received too late for abstracting in this Number of the Newsletter but abstracts will be given in NL No.28.

C. Sellner and B. Camara, "Untersuchungen von Waldgläsern (17.Jahrhundert) mit der UV-VIS-NIR-Spektroscopie und der Elektronenspin-resonanz (ESR)" (The use of UV-VIS-NIR-Spectroscopy and electron spin resonance for studying 17th-century forest-type glasses).

G. Nauer and E. Kny, "Zur numerischen Klassifikation römischer Gläser aufgrund ihrer Elementgehalte" (A numerical system for classifying Roman glasses on the basis of their chemical composition).

J.C. Ferrazzini, "Vorschlag zur theoretischen Ermittlung der Zusammensetzung der Gläser von Johannes Kunckel (1630-1703)" (Suggestion for the theoretical investigation of the compositions of Johannes Kunckel's glasses (1630-1703)).

Martha Spitzer-Aronson, "Titan als möglicher Indikator mittelalterlicher gemalter Glaser" (Titanium as a possible indicator of medieval stained glass).
G. Schulze, "Untersuchungen an Rubinglas aus Rastatt" (Researches on ruby glass from Rastatt).

H. Scholze, "Charakterisierung "kranker" Gläser" (The characterisation of "sick" glasses).

1.4 INFORMATION REQUIRED ON CONSERVATION PRACTICES

PROBLEMES DE LA CONSERVATION DES VITRAUX ANCIENS : la recherche internationale

Considérant l'ampleur des problèmes posés par la conservation des vitraux anciens sur le plan international, un rapport général sur ces problèmes qui regrouperait tous les résultats scientifiques et techniques mis en application actuellement dans le monde serait d'une aide précieuse pour les chercheurs et les techniciens de la conservation.

Le L.R.M.H. se propose de réaliser ce rapport avec la participation des membres du Comité Technique et celle de tous les chercheurs travaillant sur cette question.

Les thèmes proposés figurent dans le schéma ci-dessous.

Nous vous serions reconnaissants de bien voulour nous adresser vos commentaires et un texte rédigé sur les sujets correspondant à vos expériences pratiques.

Nous vous remercions par avance de l'intérêt que vous voudrez bien apporter à la réalisation de ce rapport primordial.

Les réponses sont à adresser à:
Monsieur Jean-Marie BETTEMBOURG, Secrétaire du Comité Technique, L.R.M.H., Château de Champs, 77420 CHAMPS SUR MARNE.

RESTAURATION ET CONSERVATION DES VITRAUX ANCIENS (schéma proposé) -

1/ NETTOYAGE DES VITRAUX ANCIENS

10- Altération des verres
- 101. Composition des verres
- 102. Formes d'altération
- 103. Pollution
- 104. Bibliographie

11- Nettoyage mécanique
- 110. Fibre de verre
- 111. Brosse
- 112. Polissage
- 113. Abrasion
- 114. Dangers ou avantages de ces procédés
- 115. Bibliographie, études réalisées...

12- Nettoyage par ultrasons
- 120. Bains utilisés (eau, produits chimiques)
- 121. Dangers ou avantages du procédé
- 122. Bibliographie, études réalisées...

13- Nettoyage chimique
- 130. Eau
- 131. Produits chimiques (liste des produits utilisés)
- 132. Dangers ou avantages des procédés
- 133. Bibliographie, études réalisées...

14- Autres méthodes

2/ RESTAURATION DES VERRES BRISES

20- Plombs de casse (traditionnel, lame de cuivre...)

21- Collage bord à bord (liste des colles utilisées)
22- Collage sur un verre blanc moderne
23- Collage bord à bord et doublage par un verre blanc (nature du joint)
24- Etudes réalisées, bibliographie...

3/ PROTECTION DES VERRES

30- Films de résine (nom des produits utilisés)
31- Doublage d'un verre par un verre blanc (mastics utilisés pour le scellement)
32- Doublage d'un panneau par un panneau en verre blanc
33- Verrières extérieures
34- Autres procédés (films inorganiques...)
35- Dangers et avantages des procédés (condensation...)
36- Etudes réalisées, bibliographie...

4/ MISE EN PLOMB

40- Nature et forme des plombs utilisés (dimensions, etc...)
41- Composition des plombs
42- Remplacement des plombs originaux
43- Méthodes de dessertissage des plombs
44- Techniques de remise en plombs

5/ MASTICAGE DES PANNEAUX

50- Mastic traditionnel (huile de lin...)
51- Mastic élastomère (nom des produits)
52- Avantages ou inconvénients des procédés (vieillissement, difficulté d'emploi...)
53. Bibliographie, études réalisées...

6/ POSE DES VITRAUX

60- Nature des ferrures (barlottieres, vergettes...)
61- Mastics (nom des produits utilisés)
62- Avantages ou inconvénients des procédés
63- Bibliographie, études réalisées...

7/ RESTAURATION DE LA GRISAILLE

70- Altération de la grisaille
71- Recuisson
72- Refixage par une résine (nom des produits utilisés)
73- Restauration de la grisaille (repeint, poudre de graphite...)
74- Avantages ou inconvénients des procédés
75- Bibliographie, études réalisées...

1.5 PRELIMINARY NOTICE OF THE VIIIth CONGRESS OF THE ASSOCIATION INTERNATIONALE POUR L'HISTOIRE DU VERRE

This Congress will be held in England in September 1979, and the preliminary programme envisages working sessions as follows:-

Roman glass, Wednesday 19th September 1979
Medieval, Byzantine and Islamic glass, Tuesday 20th September (morning)
Renaissance glass, Tuesday 20th Sept. (afternoon)
17th to 18th centuries, Friday 21st September (morning)
18th to mid-19th centuries, Saturday 22nd Sept. (morning)
Mid 19th to 20th centuries, Saturday 22nd Sept. (afternoon)
Scientific analysis and conservation in Liverpool on Monday 24th Sept. (afternoon).

During the first week, when meetings will be held in London, visits will be paid to the British Museum, the Museum of London, the Ashmolean Museum (Oxford), the Science Museum, and the Victoria and Albert Museum.

The meetings in London will be followed by a Post Congress Tour (Sunday 23rd to Tuesday 25th September) to Dudley (the new Glass Museum), St Helens (the Pilkington Glass Museum) and Liverpool (the City Museum), and to Scotland.

1.6 NEW INSTRUCTIONS FOR AUTHORS

This News Letter is the first to be published by ICCROM and the Editorial Committee is grateful to them for taking over this responsibility from the Printing Unit of the University of York. Gratitude is also expressed to the University, and especially to the Department of Physics for having produced and published Nos. 11 to 26 inclusive.

In future it will be produced by photo-reduction onto offset printing plates using the original typescript. Authors must therefore be particularly careful to follow these instructions completely. The contributions (in English, French or German) should be typed in single spacing in narrow column width on one side only on good quality paper. The maximum width of the column of typed matter is 105 mm (4 1/8 inches), but wide tables can be accommodated across two columns, in which case the maximum acceptable width is 220 mm (8 1/2 inches).

Typewriters with small typefaces should not be used because the reproduction process involves a reduction in size of about 30%, and very black carbon ribbon should be used to provide good contrast. Pages should be numbered in pencil and the typescript should not be folded or creased in any way.

The typescript should begin on the first page with a summary in English of not more than 200 words. Authors are encouraged to provide summaries in French and German also, but if there is any difficulty in preparing an English summary, the author should contact Dr Bruno Mühlethaler (Schweizerisches Landesmuseum, Postfach 3263, CH-8031 ZURICH-23, Switzerland). Line drawings or photographs should be pasted in the text at the appropriate places and the maximum widths are as before (115 mm or 260 mm). Captions should be typed below each illustration. Please remember that articles as received will not be retyped. Typescripts should be sent to Dr Mühlethaler at the address given above.

2 zur restaurierung des marienfensters von 1549 aus st. patroki in soest

by ulf-dietrich korn

English Summary

"Restoration of the 'Marienfenster' (1549) in the St Patrokli in Soest"

In addition to the well-known medieval windows in St Patrokli there is a less-known, but nevertheless important, Renaissance window. This window was a gift from the town council and was made in 1549-52 by Johan Glasemecker of Fröndenberg/Ruhr. An inscription records that the window was restored in 1876 and missing parts were replaced. It represents "The woman clothed with the sun" and two angels, holding a crown hover over her. The artist is not known and further stylistic investigation is required.

In 1941 the central panel of the window was severely damaged. A few fragments of the heads and robes were recovered by Hans Wentzel but have since been lost. The window is now being restored in Dr H. Oidtmann's workshop at Linnich.

Restoration of the original parts extends from simple glueing of cracks to plating and fixing of loose paintwork. Araldite is used as the adhesive and for the interlayer of limited areas of plating, and the window will be entirely re-leaded. Isothermal glazing will be installed together with a UV-absorbent transparent sheet.

The restoration is being carried out in close co-operation with the Landeskonservator of Westfalen Lippe, and the work is sponsored by the Government of Nordrhein-Westfalen.

(Summary prepared by Ulf-Dietrich Korn and translated by Bruno Mühlethaler)
Additional note by Roy Newton: in response to my enquiry, Dr KORN informs me that the UV-absorbent material is incorporated in the plastic interlayer of the 6mm laminated safety glass, described as "Kinonglas-Kristall mit U.V.-absorber", supplied by Vereinigte Glaswerke, Jülicher Strasse 495, D-5100 AACHEN. The name suggests that a quinone-type U.V. absorber may be used.

Über Rang und Bedeutung der romanischen Glasmalereien in der ehemaligen Stiftskirche St. Patrokli in Soest ist mehrfach geschrieben worden. Nahezu unbekannt ist indes ein weiteres bedeutendes Werk der Glasmalerei, das derselben Kirche gehört: das Marienfenster von 1549. Dafür gibt es mehrere Grunde:

1. Eine zusammenfassende Darstellung der nachmittelalterlichen monumentalen Glasgemälde Deutschlands ist bisher nicht geschrieben worden.

2. Die mittelalterlichen Glasmalereien in Soest sind so umfangreich und zum Teil so bedeutend, dass dies Renaissancefenster daneben vergleichsweise uninteressant erschien.

3. Das Fenster ist seit 1941 nicht mehr zu sehen.

Auch vor 1941 werden nur wenige Besucher von St Patrokli das Marienfenster mit Bewusstsein wahrgenommen haben. Es befand sich im Obergaden des südlichen Querhauses, hoch über einem Altar in der Ostwand.

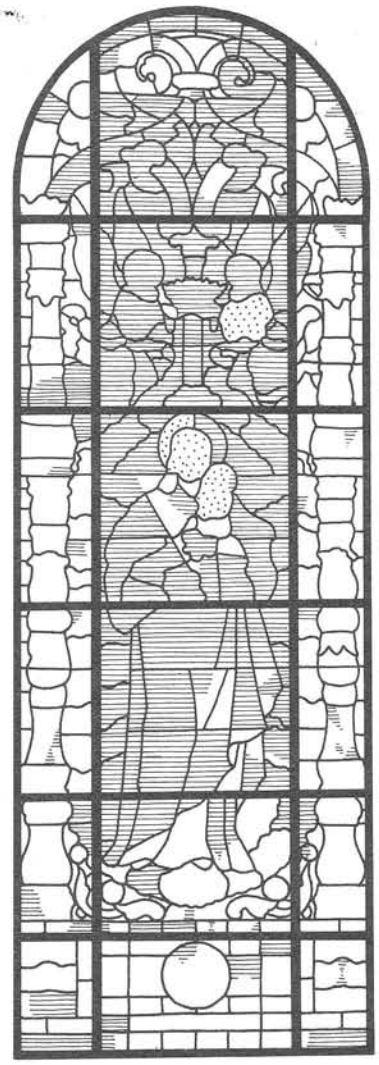
Das Fenster ist eine Stiftung der Stadt Soest. Der Rat der Stadt schloss im Jahre 1549 mit "mester Johan glasemecker" aus Fröndenberg an der Ruhr einen Vertrag über die Herstellung und Lieferung. 1552 war es fertig; Meister Johan Ryneken machte das Eisenwerk dazu. Der Anlass für die Fensterschenkung in die Stiftskirche St Patrokli war vielleicht die Beschwerde des Landesherrn, des Herzogs von Cleve, dass "die Capellen und andere Gotts-häuser, die glassfenster im Münster (= St Patrokli)...reparirt" werden müssten. Möglicherweise war die Fensterstiftung eine Geste der Wiedergutmachung für die Schäden, die in den Wirren der Reformationsjahre im katholisch gebliebenen Patroklistift entstanden waren.

Das Fenster, das 1876 von Victor von der Forst in Münster restauriert und zum Teil ergänzt wurde, zeigt in fünf Zeilen und drei Bahnen die Madonna in der von Wolken umgebenen Strahlenglorie. Über ihr schweben zwei Engel; sie halten eine sternenbesetzte Krone. Die Figurenkomposition wird an den Seiten eingefasst durch schlanke Kandelabersäulen mit Masken, Blattkelchen, geriefelten Säulen und Knäufen. Sie tragen zusammen mit einer Mittelsäule mehrfach verschlungene Volutenbögen mit Akanthuslaub, die wie Masswerk den Fensterscheitel füllen. Sie stehen weiss und silbergelb gegen Lichtblauen Grund. Weiss und Gelb sind auch in den figürlichen Teilen die Hauptfarben, begleitet und akzentuiert durch Rot und Violett an den Engelsflügeln, den Schärpen der Engel und im Gewand der Maria. - Hart am unteren Rand steht in einer Kartusche die Jahreszahl "1549", darüber in einem Medaillon die Inschrift "Renovatum 1876".

Wir wissen zwar, dass Meister Johan Glasemecker das Fenster gefertigt hat, nicht aber, wer den Entwurf lieferte. In der Soester Lokaltradition hält sich hartnäckig der Name "Aldegrever-Fenster". Es gibt dafür keinen Beleg, doch weist der Formenschatz der Ornamentik enge Beziehungen zu Heinrich Aldegrevers graphischem Werk auf. Besonders auffällig ist die vierfache Wiederholung der drei Ovalmasken an den Kandelabersäulen. Sie sind auf den von Aldegrever um 1525 gemalten Flügeln des Marienaltars in der Soester Wiesenkirche zu finden. Eine genaue stilkritische Untersuchung des Fensters steht noch aus.

Am 13.June 1941 durchschlug eine Bombe das Fenster und zertrümmerte die Figuren der mittleren Bahn bis auf geringe Reste. Einige Köpfe und Gewandteile sowie Stücke der erhaltenen Rahmung konnte Hans Wentzel bei der Bergung der Soester Glasmalereien aufnehmen lassen. Seither lagen die Fragmente in einer Kiste. Manches Stück ging in der Folgezeit verloren, auch die Köpfe der Maria und des Christkinds sind seit vielen Jahren verschollen.

Im Zuge der Gesamtrestaurierung von St Patrokli, die seit einigen Jahren im Gange ist, wird nun auch das Marienfenster wiederhergestellt. Obwohl durch den Bombenschaden von 1941 die wichtigen figürlichen Teile weitgehend zerstört sind, ist eine Rekonstruktion doch möglich und verhältnismässig einfach: Es gibt eine recht gute Gesamtaufnahme aus der Zeit um 1900 und die Detailphotos der verschollenen Köpfe, ausserdem



SOEST. ST. PATROKLI
marienfenster von 1549 zustand 1977

zerstörte teile
verschollene teile

enthält das Tafelwerk "Vorbildliche Glasmalereien aus dem späten Mittelalter und der Renaissancezeit" (Berlin 1911) die massstabgerechte und sehr zuverlässige farbige Wiedergabe eines aquarellierten Kartons. Diese, 49 x 16 cm grosse Abbildung wurde photographisch auf das Format des Fensters mit ca. 4,50 m Höhe vergrössert. Diese Vergösserung dient nun in der Werkstatt Dr.H.Oidtmann in Linnich wiederum als Karton für die Rekonstruktion der verlorenen Teile.

Die Restaurierung der erhaltenen Partien umfasst die ganze Skala der Möglichkeiten von der einfachen Klebung gesprungener Gläser bis zur doppelseitigen trockenen Doublierung und zur Schwarzlotsicherung. Unzählige Sprünge müssen geschlossen, kompliziertere Brüche durch Niete und Lötpunkte gesichert werden. Fehlende Splitter werden durch farblich passende, sorgfältig eingeschliffene Gläser ersetzt. Als Kleber wird Araldit benutzt, sowohl zum Kleben von Sprüngen als auch zur partiellen Schwarzlotsicherung. An wenigen Stellen müssen zertrümmerte Gläser mit Araldit rückseitig doubliert werden. Die Malerei ist glücklicherweise nur in geringem Masse abgerieben oder angewittert. Störende Sprungbleie werden entfernt; das gesamte, sehr brüchige Bleinetz wird erneuert. Die Felder erhalten einen stabilen Rahmen aus Messing-U-Profilen und werden mit einem Abstand von etwa 5 cm vor einer isothermischen Schutzverglasung aus Verbund-Sicherheitsglas mit UV-Schutzfolie montiert. Alle Massnahmen werden im einzelnen in der Werkstatt mit dem Landeskonservator von Westfalen-Lippe besprochen und abgestimmt.

Es ist sehr erfreulich, dass durch den Einsatz der Propsteigemeinde von St.Patrokli und durch die grosszügige finanzielle Hilfe des Landes Nordrhein-Westfalen eines der wenigen bedeutenden Zeugnisse der Glasmalerei der Renaissance in Westfalen durch die Restaurierung und die Rekonstruktion wiedergewonnen werden kann.

3 aussenschutzverglasung

3.1 KLIMATECHNISCHE VERSUCHE

English Summary

This report describes a laboratory-based experimental study of two types of external protective glazing, one where internal ventilation was used, and the other with external ventilation. Two climatic chambers were used and the window-assembly was placed between them. The temperatures and relative humidities in the chambers were adjusted to reproduce the alpine weather conditions, and the internal conditions, both actually measured at the convent church of St Maria Strassengel, i.e. five temperatures for the outside air (-15°C, 1.5°C, 10°C, 25°C and 35°C) and four temperatures for the inside air (2°, 10°, 15° and 20°C). The effectiveness of the external glazing was assessed by the extent to which it prevented condensation from occurring on the medieval stained glass. It was concluded that internal ventilation was better than external ventilation, at least under these Austrian alpine-climate conditions, because, on 13 test occasions employing the most extreme conditions (-15°C outside and 2°C inside), condensation occurred 9 times when external ventilation was used but only twice when the cavity was ventilated to the inside of the church.

Sinn und Zweck von Aussenschutzverglasungen wurden in den letzten Jahren ausführlich diskutiert[1]. Es besteht kein Zweifel, dass diese Konservierungsmassnahme, die das mittelalterliche Glasgemälde selbst nicht unmittelbar tangiert, sondern ihm sozusagen von seiner Umgebung her Schutz gegen die Verwitterung und gegen die den Verfallsprozess fördernden Umwelteinflüsse gewährt, dort, wo sie ohne Schwierigkeiten anwendbar ist, zu den praktikabelsten Massnahmen gehört, die der Denkmalpflege zur Zeit zur Verfügung steht. Unabhängig von dieser grundsätzlich positiven Einstellung und den bislang vorhandenen guten Erfahrungen mit Aussenschutzverglasungen ist die Diskussion dort noch immer im Gang, wo es darum geht, Detailprobleme zu lösen, von denen die Wirksamkeit dieser Konservierungsmassnahme abhängt. Dazu gehören vor allem Fragen der Konstruktion, d.h. die Diskussion eines bestimmten Systems in der Anlage der Schutzverglasung, das eine sinnvolle und ausreichende Belüftung garantiert, etc. Die Tatsache, dass zur Beantwortung dieser Fragen noch sehr wenig Erfahrungswerte vorliegen, weil eine systematische, darauf abzielende Kontrolle installierter Aussenschutzverglasungen schwer möglich ist, muss ihre Diskussion weiterhin im Gang halten. Von diesen Voraussetzungen ausgehend, hat das Bundesdenkmalamt im Frühjahr 1977 bei der Bundesversuchs- und Forschungsanstalt in Wien, Abteilung Kälte- und Klimatechnik, das Versuchsprogramm "Klimatechnische Versuche im Zusammenhang mit dem Schutz mittelalterlicher Glasfenster durch Aussenschutzverglasung" in Auftrag gegeben, über dessen Ergebnisse im Folgenden kurz berichtet werden soll [2].

Das in Österreich praktizierte System der Aussenschutzverglasung variiert das in der Schweiz und in Deutschland verwendete: In den originalen Fensterflaz werden die Tafeln der Schutzverglasung eingebaut, die mittelalterlichen Scheiben etwa 8 - 10 cm zurück ins Kircheninnere versetzt [3]. Die offenen Fragen, die sich dabei in der Praxis stellen, gelten in erster Linie der Klimatisierung der zurückversetzten mittelalterlichen Scheiben, d.h. der Belüftung des Zwischenraumes:

a) In welchem Ausmass ist eine Belüftung für die beabsichtigte Schutzfunktion notwendig, d.h. welche klimatischen Bedingungen schliessen Kondensatbildung, die es unbedingt zu vermeiden gilt, aus bzw. schränken diese ein.

b) Welche konstruktiven Voraussetzungen gewährleisten diese Bedingungen; wie gross muss der Abstand der beiden Verglasungen voneinander sein, welche Öffnungen zuunterst und zuoberst einer Bahn, sowie eventuell auch an den Seiten sind notwendig oder günstig, etc. [4].

Neben diesen Fragen war es auch das in letzter Zeit mehrmals zur Diskussion gestellte System einer Aussenschutzverglasung mit aussenseitiger Belüftung bzw. Hinweise auf dessen Vorzüge [5], die in dieses Versuchsprogramm miteinbezogen wurden, um durch einen Vergleichstest Anhaltspunkte über die Wirksamkeit, d.h. Vor- und Nachteile beider Konstruktionssysteme zu bekommen.

Die Versuchsanordnung ergab sich durch die lokalen Gegebenheiten im Labor der Bundesversuchs- und Forschungsanstalt Arsenal in Wien mit zwei unabhängig voneinander klimatisierbaren Klimakammern und einer verbindenden grossen Türöffnung. Diese bot als "Fenster" zwischen den beiden Kammern als "Innen-und Aussenraum" die Möglichkeit, die beiden erwähnten Konstruktionssysteme nebeneinander zu installieren:

Variante I (von innen belüftet) nach dem in Österreich praktizierten Konstruktionssystem,

Variante A (von aussen belüftet) nach dem in York/England getesteten Modell [6],

Als mittelalterliche Verglasung dienten je zwei übereinandergestellte (aus mittelalterlichen Scherben zusammengesetze) Scheiben aus Maria am Gestade, das Ausmass der simulierten Fensterbahnen betrug zirka 2,20 m x 0,75 m. Dass dieses weit unter den üblichen Dimensionen zurückblieb, schränkt die Aussagekraft der gewonnen Werte naturgemäss etwas ein, deren grundsätzliche Gültigkeit wird davon aber nicht betroffen.

An klimatischen Bedingungen wurden dem Versuchsprogramm das Innenklima der Kirche von Maria Strassengel (Temperatur- und Feuchtigkeitsmessungen 1974/75) und die allgemeinen klimatischen Verhältnisse im Alpenraum mit ihren möglichen Extremwerten zugrunde gelegt.

Um bei Variante I zwei verschiedene Abstände zwischen glasgemälde und Schutzverglasung zu testen (zirka 10 cm und ca. 2 cm), wurde das auf 13 Tage verteilte Klimaprogramm zweimal durchgefahren.

Ergebnisse: [7]

Das Interesse galt in erster Linie der Frage, ob und wie oft es zu der für die Glasgemälde gefährlichen Kondensatbildung kommt [8]. Hier fiel der Vergleichstest zwischen den Varianten I und A klar zu Gunsten der Aussenschutzverglasung mit innenseitiger Belüftung aus, und zwar so eindeutig, dass man sagen kann, dass die von aussen belüftete Variante für die klimatischen Verhaltnisse in unserem Raum nicht geeignet ist. Während bei der Variante I fallweise Kondensatbildung auftrat (bei 2 von 13 Positionen), kam es bei der Variante A sehr oft dazu (bei 9 von 13 Positionen) [9]. Innerhalb der beiden Varianten der Versuchsanordnung mit innenseitiger Belüftung (Abstand ca. 10 cm und ca. 2 cm) erwies sich die mit grösserem Zwischenraum (10 cm) als die günstigere. Die Tatsache, dass Kondensat zwar relativ selten (und nur dann, wenn bei tiefen Aussentemperaturen der Taupunkt im Kircheninneren, etwa durch Atmungsfeuchte, nasse Kleider, etc., kräftig angehoben wird), aber doch auch bei der am besten abschneidenden Variante auftritt und nicht nur bei klimatisch extremen Bedingungen (-15,2/2,3 Grad Aussen-/Innentemperaturen), sondern auch bei Verhältnissen, wie sie etwa in der Übergangszeit im Frühjahr und Herbst möglich sind (0,5/9,1 Grad Aussen-/Innentemperatur), ist ein wichtiger Hinweis, dass eine Aussenschutzverglasung (Variante I) wohl weitgehend jene Funktion erfüllt, die man von ihr erwartet, dass sie die Gefahr einer Schwitzwasserbildung aber nicht grundsätzlich ausschaltet. Bei -15,2/2,3 ° Aussen- bzw. Innentemperatur darf der Taupunkt im Kircheninneren - 0,8°, das entspricht einer relativen Feuchte von 80% (bei einem Scheibenabstand von 10 cm) bzw. einem Taupunkt von - 3,9°, entsprechend einer relativen Feuchte von 63% (bei einem Scheibenabstand von 2 cm) nicht übersteigen. Bei 0,5/9,1° Aussen- bzw. Innentemperatur liegen die entsprechenden Grenzwerte bei einem Taupunkt von 6,5°, entsprechend 84% relativer Feuchte (10 cm Scheibenabstand) bzw. bei einem Taupunkt von 6,2° , entsprechend 82% relativer Feuchte (Scheibenabstand 2 cm).

Man wird diese Erkenntnisse im Gesamtkonzept kühftiger Restaurierungen berücksichtigen, d.h. alle anderen Konservierungsmassnahmen darauf abstimmen müssen.

Interessant ist die Feststellung, dass die Strömungsgeschwindigkeiten zwischen den beiden Verglasungen bei den Klimazuständen, bei denen Kondensationsgefahr besteht, so hoch sind, dass zwischen den Scheiben annähernd gleiche absolute Feuchte ist wie in der umgebenden Luft [10]. In diesem Zusammenhang erwies sich auch, dass die schmale Öffnung an den seitlichen Scheibenrändern zwischen den Glasgemälden und dem Steingewände bzw. den Fensterpfosten keinen nachweisbaren Einfluss auf die Versuchsergebnisse hatte, d.h., dass man auf die seitliche Lüftung (oder die Abdichtung) verzichten und die störenden Lichtschlitze soweit es geht schliessen kann.

Zusammenfassend kann man sagen, dass die "Klimatechnischen Versuche im Zusammenhang mit dem Schutz mittelalterlicher Glasfenster durch Aussenschutzverglasungen" den Weg bestätigt haben, der in der Praxis bisher beschritten wurde [11]. Als grundsätzlich entscheidender Gesichtspunkt im Zusammenhang mit dieser Konservierungsmassnahme ist wohl die Tatsache zu werten, dass unsere Glasgemälde, die in den Jahrhunderten seit ihrer Fertigung im Ablauf der klimatischen Jahreszyklen immer wieder Kondenswasserbildung ausgesetzt waren, an der Aussenseite durchwegs stärker verwittert sind als an der Innenseite. Das heisst nichts anderes, als dass zu den Schäden, die Schwitzwasser und Kondensfeuchtigkeit sowie die Belastung des Glases in seiner Funktion als Klimascheidewand anrichten, zusätzlich noch sehr wesentlich andere Faktoren für den Zerstörungsprozess verantwortlich sein müssen, die offensichtlich von aussen auf das Glas einwirken. Wenn wir die Scheiben hinter eine Schutzverglasung ins Kircheninnere zurückversetzen, bieten wir ihnen daher nicht nur bessere klimatische Bedingungen, sondern einen grundsätzlich günstigeren Lebensraum, von dem wir erwarten können, dass er den Verfallsprozess, wenn schon nicht zu stoppen, so doch wesentlich zu verzögern vermag.

Es wird dessenungeachtet notwendig sein, Fragen und Probleme, die sich bei der praktischen Anwendung dieser Konservierungsmassnahme ergeben, weiterhin zu diskutieren, um aus den Erfahrungen für die Zukunft zu lernen.

E. Bacher

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1) Alle bibliographischen Hinweise über die zahlreichen Diskussionsbeiträge zum Thema Aussenschutzverglasung finden sich bei R.G. Newton; Bibliography in British Academy Occasional Papers I, London (1974); Bibliography of Studies on the Deterioration and Conservation of Stained Glass, Art and Archaeology technical abstracts, IIC, Vol.10, Nr.2, 1973, S.139; sowie unter den Stichworten Aussenschutzverglasung und Isothermale Verglasung im Index zu den News Letters 1 - 15 (News Letter 15/1975, S.28 ff.) bzw. 16 - 25 (News Letter 25/1977, S.24 ff.).

Eine Studie zum Thema Aussenschutzverglasung hat auch Dr. Gottfried Frenzel, Institut für Glasgemäldeforschung und Restaurierung, Nürnberg, angekündigt.

2) Die Versuche wurden vom Leiter der Abteilung Kälte und Klimatechnik der Bundesversuchs- und Forschungsanstalt, Herrn Dipl. Ing.G.Schuecker, projektiert und durchgeführt, dem das Institut für sein Interesse an der Sache zu grossem Dank verpflichtet ist. Der abschliessende Bericht über "Klimatechnische Versuche im Zusammenhang mit dem Schutz mittelalterlicher Glasfenster durch Aussenschutzverglasungen" vom 28.6.1977 (Zahl 404576-440/383), den die Bundesversuchsund Forschungsanstalt vorlegte, ist die Grundlage für das vorliegende Resume.

3) Siehe E. Bacher, Aussenschutzverglasung,

in: Österr.Zeitschr.f.Kunst und Denkmalpflege, 1973, XXVII, S.66 ff., Abb.73, 74.

4) Da das bis dato in Österreich angewandte Konstruktionssystem die Möglichkeit bietet, die Abstände in einem gewissen Rahmen zu variieren, lassen sich auch bereits bestehende Aussenschutzverglasungen neueren Erkenntnissen über das Ausmass der notwendigen Belüftung anpassen.

5) Siehe dazu die in Anm. 1 zitierten bibliographischen Hinweise in den News Letters (insbesonders Nr.16/1975, S.5 ff. und 22/1976, S.5 ff.) sowie R.G. Newton, Experimental Studies of the Protection of Mediaeval Windows Using External Glazing, Actes du IX^{e} Colloque International du Corpus Vitrearum Medii Aevi, Paris 8 - 12 Septembre 1975, in: Verres et refractaires, 30/1, Paris 1976, S.80 - 86.

6) Als Vorbild diente das in News Letter 16/1975, Fig.4 bzw. 22/1971, Abb. 1, 2 skizzierte Modell.

7) Auf die genaue Versuchsanordnung und Durchführung kann hier ebensowenig eingegangen werden, wie auf die gemessenen Grössen (8 Luft-, 16 Oberflächen- und 2 Taupunkttemperaturen, sowie 2 mittlere Luftgeschwindigkeiten) und deren Messgeräte. Diese sind in dem in Anm.2 zitierten Bericht des Bundesversuchs-und Forschungsanstalt Arsenal enthalten, der im Bundesdenkmalamt aufliegt. Dasselbe gilt für die die Messwerte veranschaulichenden Diagramme und Tabellen.

8) Kondensat tritt dann am Glasgemälde auf, wenn die Oberflächentemperatur den Taupunkt der umgebenden Luft unterschreitet. Dieser massgebende Taupunkt ist bei der Variante I in jedem Fall der Taupunkt der Luft im Kircheninneren. Bei der Variante A jedoch der höhere der beiden Taupunkte (Innenzustand, Aussenzustand), G. Schuecker, Bericht zit.Anm.2, S.6.- Die Strömungsrichtung der Belüftung des Zwischenraumes erfolgt rein statisch durch die Dichteunterschiede zwischen der Luft im Kircheninneren und der Luft zwischen den Scheiben. Wenn die Aussentemperatur uber der Temperatur im Kircheninneren liegt, erfolgt die Durchströmung des Zwischenraumes von unten nach oben, im anderen Fall von oben nach unten. (Gilt für die Variante I, bei der Variante A ist es umgekehrt.)

9) Der Hinweis von Prof.Newton, dass geringere Abstände bzw. kleinere Lüftungsschlitze bei der Variante A die Häufigkeit der Kondensatbildung etwas eingeschränkt hätten, trifft sicher zu. (Dazu ist aber anzumerken, dass der Diffusionswiderstand eines mittelalterlichen Glasgemäldes gegen Feuchtigkeitsdurchtritt unsicher ist, d.h., dass immer damit gerechnet werden muss, dass aus dem Kircheninneren Feuchtigkeit in den von aussen belüfteten Zwischenraum durchtritt und dort die Kondensationsgefahr erhöht.) Dessenungeachtet besteht nach den erzielten Daten dieses Versuches kein Zweifel, dass die ins Kircheninnere zurückversetzten Glasgemälde klimatisch günstigeren Bedingungen ausgesetzt sind als jene mit einer von aussen vorgesetzten Schutzverglasung.

10) G.Schuecker, Bericht zit.Anm.2, S.6.

11) Ein ähnliches Ergebnis brachten die 1974/75 durchgeführten Untersuchungen im Freiburger Münster, siehe K.Geis, Raumklima und Schwitzwasserbildung im Freiburger Münster, Oktober 1976 (gedrucktes Faltblatt) sowie G.Rönicke und R.Rönicke, Das Raumklima des Freiburger Münsters und die Möglichkeit der Schwitzwasserbildung an den Buntglasfenstern, Schallstadt, 28.Oktober 1976 (maschinschriftliche Vervielfältigung).

3.2 COMMENTS BY ROY NEWTON

The extremely interesting report given in Section 3.1 was received just as this News Letter was going to press and hence it has not been possible in the time available to prepare a proper discussion of this valuable contribution to the problems of how best to use external protective glazing. However, there are two aspects of this experiment which are unrealistic, and their implications will have to be discussed before the conclusions can be accepted, even for these extreme Austrian alpine conditions.

The first comment is that no account has been taken of the radiation from sunlight, or even from daylight. For example, the experiments at present being carried out at Canterbury and at York have both shown that winter sunshine will produce a temperature of 40°C in the cavity (a temperature rise of at least 35 degC) and this will modify the conclusions to an extent which is as yet unknown.

The second comment is that surprisingly large ventilation openings were used for introducing external air into the cavity. These openings were 5 mm wide and in consequence the air velocity up the cavity was about 0.25 m/s, with the result that the stained glass was made very cold and condensation occurred. By comparison, the experiments carried out in York Minster in 1975 showed that the ventilation openings for outside air should be made as small as possible (in contrast to internal ventilation, where they should be made as wide as possible). In fact the external ventilation slots should preferably be "fully closed" because, in the practical situation of a large window, even "closed" slots allowed some leakage of air at about 0.02 m/s (20 mm/s) - see Table II on p.8 of NL No.16, and the accompanying discussion.

The undesirable effect of these high air velocities in the Austrian experiment can be seen from the fact that the bottom of the stained glass was 4.7 degC colder than the top, and it will be interesting to see what happens when the slots are reduced so that the air flow is only 20 mm/s or even 2 mm/s.

4 recent work

4.1 FURTHER TESTS ON VIACRYL RESIN COATINGS EXPOSED TO WET SAWDUST

Readers of NL No.24 (18 Feb 1977) will know of the test of Viacryl resin described in Section 3 (pages 6 - 8) in which a piece of poorly-durable glass (British simulated glass No.2) had been given one coat of Viacryl resin and then exposed for 10 months to wet sawdust in a damp chamber in the medieval walls of York City, where the average temperature was about 7°C. It was concluded that the water from the sawdust, which contained organic acids and had a pH value of about 6, had penetrated the Viacryl and attacked the glass underneath.

There were two criticisms of this test. (a) Only a single layer of Viacryl had been applied and hence it was possible that there had been a "pinhole" in the resin through which the sawdust-water might have penetrated and spread under the Viacryl. (b) Wet sawdust might be too aggressive an agent for the test to be a satisfactory one. The answer to (a) lies in the new experiment, described below, and the answer to (b) is that there was no sign of damage of the Viacryl by the sawdust-water and hence the liquid penetrated it by diffusion. Certainly, the sawdust-water is more acid than ordinary rain and it is aggressive towards the glass but if the Viacryl fails to exclude sawdust-water, then it will also fail to exclude rain water.

The new experiment, planned to take account of criticism (a) was therefore carried out by Mr Cole of the Canterbury Stained Glass Studio. He first deepened the four reference marks (A-D, shown in Figs 1 and 3, on page 7 of NL No.24) using a writing diamond so that they were again easily visible. The sample was then framed in lead and cemented as described on p.8 of NL No.24. Then he applied two coats of Viacryl resin, the second one after an interval of 24 hours at 21°C so that the first coat could dry properly; the second coat was diluted, again as described in NL No.24.

The double-coated sample was again placed in the wet sawdust for 12 months and removed on 21st February 1978. The Viacryl coating again had white blisters on it, rather like those in Fig.2 of NL No.24, although none were as large as those shown at (1) and (2) in that photograph.

The small nature of the blisters, compared with those found in January 1977, suggests that there had been less attack on the glass. When the leads were cut away, however, it was found that all adhesion had been lost between the glass and the resin because the resin coating came off at once and the glass was found to be wet and slippery. The index marks, which had been renewed by Mr Cole, had again nearly disappeard. Mr Cole agrees that they are now nearly invisible, and their appearance under the microscope is quite rounded. He has made some fresh marks nearby, using various diamonds, and all of these appear narrow and sharp-edged under the microscope, compared with the rounded and shallow appearance of the year-old marks. This confirms that the sawdust-water can penetrate the double-coating of Viacryl and attack the glass.

The three lines (1, 2 and 3 in Fig.1 of NL No.24) were again measured with the Talysurf at Sheffield, but the results are ambiguous. The "centre line average" figures were 1, 2.5 µm; 2, 2.2 µm; 3, 2.8 µm; thus, compared with the figures on p.8 of NL No.24, lines 1 and 2 are now less rough but line No.3 is rougher. The changes in roughness are large enough to indicate that something had happened to the glass under the resin, and a closer study was therefore made of the 12 individual Talysurf traces (i.e. one each for lines 1, 2 and 3, made on the following dates: 2 September 1975; 10 February 1976; 12 January 1977 and 1 March 1978) but no consistency in the patterns (hills and valleys) could be found. It has therefore been concluded that the sawdust-water has been attacking the glass in such a manner that it simulates the roughness of the original airbrasive treatment, using No.3 grit. In other words, the conclusion is NOT that the new attack has followed the original contours of the glass, but new contours have been produced by attack under the Viacryl which are rather like the airbrasive roughness but are sometimes rougher and sometimes smoother. If this conclusion is correct, the sawdust-water must be removing much more than 10 µm of glass in a year, and this explains why the diamond marks have been made so much smoother.

With "nindsight" the experiment could have been improved by sputtering a patch of a noble metal, such as gold, on the surface of the glass at the beginning of the experiment to act as a reference point (a "bench mark") from which the loss of surface of the glass could have been measured. It had been hoped that the lead frame would have helped to give information on this point; the edge does appear to be somewhat smoother, and raised relative to the rest of the glass but unfortunately the edges of the glass are rounded and no reliable measurements can be made. (See also the discussion at the end of Section 5.)

The experiment has now stopped because it is concluded that the Viacryl does not protect ancient (poorly durable) glass against weathering and it is even thought likely that the alkaline products which accumulate under the Viacryl may eventually do more harm to the glass than leaving it unprotected.

4.2 USE OF THE AIRBRASIVE WITH GLASS BEADS OF DIFFERENT SIZES

Previous work in Britain, using the airbrasive to remove heavy crusts from medieval glass, suggested that the risk of damage to the glass from abrasive particles might be reduced by replacing the abrasive by minute glass beads (ballotini). This belief was based on (i) the extreme difficulty in producing damage on the surfaces of modern microscope slides when ballotini were used, compared with the ease with which damage occurred when abrasives were employed, and (ii) the effective

removal of the crust, and apparent lack of damage caused to medieval glass when ballotini were used at the Canterbury Stained Glass Studio.

When tests were carried out at the York Glaziers Trust it was found that the ballotini supplied by G.E.C. Mechanical Handling Ltd. would damage the surface of medieval glass after the crust had been removed. A re-test of these ballotini on modern microscope slides still failed to produce significant damage, and it was therefore agreed to test some of the "Canterbury" ballotini and the results showed that it was conspicuously less damaging when used on the same pieces of medieval glass at York, than the "York" ballotini.

A microscopic study of the two deliveries of ballotini showed that the material from G.E.C. Mechanical Handling Ltd. had an average particle size of 60 μm, whereas that used at Canterbury and obtained from Bassett Smith & Co., London E.1., was only about 20 μm in diameter. The kinetic energy of the larger particles was about 27 times greater than the energy of those used at Canterbury. Thus it is not surprising that the material used at York causes more damage.

A sample of ballotini is now being obtained from the Ballotini Manufacturing Company, of Barnsley, Yorkshire, which is in the particle range 0-10 μm and it is hoped that even better results can be obtained with it. It is not known why it is easier to damage medieval glass than modern microscope slides but there are several possibilities; for example, the surface of the microscope slides is both polished and fire-finished; the modern glass may be harder; the weathered medieval glass may have a fissured surface.

4.3 MORE DURABLE BLUE 12th-CENTURY GLASS PART 5

Some more soda-rich blue 12th-century glass has been found by Miss Fiona Gale in a mid-13th-century earthwork surrounding the 11th-century church of St. Mary-in-Castro at Dover. The sample has the composition: SiO_2, 69.7%; Na_2O, 16.5%; K_2O, 1.4%; MgO, 0.7%; CaO, 7.0%; MnO, 0.5%; CuO, 0.4%; ZnO, 0.03%; PbO, 0.8%; Al_2O_3, 1.1%; Fe_2O_3, 0.96%; P_2O_5, 0.9% and it is thus similar to the durable blue glass found at Winchester and quoted in Part 4 of this investigation (Section 1.9 of NL No.24, tabulated on p.4). A search for glass like this still continues at Canterbury Cathedral, but none has been found.

These glasses have also been analysed by Neutron Activation Analysis at the University of Bradford, with the following results:-

		Soda %	Antimony %	Iron %	Cobalt ppm	Thorium ppm
Winchester	514	13.5	1.4	1.2	530	6.4
"	515	17.2	0.9	1.1	470	< 2.7
Old Sarum	516	14.9	1.5	1.7	610	5.0
" "	517	13.0	0.7	1.0	400	4.1
Dover	531	16.8	0.9	0.8	330	3.2
York (mean*)		16.6	0.88	1.6	555	?

* This is the mean of the four samples from York, quoted on page 7 of NL No.22.

Based on these N.A.A. results, there is no significant difference between any of these blue 12th-century glasses.

5 discussion section

This is a comment by Roy Newton on the Report by Dr E. Bacher on the Test of Viacryl at St Maria am Gestade.

I have read with great interest and attention the report by Dr Bacher on pages 5 and 6 of NL No.26 because it is most important to establish without any doubt whether a Viacryl coating gives some protection to medieval glass against atmospheric attack or whether, as is suggested by Section 4.1 of the present NL, the Viacryl may eventually cause more harm to the glass than leaving it unprotected.

Dr Bacher concludes that the Viacryl has performed the tasks required of it, but there are two points in his account which I do not fully understand and which should be considered further.

My first comment is that, in Section 4 of his report (i.e. p.5, col.2 of NL No.26, lines 4-1 from the bottom), he states that a comparison of panels 4 and 5 with panel 2 illustrates the attack on unprotected glass during the last 5 years, and the extent of weathering of the protected and unprotected glass. This suggested to me that Dr Bacher implied that panel 2 had by 1976 been corroded more than it was in 1971; if so, it would be important for everyone that this should be demonstrated.

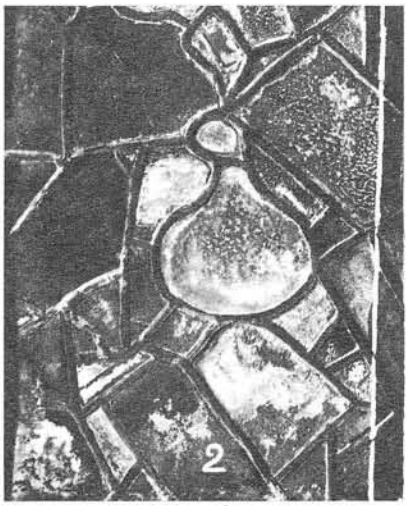
Dr Bacher has kindly supplied two photographs which are reproduced below, and I am now convinced that some of the pieces of glass are more corroded in 1976 than they were in 1971. This applies particularly to the upper half of the photographs and I am delighted that Dr Bacher has provided these illustrations for all to see. I must add that I do not know of any instance in England where so much crusting would have occurred in only 5 years.

My second comment concerns the changes in size of the two holes which had appeared in the Viacryl coating. In his Note No.6 (near the top of col.2 on p.6 of NL No.26) Dr Bacher states that two small holes were probably present in the lower part of panel No.3 when it was fixed in the window in 1971, and may have been caused by accidental damage; moreover no subsequent enlargement had been noted ("Eine Vergrösserung der Schadenstellen seither ist nicht feststellbar").

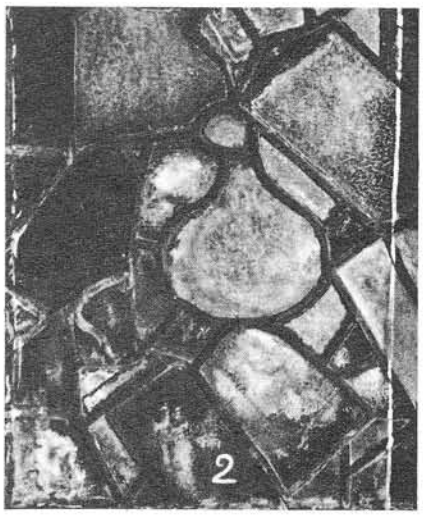
This is not my recollection of the situation because I first knew about these two holes when Mr Peter Gibson photographed the

panel in May 1973; his photograph showed only one hole present. When I took my photographs on 13th May 1974 there was still only one hole present but it had become larger. A photograph kindly supplied to me by Dr Bacher in September 1975 showed two holes in the film and the first hole had become larger still. Dr Bacher has replied that, in his belief, the holes had really been there all the time but they could not be seen because the Viacryl film was bridging a gap between a piece of curled-up, partly-detached crust and the rest of the crust. Thus, eventually, the "bridges" of resin could have been broken merely by wind pressure, or other kinds of damage.

Thus, it seems that we have probably learnt as much as we can from this interesting first experiment, but there is an urgent need for a really critical experiment to be carried out to discover what happens to a perfectly clean piece of medieval glass when coated with Viacryl and exposed in an accelerated weathering test. The essential experimental requirements were precisely defined at the meeting of ESF "experts" held in Munich on 25th February 1976, but the proposal to do the work was not implemented. However, it is hoped that such an experiment will be carried out at the University of Sheffield during 1978. I hope, also, that the new test programme, to be carried out at Vienna, can include a piece of medieval glass having a precisely-defined surface, (such as one which has been ground flat and polished to an "optical" finish, say within one or two wavelengths) so that any changes in the surface under the Viacryl coating can be precisely defined. Another aspect, which unfortunately was ignored in the sawdust-experiment at York, described in Section 4.1, would be to test the pH value of any wetness detected underneath the Viacryl if it can be peeled off, instead of using Cital 12-12 as had been intended.



Panel No.2 at St Maria-am-Gestade, as photographed in 1971 after cleaning with water. By courtesy of Dr Bacher and the Bundesdenkmalamt, Neg. No.N61526.



Panel No.2 at St Maria-am-Gestade, as photographed in 1976, after exposure to the atmosphere for 5 years in an unprotected state. By courtesy of Dr Bacher and the Bundesdenkmalamt, Neg. No.N71167.

6 abstracts

The papers read to the XIth International Congress on Glass, held in Prague in July 1977, have been published in 8 volumes comprising 3837 pages in all. The papers are essentially technical in nature, but six of them are of potential interest to scientists concerned with the deterioration of glass.

268. HENCH, L.L. (1977) "Physical Chemistry of Glass Surfaces", see p.10 of NL No.25, the full paper has now been published in Survey Papers Vol.II, pp. 343-369.

302. AHMED, A.A., ASHOUR, G.M. and EL-SHAMY, T.M. (1977) "Effect of melting conditions on the crystallisation of cuprous oxide and copper in glass", Proceedings Vol II, pp. 177-187.

Glasses of composition suitable for the production of cuprous oxide aventurine glass were prepared under different melting conditions, different melting temperatures or times or under reducing conditions by the addition of metallic iron powder. The number, size and type of crystals precipitated in glass after heat-treatment were determined for each glass.

There was a qualitative agreement between the results of the effects of temperature and time of melting. Increasing either temperature and time of melting increased the number of cuprous oxide crystals while their size decreased. These changes were attributed to the effect of increasing temperature or time of melting on the intermixing of the liquid-liquid phase separation which occurs above the liquidus temperature.

The addition of metallic iron led to the precipitation of metallic copper crystals. The dimensions of these crystals varied with the subsequent heat-treatment. The effect of iron on the reduction of cuprous ions and the effect of heat-treatment on the size of the crystals precipitated are discussed. (Authors' abstract.)

303. EL-SHAMY, T.M. and AHMED, A.A. (1977) "Corrosion of some common silicate glasses by aqueous solutions", Proceedings Vol III, pp. 181-195.

A study has been made of the corrosion of five industrial silicate glasses of common commercial application. The study involved treatment of powdered glass with water, 0.1N HCl and 0.1N NaOH for a fixed time at 100°C. The extent of corrosion was assessed by analysing the solution for the main corrosion products at the end of each experiment.

The quantities of silica extracted from the five glasses studied followed the order acid < water << alkali ; "E" glass was exceptional in that the acid extracted more silica than water. Calcium and magnesium extraction by the acid was noticeably greater than the extraction by water; both oxides were practically not extracted by the sodium hydroxide solution.

Extraction of the main glass-forming oxides in various aqueous solutions is discussed in relation to the constitution of the host glass. Basic rules are deduced which would enable the prediction of the corrosion behaviour of a glass from its composition and the conditions to which it will be subjected. (Authors' abstract.)

304. HUFF, N.T. (1977) "The development of glass-property correlation equations", Proceedings Vol III, pp. 397-406.

As large computers have become easily accessible by glass technologists the development of empirical and theoretical equations relating glass composition to properties has become fairly commonplace. However, unless care is taken in developing the equations, use of these equations can lead one to make incorrect conclusions regarding the variation of properties with composition. This paper first looks at the theoretical and empirical bases one can use to develop property-composition correlation equations. Some of the subtle but important problems which may arise in the calculation of the equations are then discussed. These problems may arise from using readily available but inferior mathematical algorithms, from using computers with insufficient arithmetic precision or from generating equations which "overfit" the data. Methods of detecting and avoiding these problems will be discussed. (Author's abstract.)

305. OHTAKE, K., KARIYA, M. and ITIMURA, T. (1977) "The chemical durability of $PbO-SiO_2$ glasses". Summary Vol. p.164.

The leaching behaviour of the surfaces of $PbO-SiO_2$ and $PbO-SiO_2-R_2O$ (R=Na, K) glasses in diluted nitric acid solution was investigated by ellipsometry, bulk solution analysis and infrared reflection spectroscopy. The thickness and refractive indices of the leached layer of the surfaces of the glasses during the acid treatment were measured by Nikon Auto-ellipsometer.

The rate of the leached layer growth increased and the refractive indices of the layer decreased with the PbO content of the glasses. The refractive indices approached to constant value except the high PbO content glasses.

The relation between the thickness of the leached layer (d) and the treatment time (t) was expressed by $d=Ct^n$ where $n \neq 1$ for the high PbO content glasses,

$1/2 < n < 1$ at the first stage and
$n \neq 1/2$ at the second for the other glasses.

The two step leaching mechanism was estimated from these results. (Authors' abstract.)

306. SPITZER-ARONSON, Martha (1977) "Le microanalyseur ionique, methode nouvelle d'étude des verres par spectrometrie de masse et images ioniques" (Ion microanalysis. A new method for the study of glasses by mass spectrometry and ion-imaging). Proceedings, Vol III pp.323-31.

The Ion Microanalyzer detects with a high sensitivity the various secondary ions resulting from the bombardment of a glass with primary ions.

It delivers the mass spectrum of the ions emitted by a small region of the specimen (Mass Spectrometry). Conclusions have thus been drawn about the glass hydration phenomenon, owing to the presence of polyatomic ions containing hydrogen.

It gives for any selected mass and a small area of the specimen, an image of the surface parts containing elements of this mass (Ion Images). In this way we were able to show, for a "multi-layered" copper red glass, the distribution of titanium in the form of layers, and for a "flashed" copper red glass, the presence of grains with a high copper content, in the copper containing layer. (Author's abstract.)

307. WILL, G. and SCHAEFFER, H. (1977) "Tritium tracermethode zur Untersuchung der Reaktion von Wasserdampf mit einem $Na_2O-CaO-SiO_2$ glas" (Tritium tracer method for the investigation of the reaction of water vapour with an $Na_2O-CaO-SiO_2$ glass). Proceedings, Vol III, pp. 341-350.

The tritium tracer method is adapted for the determination of the penetration profile of water in glasses. It allows a residual activity to be measured, if after layer-by-layer removal of the sample surface the remaining activity of the tritium (β^- emitter) which has diffused in is ascertained.

The diffusion experiment was carried out essentially at temperatures below the glass transformation point Tg, for various water vapour partial pressures (applied using tritiated water) with a soda-lime-silica glass of wt.% composition 15.81 Na_2O, 9.98 CaO, 73.83 SiO_2.

The measured tritium diffusion profile exhibits a short-range and a long-range part

so that an interpretation using a constant diffusion coefficient is not possible. On the basis of two independent diffusion processes, two different water transport mechanisms can be evaluated. The results lead to the conclusion that in one case the water breaks up the glass network, i.e. gives rise to Si-OH groups by splitting Si-O-Si linkages, and in the other case it undergoes an ion exchange process with the Na ions in the glass. The dependence of the water transport on temperature and on water vapour partial pressure is discussed for the two mechanisms. (Authors' abstract.)

Les Dossiers de l'Archéologie, No.26 (Janv. - Fév. 1978) is a special issue entirely devoted to stained glass and its problems, historical and technical. It is a veritable mine of information and it contains twelve articles which are abstracted below (Nos. 308-319).

308. ANON (1978a) "L'origine et l'evolution du vitrail" pp.8-10.

This is a general article on the historical development of stained glass windows, with sections on: the discovery of glassmaking; the first windows; Romanesque windows of the 12th century; the grand period of glass painting in the 13th century; the glassmakers of the 14th century with their inheritance of two centuries of tradition; and the 15th century with the innumerable techniques which followed it. (Abstract prepared by Roy Newton.)

309. ANON (1978b) "Les vitraux de France", p.11.

This page displays a map of France, showing the locations of 56 centres having stained glass of the 12th to the 20th centuries, i.e., 15 of the 12th century; 34 of the 13th; 29 of the 14th; 24 of the 15th; 24 of the 16th; two with windows of the 17th century; and one (Nancy) having windows dated to 1900. (Abstract prepared by Roy Newton.)

310. BETTEMBOURG, J.M. (1978) "Dégradation et conservation des vitraux anciens", pp.102-111, with 12 illustrations.

This paper summarises the scientific aspects of the problems of deterioration and conservation, recalls what we know about the processes of decay and summarises the attempts which have been made to preserve ancient stained glass. (Abstract prepared by Françoise Perrot.)

311. BEUCHER, Monique (1978) "Les verrières du choeur d'Evreux. L'influence de Paris au XIVème siècle". pp.63-75, 17 illustrations.

The new chancel of the cathedral at Evreux was rebuilt between 1308 and 1318, and the upper windows were glazed from 1318 onwards. The author has made a study of the eight windows having tall figures and donors, and she discusses her researches to identify the various donors, particularly Regnault de Molins. Her stylistic analysis leads her to date the various glazing campaigns as follows:- 1318-1325, first glazing of the apse; 1325-1330, glazing of the choir; 1330-1340, second glazing of the apse. This stylistic study reveals how there are clear connections with Jean Pucelle's Parisian workshop for producing miniatures, and also with Parisian sculpture. (Abstract prepared by Françoise Perrot.)

312. BRISAC, Catherine (1978) "La peinture sur verre à Lyons au XII^{e} siècle et au début du XIII^{e} siècle", pp. 38-49, 15 illustrations.

The author discusses the main directions taken by glass painting in Lyons at the end of the 12th and beginning of the 13th centuries. For her demonstration, she uses the glass in the lower windows of the eastern part of the cathedral of St John. The oldest panels are dated to around 1190 and illustrate the life of St Peter. Despite their bad state of conservation, their iconography and style show a strong Byzantine influence, which also appears in other works of art in this area. The seven lower windows of the Chancel constitute another group by which one can follow the development from the 12th to the 13th century. The author concludes that four windows portray the Redemption, the History of St Lazarus, St John the Evangelist, and St Cyprian of Carthage (and not to the lives of the founders of the Church of Lyons, as had previously been believed) and they still show various Byzantine characteristics. On the other hand, the Infancy of Christ, the History of St Stephen (1215-1220) and the life of St John the Baptist (later than 1226) show that Lyons was also open to the influence of the art of northern France which at that time could be described as the most progressive style of art. (Abstract prepared by Françoise Perrot.)

313. FOY, Danièle (1978) "Les verres trouvés dans les fouilles archéologiques", pp.144-122, 12 illustrations.

Many fragments of window glass have been found in excavations. For the south-eastern part of France, they are now the evidence for the glazing of many Romanesque and Gothic churches. The author describes fragments from St Victor of Marseilles; from Ganagobie; from Psalmodi; from St Felix of Montceau; and from Avignon, thus demonstrating the importance which this place had during the 14th century. (Abstract prepared by Françoise Perrot.)

314. GATOUILLAT, Françoise (1978) "A Saint-Sulpice de Favières, des vitraux témoins de l'art parisien au temps de Saint Louis", pp.50-62, 14 illustrations.

The small village of Saint-Sulpice de Favières, to the south of Paris, has a church whose importance can be explained by a famous pilgrimage in the Middle Ages. This beautiful church, rebuilt around 1245, still retains three stained glass windows; first, a grisaille window (ca. 1260) has naturalistic foliage and it seems to be one of the oldest examples of this type of decoration. Secondly, the east window which now contains panels from three windows, a Passion window (1235-1240), a Life of St Sulpice (1235-1240), and two scenes from the Infancy of Christ (ca. 1280). The third window, devoted to the Life of the Virgin and to the Infancy of Christ, is by far the most interesting; its iconography is homogeneous, using several apocryphal sources. Its style is related to the Parisian style which one can

see in illuminated manuscripts. It is a unique example of monumental decorative art of this period (ca. 1270). (Abstract prepared by Françoise Perrot.)

315. GRODECKI, L. (1978a) "Sauvons les vitraux anciens!", pp.12-25, 20 illustrations.

In this introductory article to the volume the author draws attention to the poor state of conservation of the stained glass and emphasises the weak points which require conservation, the decay of the glass and the leads and the corrosion of the ferramenta. He discusses the various causes of the present poor state of the glass and emphasises the harm done by previous restorations. (Abstract prepared by Françoise Perrot.) Further note by Roy Newton: this paper is a valuable one for those who wish to have photographic evidence of the damage to medieval windows; these illustrations show: p.14, breakage of glass due to weak stonework; p.17, deformations caused by faulty stonework; pp.20 and 21, the additional deterioration which occurred between 1943 and 1947.

316. GRODECKI, L. (1978b) "Une grande entreprise internationale. Le Corpus Vitrearum Medii Aevi", pp.124-125.

This article is a review of the history and the achievements of the C.V.M.A. since it was formed in 1952. (Abstract prepared by Roy Newton.)

317. HANY-LONGUESPE, Nicole (1978) "Troyes, haut lieu du vitrail", pp.86-101, 15 illustrations.

The author summarises her study of the output from the Troyes workshops during the 16th century by sorting out the various trends and their specific characteristics and emphasising the role of Dominique Florentin, who introduced the style of Fontainbleu to this province. She then discusses the products of the Gontier workshop, which was active in the 17th century, first establishing the precise genealogy of this family, based on archival evidence, and their relations with other Troyes glass painters. Then she tries to sort out the works painted by each member of the family, especially that produced by Linard Gontier, one of the most famous glass painters of his generation. (Abstract prepared by Françoise Perrot.)

318. LAUTIER, Claudine, (1978) "La technique du vitrail", pp.26-37, 16 illustrations.

This is a detailed article in which the author explains how medieval glass was made and how the stained glass windows were assembled. (Abstract prepared by Françoise Perrot.) Further note by Roy Newton: the diagrams of the 12th-century furnace, and the methods of making crown glass and cylinder glass are particularly clear; they should be useful as lecture-diagrams.

319. PERROT, Françoise (1978) "Chefs d'oeuvre meconnus de la renaissance; les vitraux d'Écouen", pp.76-85, 12 illustrations.

Although the Château of Écouen is very famous, nobody has ever paid much attention to the parish church in this little village north of Paris, though it still retains the windows donated by the Constable Anne de Montmorency and members of his family. One can still admire, as if they were still in the chapel of the château, the portraits of Anne de Montmorency and his sons, and of Madeleine de Savoie, his wife and their daughters, and also a portrait of his nephew, the Cardinal of Châtillon, donors of the windows of the choir (1545). In the north aisle there are three windows of the same quality, probably a product of the same workshop, whose donors were mainly vicars of the parish. The series is completed by the two windows donated by Henri de Montmorency in 1587. The first series is of very fine quality and the connections with the style of Geoffroy Dumonstier would suggest that he might have drawn the cartoons for this glass. (Author's abstract.)

320. BRUNGS, M. and MICHELL, R. (1977) "Development of colour during changes between glasses of different oxidation states". Glass Technology 1977, 18, 174-7.

Commentary by Roy Newton: this technical paper will be of interest to anyone who wishes to study the effects of colour changes which occur when the state of oxidation of the glass is changed. As was pointed out by Sellner (Abstract No.298 on p.13 of NL No.26) the colour of medieval glasses depends on their state of oxidation. These authors show that sulphur dioxide in the glass also plays a part in affecting the oxidation-reduction situation.

321. CHARLESWORTH, Dorothy (1977) "Roman window glass from Chichester, Sussex". J.Glass Studies, 1977 XIX 182.

Commentary by Roy Newton: The special interest of this item is that Miss Charlesworth found a piece of crown window glass in a Roman context dated to the 4th century. This is very much earlier than had previously been thought possible for a western origin of such glass. Samples of cast window glass and cylinder window glass were also found on the site.

322. DEKOWNA, Maria (1973) "Problème de l'existence d'un atelier verrier à Szczecin au haut moyen âge". (The problem as to whether a glass workshop existed at Szczecin in the ninth century.) Ann.6e Cong. Assoc. Internat. Hist. du Verre, Cologne, July 1973, pp.143-158.

Commentary by Roy Newton: This is an important paper from the point of view of the history of the technology of glassmaking because the author found some high-potash glass on a site of 9th century date, the first time that such an early date has been found for this kind of glass. During the excavation of the medieval castle of Szczecin (near the Baltic coast of Poland) a 9th-century habitation site was found with plenty of evidence that iron-working had been carried out there. But there were two yellow glass beads, a fragment of a glass vessel, two pieces of broken glass and two very small crucibles with a layer of glass on them. The fragment of the vessel contained 58% SiO_2, 19% K_2O, 9% CaO, etc, rather like a medieval glass. The glass on the crucibles was also a high-potash material and the author

makes a number of comparisons, of a chemical nature, between these glasses and others from Cordel, Kiev, Halič, Cracow, etc, and concludes that there are no very close parallels between her glasses, these other finds, and the compositions of the ashes from wheat straw or the trunks of beech trees (which come nearest in composition to her glass). The commentator believes, however, that the glasses from her crucibles were heavily contaminated by the solution of refractory material and that this part of her exercise was certain to fail; however, her glass fragments are undoubtedly high-potash lime-glasses and of an exceptionally early date, so that her paper is an important one.

There is, however, some doubt as to whether the glasses were made on the site from sand and plant ash because the crucibles are so very small, being only 35 mm in diameter! However, these small crucibles could have been used for re-working cullet made at some other place, as yet unknown.

The two yellow beads have quite a different composition, being high-lead soda glasses (30-40% PbO, 5-10% Na_2O) and seem to be imports, perhaps from the Levant.

323. GOLDSTEIN, S.M. (1977) "Forgeries and reproductions of ancient glass in Corning", J. Glass Studies, 1977, XIX, 40-62.

The Corning Museum of Glass has been making a special collection of forgeries, and reproductions, of ancient glasses so that scholars can study the methods used by modern workers to copy or alter ancient glass objects. (Abstract prepared by Roy Newton.)

324. GROSE, D.F. (1977) "Early blown glass", J. Glass Studies, 1977, XIX, 9-29.

Commentary by Roy Newton: This is a particularly interesting paper for anyone who wishes to learn what is known about the date when glassblowing was invented. The author discusses a great deal of evidence of all kinds, especially recent discoveries in Israel in 1961 and 1970, but also wall-paintings in Pompeii, etc, to throw more light on the problem of when and where glassblowing was invented. He believes the date is now as early as 40-30 BC, and that the invention took place at an inland site (perhaps Israel), rather than on the Syrian-Phoenecian coast.

325. HAN, Verena (1973) "Les relations verrières entre Dubrovnik et Venise du XIV^{e} au XVI^{e} siècle" (Relations between glassworks in Dubrovnik and Venice from the 14th to 16th centuries), Ann. 6^{e} Cong. Assoc. Internat. du Verre, Cologne, July 1973, pp. 159-168.

Commentary by Roy Newton: This paper is packed with detail derived during the last ten years by studying the archives at Dubrovnik She shows that there were exceedingly close links with Murano, with many records of imports of glass; the migration of master glassblowers from Murano to work at Dubrovnik; and the use of terminology which was derived from that used at Murano. This is a well-documented paper of great interest to anyone concerned with such historical developments.

326. HUNTER, J.R. (1977) "Glass fragments from the Vicarage garden, Brixworth", Journ. Brit. Arch. Assoc., 1977, pp. 104-107.

This is part of the Report of the Brixworth Archaeological Research Committee excavations at Brixworth Saxon church. Twentyfour fragments of vessel- and window-glass were discovered, 9 of which had heavy incrustations and were considered to be medieval but the remaining 15 were more durable and are considered to be of Saxon origin like those at Jarrow, Monkwearmouth, Escomb, Repton and Hamwih. The colours of the 15 pieces were blue, light green, emerald green, yellow and brown; some pieces were grozed. (Abstract prepared by Roy Newton.)

327. MARECHAL, J.R. (1973) "Equipement minimum de laboratoire pour l'analyse chimique et spectrographique des verres du Moyen Age et étude de leur alteration par examen au microscope du lame mince" (The minimum laboratory equipment needed for chemical and spectrographic analyses of medieval glasses and the microscopic study of their weathering, using thin sections). Ann. 6^{e} Cong. Assoc. Internat. Hist. du Verre, Cologne, July 1973, pp.299-307.

The author describes the principles of chemical analysis of glass, using various types of equipment and indicates what could be bought for different amounts of money when setting up a laboratory. (Abstract prepared by Roy Newton.)

328. PAUL, A. (1977) "Chemical durability of glasses; a thermodynamic approach", J.Mater. Sci. , 1977 12, 2246-2268.

Commentary by Roy Newton: This paper by Dr Paul, who has contributed several useful items to earlier News Letters, is one that glass scientists have been waiting for because it presents, in an easily readable manner, a masterly review of the present state of knowledge of the durability of glasses. The title of the paper is rather formidable but most of the text is entirely readable and the thermodynamics can stay in the background for those who need them as an explanation of the experimental results obtained. He shows why the extraction of silica from glass, by aqueous solutions, increases when the lime content is higher than 10 mol% as a result of microphase separation in the glass. Lime is leached from the surface of the glass to a depth which is smaller than that for soda and silica and it is not yet clear why this is so, although some hypotheses have been put forward to explain it. The relative durabilities of glasses can depend markedly on temperature, for example, most glasses at 98°C have only about one third of the durability which they possess at 60°C but glasses containing BaO become even less durable at 98°C, having only about one-eighth of that at 60°C. He also remarks that the currently accepted idea, that protons enter the glass in exchange for alkali ions is probably wrong and it is more likely that the hydronium ion (H_3O^+) is the one which enters the glass; also, free water molecules can occur within the leached surface layer.

329. SPITZER-ARONSON, Martha (1977b) "Calculs sur images X de corrosion des vitraux,

des taux d'elimination par élément, entre la surface corodée et le verre intact sous jacent" (Calculations based on X-ray images of the weathering of glass, including the extraction of different elements from the corroded glass and the nearby intact glass). Compt. Rend. Acad. Sci., Paris, Series C285 (11 July 1977) pp. 41-43.

A new, non-destructive, repetitive, method for studying corrosion - old corrosion and that which was almost stopped under the various old stained glass restorations done in Europe - is presented. It allows us to evaluate the elimination rate of the elements and compare the successive measures performed on a special sample series. The choices are described: of the electronic treatment done on the digitalised X-images; of the various iso-concentration surfaces by element; and concerning the storage of the signals in a memory. (Author's abstract.)

330. SPITZER-ARONSON, Martha (1977c) "La répartition << initiale >> du cuivre, retrouvée et calculée dans certains vitraux rouges médiévaux" (The original distribution of copper, both as found and as calculated, in certain medieval red glasses). Compt.Rend. Acad.Sci., Paris, Series C285 (10 Oct 1977) pp.269-272.

The distribution curves of Cu, Zn, Sn in red multilayered stained glass of the Middle Ages, their disparities and their correlations, are explained by the diffusion of Cu in the hot glass, whereas Zn and Sn are not diffused in these conditions. The computation of the diffusion allows us to find the concentration of Cu at the beginning of the fabrication of the layers with Cu and gives indications on the composition of the brasses used. (Author's abstract.)

Comment by Roy Newton: This interesting paper by Dr Spitzer-Aronson raises some fascinating unanswered questions. The diffusion of the copper, and the non-diffusion of the tin and zinc can readily be understood because the copper will be present as Cu_2O, and the Cu^+ ions are small and mobile, like Na^+ ions, in contrast to the Sn^{2+} (probably Sn^{4+}) ions, and the Zn^{2+} ions, where the metal-oxygen bonding is highly covalent and the charge on the metal ion is high, making them immobile. But the bands of red colour shown in her Fig.1 are generally where the Sn and Zn are not present! In correspondence with me on this point, Dr Spitzer-Aronson has suggested that the red colour develops where the concentration gradient of copper is greatest, but a second possibility is that some element in the base glass may have to be present, in association with the copper, in order to develop the red colour.

331. STRAUSS, J. (1977) (Use of the archaic word "metal" for glass.) J.Glass Studies, 1977 XIX 186.

In a letter to the Editor of the Journal, the author deplores the use by archaeologists and art historians of the term "metal" to mean glass, because it is ambiguous and misleading. (Abstract prepared by Roy Newton.)

332. WALTERS, H.V. and ADAMS, P.B. (1975) "Effects of humidity on the weathering of glass". J.Non-Cryst.Solids, 1975 19 183-199.

The authors' abstract is:- The weathering of 26 glass compositions under static conditions of 30%, 50%, 75%, 90% and 98% relative humidity (RH) at 50°C and a cycling condition between 77% and 98% RH at 50°C. The cycling condition was found to be less severe than static 98% RH. The effect of humidity level on weathering was studied and showed that water adsorption increases with time and humidity, whereas alkali generation increases with time, but not always with humidity. Significant weathering occurs for some glasses at 30% RH with the quantitative effect being almost as great as at 90% RH. Visual weathering was observed for some glasses when the level of generated alkali was less than 0.5 $\mu g/cm^2$.

Various techniques for evaluating the weathering of glass under humid conditions were investigated. Visual appearance was judged to be the best evaluation method for routine weathering tests. It represents the effect of most concern and is sufficiently precise. Electron microscopy, measurement of sorbed water and alkali generated are principally used for research studies. Weight change and haze measurement lack sensitivity and reproducibility. A standard test was defined. The conditions are 98% RH at 50°C for 12 weeks. The visual ranking system was used. The glasses were generally ranked in the same order by the various evaluation techniques.

Additional commentary by Roy Newton: This is an important paper for those who are concerned with arranging the environment of windows for their best conservation, for several reasons. First, the authors find the same results as those discussed in News Letter No.24, Section 4.3 (p.10), that repeated cycling of condensation is less damaging than a continuous high humidity, despite all the theoretical arguments that condensation, followed by drying, "should" build up an alkaline layer on the glass. It seems that the periods of condensation produce a "washing" effect, thereby removing the alkaline products which are "supposed" to accumulate. On the other hand, continuous high humidity can lead to the accumulation of alkaline products, as is dramatically shown by their Fig.19 (p.196). The second important point is that some lead glasses will show serious weathering at only 30% RH, and these findings must be given careful consideration in connection with museum atmospheres used for storing lead glasses (eg Ravenscroft's glasses). The third point of special interest is that high RH values (above 90%) cause the surfaces of some glasses to absorb excessive amounts of water.

333. WERNER, Ferdinand, (1978) "Zehntes Internationales Colloquium des Corpus Vitrearum Medii Aevi", Kunstchronik 1978 31 (2) 55-59.

This is a short account in German of the 10th CVMA Colloquium, with emphasis on the art-historical papers.