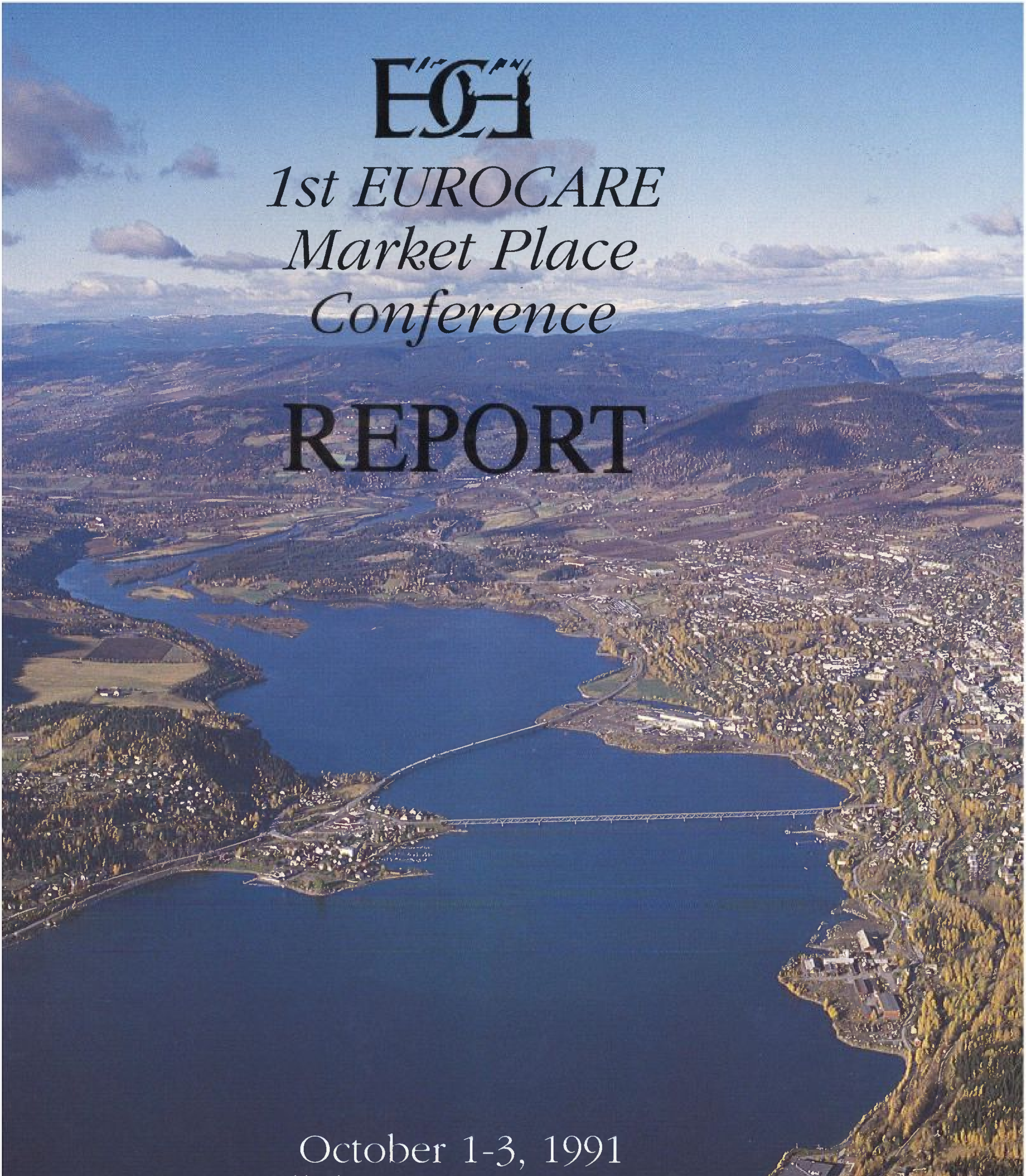

EOE

1st EUROCARE Market Place Conference

REPORT

October 1-3, 1991
Lillehammer - Norway

Lillehammer'94

EUREKA

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1ST EUROCARE MARKET PLACE CONFERENCE

E. Dahlin

NORWEGIAN INSTITUTE FOR AIR RESEARCH
P.O. BOX 64, N-2001 LILLESTRØM
NORWAY

* Photo front page: ©: Kjetil Rolseth

CONTENTS

1ST EUROCARE MARKET PLACE CONFERENCE

1 INTRODUCTION

The business of EUROCARE is the conservation, restoration and maintenance of our built environment. It is based on the fundamental need to promote the skilful conservation not only of Europe's cultural heritage, but of its modern building stock as well. The ability to take care of our buildings and structures - old and new - will be of decisive importance in the future international race for competitiveness. The environmental damage has now reached such a level that the problem cannot be solved without a joint effort on the part of industry, research and administration. As an EUREKA project, EUROCARE is the only international organization which puts industry in the lead in this partnership.

The 1st EUROCARE Market Place Conference was arranged at Lillehammer from 1 to 4 October, 1991. The aims of the conference were to bring together actors engaged in industry, conservation, restoration and maintenance in order to report on existing projects and promote new ones within EUROCARE, as well as addressing the CEC's STEP and BRITE/EURAM programmes.

1.1 ORGANIZING COMMITTEE

The organizers of the conference were the following:

- Chairman: Svein Haagenrud, Norway, EUROCARE Chairman
- Secretariat:
  Elin Dahlin, Norway, EUROCARE Secretary
  Kristine Aasarød, Norway, NILU
  Britt Elton, Norway, Lillehammer Olympic Organization Committee.

The conference programme group:

- Svein Haagenrud, Norway, EUROCARE Chairman
- Elin Dahlin, Norway, EUROCARE Secretary
- Jan Rosvall, Sweden, EUROCARE Past-chairman
- J. Owen Lewis, Ireland, EUROCARE WG2
- Pio Baldi, Italy, EUROCARE WG2
- Jacques Philippon, France, EUROCARE WG2
- Frank Henning Holm, Norwegian EUROCARE Committee
- Agnes Skarholt, Norwegian EUROCARE Committee
- Nils Marstein, Norwegian EUROCARE Committee
- Kim Ruberg, EUREKA Secretariat
- Christer Sjöström, Sweden - RILEM, CIB and NSB-MK.

1.2 SPONSORS

EUROCARE is grateful to the following sponsors for their economical support of the 1st EUROCARE Market Place Conference (for the presentation of the sponsors, look at the back page):

- Ministry of Environment
- Royal Norwegian Council for Scientific and Industrial Research
- Commission of the European Communities
- ABB Miljøkontroll AS
- Hydro Aluminium A/S
- IBM
- Jotun Decorative Coating
- Moelven Treindustrigruppen a.s
- Norcem FoU
- Norwegian Institute for Air Research

2 PRE-MARKET ACTIVITIES

The idea of arranging a EUROCARE Market Place Conference was first announced at the EUROCARE Board meeting in Paris in

January 1991. The Board made the following decision: "The 1st EUROCARE Market Place Conference with Board meeting and project reporting will be held in Lillehammer, Norway, on October 2 and 3, 1991". The chairman and the secretariat worked with the preparation for the conference during the spring 1991, and in June 1000 invitations were sent out all over Europe to people engaged in industry and research concerning conservation, restoration and maintenance (Appendix 1). Altogether 1500 invitations were sent out. In the invitation requests also were made for new EUROCARE project proposals, and of presentation of projects in the poster exhibition.

The EUROCARE project leaders were asked to present their EUROCARE project at the poster exhibition. Project leaders of the ECE STEP programmes were also invited.

The costs for the conference were covered by grants from: Ministry of Environment, Royal Norwegian Council for Scientific and Industrial Research, Commission of European Communities, Norwegian Institute for Air Research, and a few industrial sponsors, plus the conference fee, which was 200 ECU per participating person. The expenditure covered all the administrative costs, all conference documents, travel costs and expences for speakers, poster exhibitions, excursion, transport and conference dinner.

3 THE MARKET PLACE CONFERENCE

As Lillehammer will be the location of the 1994 Winter Olympics, with strong conservation and environmental dimensions, Lillehammer Hotel in Lillehammer was selected as the locality of the 1st EUROCARE Market Place Conference.

The conference programme of the 1st EUROCARE Market Place Conference is given in Appendix 2. The formal opening was done by the Mayor of Lillehammer - Audun Tron, the Secretary General Oddmund Graham - Ministry of Environment, and President Henrik

Andenæs - OL '94 AS, Norway. The conference attracted about 120 participants from 14 European countries and the USA. 72 different companies and research organizations were represented.

3.1 THE LECTURES

On the opening session of the conference, the following lectures were presented:

- The EUREKA concept - aims and strategies,
  Dr. Svein Haagenrud, chairman of EUROCARE, Norway (Appendix 4.1)

- Suggestion for a logically consistent structure for service life prediction standards, and joint CIB/RILEM activities in this area,
  Dr. Larry Masters, National Institute of Standards and Technology, USA (Appendix 4.2)
  Dr. Christer Sjöström, Swedish Institute for Building Research, Sweden (Appendix 4.3)

- EUROCARE - Standards for conservation products,
  Dr. Ingemar Holmström, Royal Institute of Technology, School of Architecture, Sweden (Appendix 4.4)

- Application of new technologies, conservation processes and materials: An industrial view-point,
  President Paolo Parrini, Syremont, Italy (Appendix 4.5)

- CEC's Research Programmes STEP and BRITE/EURAM and co-operation with EUROCARE,
  Dr. Andrew Sors, CEC Environment Research Programme, had to make a last minute withdrawal, the presentation was therefore held by Mr. Paul Caluwaerts from the EUREKA Secretariat, Brussels (Appendix 4.6)

On the second day 3 lectures were presented:

- Environmental Olympics,
  Senior vice-president Osmund Ueland, OL '94 AS, Norway (Appendix 4.7)

- EUREKA Lillehammer '94,
  Dr. Svein Haagenrud, NILU, Norway (Appendix 4.8)

- Olympic arenas,
  Managing director Bjørn Sund, LOA AS, Norway (Appendix 4.9)

At the excursion to Hamar 3 lectures were presented:

- Project EU 446 EUROCARE CAREBUILD,
  Dr. Kristoffer Apeland, Dr.techn. Kristoffer Apeland, Norway (Appendix 4.10)

- Architectural process of the envelop building,
  Arch. Anders Tjønneland, Lund & Slaatto Arkitekter A/S, Norway (Appendix 4.11)

- The history of Hamar Cathedral,
  Siv.ing. Harald Ibenholt, COHMS, Norway (Appendix 4.12)

3.2 THE WORKSHOPS

3 workshops were arranged at the market place conference:

- "What is EUREKA? - What is in it for you?", presented by Paul Caluwaerts, Kim Ruberg, and Markku Warras, EUREKA Secretariat, Belgium (Appendix 5.1)

- "Predicting the service life of coating systems", presented by Jonathan W. Martin, National Institute of Standards and Technology, USA (Appendix 5.2)

- "EU 454 EUROCARE DATA", presented by Renzo Carlucci, Leica SpA, Italy, Stephan Fitz, Umweltbundesamt, Germany, and Svein Haagenrud, EUROCARE, Norway, Godtfred Rygh, National Mapping Authority, Norway (Appendix 5.3)

3.3 THE POSTER EXHIBITION

Great interest were shown in the poster exhibition, which altogether had 64 participants. The posters were shown in 5 different rooms divided into the following themes:

A: Organization and research programmes (14 participants)
B: Information databases - systems (9 participants)
C: Monitoring and control methods (9 participants)
D: Building materials (16 participants)
E: Cultural heritage (16 participants).

The poster exhibition was displayed only for the first day, and it is thought that this is too short time for such a big exhibition (Appendix 6).

3.3.1 EUROCARE project proposals

Altogether 14 EUROCARE project proposals were presented at the poster exhibition. These proposals have later been approved by the EUROCARE Board, and some of the projects will be announced as EUREKA: EUROCARE projects at the Ministerial Conference in Helsinki, May 1992. The EUROCARE project proposals were:

EC-41/EU : EUROCARE NON-DESOBAR - Non-destructive analysis of objects of art and archaeology (R&D area 8), by Academy of Fine Arts, Austria

EC-42/EU : EUROCARE MED-GLASS - Weathering of medieval glass - stained glass objects (R&D area 5), by Academy of Fine Arts, Austria

EC-43/EU : EUROCARE SERVLIFE - Control system for durability and service life of building products (R&D area 8), by the association of Finnish civil engineers, Finland

EC-45/EU : EUROCARE EUROLIME - Development and manufacturing of lime for preservation of monuments (R&D area 12), by SFB 315, Germany

EC-46/EU : EUROCARE PAPERMEC - Methods to improve the mechanical properties of degraded paper (R&D area 7), by Central Research Laboratory, the Netherlands

EC-47/EU : EUROCARE RADARCARE - Radarcare in restoration and for archaeological investigations (R&D area 8), by Norwegian Geotechnical Institute, Norway

EC-48/EU : EUROCARE ENACCOUNT - Energy and environmental influence by the use of building materials (R&D area 1), by Norwegian Building Research Institute, Norway

EC-49/EU : EUROCARE NORHER - Norwegian Heritage/Conservation Centre for Traditional Rural Culture (R&D area 1), by Norwegian Heritage, Norway

EC-50/EU : EUROCARE ACOUSTICS - Acoustics (R&D area 8), by SINTEF Rock and Mineral Engineering, Norway

EC-51/EU : EUROCARE ELKINET - Elkinet ahead-cathodic protection of concrete (R&D area 12), by Coating A/S, Norway

EC-52/EU : EUROCARE TRANSICE - Atmospheric ice on transmission line insulators (R&D area 1), by Statkraft, Norway

EC-53/EU : EUROCARE PHOTOGRAM - Measurement of deformation by use of photogrammetical methods (R&D area 8), by the National Swedish Institute for Building Research, Sweden

EC-54/EU : EUROCARE PHOTOCHEM UV - Photochemical dosimeters for measurements of ultraviolet solar radiation (R&D area 8), by the National Swedish Institute for Building Research, Sweden

Cathedral the participants could study the ruin themselves. There was also a guided tour around the Hedmark Museum, which is the old bishop's palace from the medival time (Appendix 4.10, 4.11, 4.12).

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

On the 2nd Board meeting in 1991, the 1st EUROCARE Market Place Conference was considered to be a substantial progress and success for EUROCARE. There were 17 new project proposals, and 14 of these proposals were illustrated by posters at the poster exhibition. 19 of the 21 existing EUROCARE projects were presented at the poster exhibition. Altogether 5 different STEP projects and 1 project proposal for the STEP programme were presented.

At the 2nd EUROCARE Board meeting in 1991 in EUROCARE at Lillehammer, the programme and organization of the poster sessions and workshops at the 1st EUROCARE Market Place Conference were discussed. To evaluate the outcome of the various themes, the following reporting groups were established, with rapporteur underlined:

B. Information databases
Norway (Svein Haagenrud), Italy (Sandro Massa) and Germany (Stephan Fitz).

C. Monitoring and control methods
Sweden (Jan Rosvall, Christer Sjöström).

D. Building materials
Norway (Svein Willy Danielsen), Germany (Egon Althaus), Sweden (Ingmar Holmström), Iceland (Hakon Olafsson).

I. Cultural heritage
United Kingdom (<u>John Fidler</u>), Denmark (Lisbeth Saaby), France (Jacques Philippon), Austria (Johannes Weber).

The groups were given the task of evaluating the extent and need for co-operation between projects, the consistency of goals and strategies in projects, existing and potensial industrial involvement, market orientation and possibilities for giant projects with CEC. These reports and the further evaluation of the project portfolio along these lines will be main topics for the Boards consideration.

4.2 RECOMMENDATIONS

The following recommendations were made: The EUROCARE Market Place Conference should be arranged yearly for the next 3 year period, bearing in mind, however, that the arrangement should be flexible and that each organizer should be free to act according to local possibilities and aims, emphasizing, however, that project reporting and generation should always be a core business. All efforts must be taken to increase the involvement of industry. Sweden and Austria came up with a kind offer to arrange the EUROCARE Market Place Conference in 1992 and 1993.

APPENDIX 1

Invitation to the
1st EUROCARE Market Place Conference,
Lillehammer, Norway, 1-4 October 1991

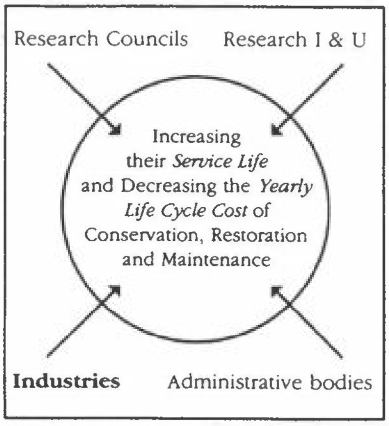
The EUROCARE concept

The business of EUROCARE is the conservation, restoration and maintenance of our built environment. It is based on the fundamental need to promote the skilful conservation not only of Europe's cultural heritage, but of its modem building stock as well. The ability to take care of our buildings and structures - old and new - will be of decisive importance in the future international race for competitiveness. Environmental damage has now reached such a level that the problem cannot be solved without a joint effort on the part of industry, research and administration. As an EUREKA project, *EUROCARE is the only international organization* which puts Industry in the lead in this partnership.

EUROCARE
EUREKA Project - EU 140

Co-ordinated effort in:
Fighting Outdoor and Indoor Environmental Degradation of the European Cultural Heritage, Building Stock and other objects and material structures

With the Goal:



to be achieved by Development of:
- New technologies
- Products and processes
- Infrastructures
- Methods
- Standards
- and within an environmental policy of "Sustainable development".

EUROCARE aims at the development of new materials, technologies, infrastructures and standards, as well as promoting a sustainable environmental policy. These are the pieces of the jigsaw which, taken together, will increase the Service Life and decrease the Yearly Life Cycle Costs of our historic and present day material structures.
Projects within the EUREKA initiative are essentially market-oriented. EUROCARE must therefore have a clear understanding of its market. Apart from cultural and environmental repercussions, environmental damage to our buildings and monuments has an enormous economic impact. Tackling its effects consequently offers a rapidly expanding market for new materials, technologies and infrastructures that industry develops.
The EUROCARE Board have been working hard in developing this concept. Now that the concept is fully developed and approved, emphasis will be put on communicating with the market. In order to accelerate this process, the Board has developed its information and market strategy: One of its measurers is a new 12 page brochure in four languages to be distributed in all EUROCARE countries. A further measure in the market plan is arrangement of the 1st EUROCARE Market Place Conference.

Aim of the EUROCARE Market Place Conference

The aims of the EUROCARE Market Place Conference is to bring together industry, researchers. conservators, restorers, engineers, architects, scientists, and other actors engaged in conservation, restoration and maintenance in order to report existing EUROCARE projects and promote new ones. Due to close relationships and collaboration, projects within CEC's STEP programme, "Area 7—Protection and Conservation of European Cultural Heritage", and the BRITE/EURAM programme are also invited to present their projects. So are the UN ECE - ICP on Materials. In addition the collaborating organizations RILEM and NBS-MK will take part in the conference, and the EUREKA framework will be presented.

Themes

Project ideas can be proposed and developed in all areas of development addressing the problem of environmental degradation of the built environment. So far the existing R&D areas cover buildings and constructions, various types of materials such as stone, wood, glass, metal and concrete, museums, paper and archives as well as monitoring and control methods. Science and industry will identify the R&D areas themselves as well as defining their requirements.

Presentation of projects and project proposals

The 1st EUROCARE Market Place Conference will be a unique chance to present new projects and an ideal place for following groups to meet:
Industry
Consultants
Contractors
Conservators
Restorers
Scientific institutes etc.

- Existing projects within EUROCARE, STEP, BRITE/EURAM, UN ECE - ICP on Materials are invited to be promoted by posters. An outline of posters are enclosed. In addition project proposals and requests could be presented.
- For new project proposals please fill out the enclosed project proposal sheets and return together with the application form by **1st August** 1991. We would also like the project proposals to be presented as posters.

- All posters must follow the same size: 1 m high and 0,7 m wide.

Exposition areas

The exposition area will be free of charge. Participants will have at their disposal a stand: 1 m wide and 2,2 m high on which it will be possible to affix posters. Exposition stands for the display of instrumentation etc. are available to a limited degree.

Excursions

In connection with the conference there will be arranged excursions in the Lillehammer area, visiting the new sports arenas and buildings for the Olympic Games. A guided tour to the Open Air Museum at Maihaugen with old wooden buildings and a stave church, as well as a trip to Hamar to study the Ruins of Hamar Cathedral and the EU 446 EUROCARE CAREBUILD project. Will be arranged.

Language

The conference language will be English.

Venue

Lillehammer is one of the older towns in the inland area of Norway. The town is centrally situated about 180 km north of Oslo. It is a picturesque small town with a lot of old wooden houses and the municipality is very concerned with preserving the identity and small town character of Lillehammer.

Participation

The conference will be arranged at the Lillehammer hotel and the Secretariat has reserved an adequate number of rooms at the Lillehammer hotel. The number of participants will be limited to 130. Participants must return the enclosed application form to the Secretariat by **1st August** 1991. For accompanying persons there will be possibilities to join a special tourist programme. This programme must be booked on the enclosed application form.

Organization

The Conference is being organized by EUROCARE in co-operation with NTNF, MoE, NBS-MK, RILEM and CEC, and the EUREKA-sekretariat.

Correspondence address:
Norwegian Institute for
Air Research, E.Dahlin
P.O.Box 64
N-2001 Lillestrøm
Tel.: +47 6 81 41 70
Fax: +47 6 81 92 47

APPENDIX 2

Programme for the conference

Programme

October 1

1500-1900 Registration and organization of posters and project proposals

October 2

0800-1000 Market
Poster sessions

0845-0930 Workshop
What is EUREKA? - What is in it for you?
Presentation by the EUREKA Secretariat

1000 Official opening
Mayor of Lillehammer Audun Tron
Secretary General Oddmund Graham, Ministry of Environment
President Henrik Andenæs, OL '94 AS, Norway

1020 The EUROCARE concept — aims and strategies,
Dr. Svein Haagenrud, chairman of EUROCARE, Norway

1050 Pause

1110 Suggestion for a logically-consistent structure for Service Life Prediction standards, and joint CIB/RILEM activities in this area,
Dr. Larry Masters, National Institute of Standards and Technology, USA,
Dr. Christer Sjöström, Swedish Institute for Building Research, Sweden

1140 EUROCARE -- Standards for conservation products,
Dr. Ingmar Holmström, Royal Institute of Technology, School of Architecture, Sweden

1200 Application of new technologies, conservation processes and materials: an industrial view point,
President Paolo Parrini, Syremont, Italy

1230 CEC's research programmes STEP and BRITE/EURAM and co-operation with EUROCARE,
Dr. Andrew Sors, CEC, Environment Research Programme

1300 Lunch

1400-1700 Market
Poster sessions

1430-1530 Workshop "Predicting the Service Life of Coating Systems",
Dr. Jonathan W. Martin, National Institute of Standards and Technology, USA

1600-1645	Workshop "EU 454 EUROCARE-DATA", *Dr. Svein Haagenrud, EUROCARE, Norway,* *Dr. Stephan Fitz, Umweltbundesamt, Germany,* *Eng. Gotfred Rygh, National Mapping Authorities, Norway,* *Prof. Renzo Carlucci, Universita dell' Aquila, Italy*
1700	Guided tour: Open air museum Maihaugen
1900	Reception Lillehammer Olympic Information Centre
2030	Conference dinner

October 3

0800-0900	Closure of Poster exhibition
0900-0920	Environmental Olympics *Sen. vice-president Osmund Ueland, OL '94 AS, Norway*
0920-0940	EUREKA Lillehammer '94 *Dr. Svein Haagenrud, NILU, Norway*
0940-1000	Olympic arenas *Managing director Bjørn Sund, LOA AS, Norway*
1000	Excursion - OL arenas
1130	Collection of Project proposals
1200	Closure
1230	Lunch
1330	Excursion - Hamar
1430	Lecture - project EU 446 EUROCARE CAREBUILD *Dr. Kristoffer Apeland, Dr.techn. Kristoffer Apeland, Norway*
1450	Architectural process of the envelope building *Arch. Anders Tjønneland, Lund & Slaatto Arkitekter A/S, Norway*
1510	Pause
1530-1550	The history of Hamar Cathedral, *Civ.eng. Harald Ibenholt, COHMS, Norway*
1550-1630	Visiting the ruin of Hamar Cathedral
1630	Departure to Oslo/Lillehammer

APPENDIX 3

List of participants

NAME	ORGANIZATION/COMPANY & ADDRESS	TELEPHONE & FAX	POSTER NO.	PARTICIPATING IN PROJECTS * = PROJECT LEADER
Egon Althaus	Mineralogisches Institut der Universität Kaiserstrasse 12 W-7500 KARLSRUHE 1 GERMANY	+49-721-608 33 16 +49-721-69 76 82	D10	EC 45 EUROLIME
Odd Anda	Norsk institutt for luftforskning P.O. Box 64 N-2001 LILLESTRØM NORWAY	+47-6-81 41 70 +47-6-81 92 47		
Henrik Andenæs	Lillehammer OL '94 AS P.O. Box 300 N-2601 LILLEHAMMER NORWAY	+47-62-71 994 +47-62-63 175		
Tord H. Andersson	Restaurator AB P.O. Box 5480 S-114 84 STOCKHOLM SWEDEN	+46-8-662 75 75 +46-8-660 09 76		
Kristoffer Apeland	Dr.techn. Kristoffer Apeland Fagerborggt. 12 N-0360 OSLO 3 NORWAY	+47-2-46 50 80 +47-2-69 03 19	E2	EU 446 EUROCARE CAREBUILD
Wolfgang Axmann	EUREKA-BUREAU DLR Deutsche Forschungsanstalt für Luft- und Raumfahrt e.V. P.O. Box 90 60 28 D-5000 COLOGNE 90 GERMANY	+49-2203-601 2748 +49-2203-673 10		
Pio Baldi	Istituto Centrale del Restauro Piazza s. Francesco Di Paola 9 I-00184 ROME ITALY	+39-6-474 34 11 +39-6-481 57 04	B8	EU 598 REFRAN
Paal Berg	Norsk institutt for luftforskning P.O. Box 64 N-2001 LILLESTRØM NORWAY	+47-6-81 41 70 +47-6-81 92 47		
Aage N. Blankvoll	FORUT Byggeteknikk og materialteknologi Ornesvn. 1 N-8500 NARVIK NORWAY	+47-82-44 020 +47-82-47 890		EU 454 EUROCARE DATA, BRUTUS

NAME	ORGANIZATION/COMPANY & ADDRESS	TELEPHONE & FAX	POSTER NO.	PARTICIPATING IN PROJECTS * = PROJECT LEADER
Erik Brandt	Statens Byggeforskningsinstitutt P.O. Box 119 DK-2970 HØRSHOLM DENMARK	+45-42 86 65 33 +45-42 86 75 35		
H.-J. Busse	Institut für Mikrobiologie und Genetik Universität Wien Althanstr. 14 A-1090 VIENNA AUSTRIA	+43-222-31336-1469 +43-222-31336-700	E5	EU 489 EUROCARE BIODECAY
Tore Lasse By	Norwegian Geotechnical Institute P.O. Box 40 Tåsen N-0801 OSLO 8 NORWAY	+47-2-23 03 88 +47-2-23 04 48	C6	EC-47 RADARCARE *
Paul Caluwaerts	EUREKA Secretariat International Avenue des Arts 19H B-1040 BRUSSELS BELGIUM	+32-2-217 00 30 +32-2-218 79 06	A1	
Renzo Carlucci	Leica SpA Via Quintiliano 41 20138 MILANO ITALY	+39-2-50 64 441 +39-2-50 23 53	B8	EU 598 REFRAN
Tim Cooper	Trinity College Dublin College Green DUBLIN 2 IRELAND	+353-1-702 18 95 +353-1-679 37 99	A2	STEP CT 90-0107
Elin Dahlin	Norsk institutt for luftforskning P.O. Box 64 N-2001 LILLESTRØM NORWAY	+47-6-81 41 70 +47-6-81 92 47		
Svein Willy Danielsen	SINTEF - FCB N-7034 TRONDHEIM NORWAY	+47-7-59 45 55 +47-7-59 71 36	D16	EC-55 CONLIFE
Roar Engdal	EB Miljøkontroll A/S Bergervn. 12 N-1361 BILLINGSTADSLETTA NORWAY	+47-2-84 30 60 +47-2-84 32 28	C1	EU 615 EUROCARE WETCORR

NAME	ORGANIZATION/COMPANY & ADDRESS	TELEPHONE & FAX	POSTER NO.	PARTICIPATING IN PROJECTS * = PROJECT LEADER
Kickan Fahlstedt	Statens Institut för Byggnadsforskning P.O. Box 785 S-801 28 GÄVLE SWEDEN	+46-26-14 78 66 +46-26-11 81 54		
Gianfranco Falcone	Ministero Universita' e Ricerca Scientifica & Tec. Longotevere Thaon de Revel, 76 00196 ROMA ITALY	+39-6-32 32 634 +39-6-32 21 584		
John Fidler	English Heritage Keysign House 429 Oxford Street LONDON W1R 2HD UNITED KINGDOM	+44-71-973 34 84 +44-71-973 34 30		
Stephan Fitz	Umweltbundesamt Bismarckplatz 1 D-1000 BERLIN 33 GERMANY	+49-30-8901 2160 +49-30-8903 2285	B3	EU 484 EUROCARE DATA
Sverre K. Fossdal	Norges Byggforskningsinstitutt P.O. Box 123 Blindern N-0314 OSLO 3 NORWAY	+47-2-96 55 00 +47-2-96 55 42	D12	EC-48 ENACCOUNT
Oddmund Graham	Miljøverndepartementet P.O. Box 8013 Dep N-0030 OSLO 1 NORWAY	+47-2-34 57 07 +47-2-34 95 60		
Unni Grønn	Riksantikvaren P.O. Box 8196 Dep. N-0034 OSLO 1 NORWAY	+47-2-94 04 00 +47-2-94 04 04		
Ebbe Grønvold	Statens Byggetekniske Etat P.O. Box 8185 Dep. N-0034 OSLO 1 NORWAY	+47-2-20 80 15 +47-2-42 38 69		
Lars Haugli	Green Business AS Ullern allé 41 N-0381 OSLO NORWAY	+47-2-50 51 00		

NAME	ORGANIZATION/COMPANY & ADDRESS	TELEPHONE & FAX	POSTER NO.	PARTICIPATING IN PROJECTS * = PROJECT LEADER
Sigmund Haugsjå	Lillehammer Olympiske Organisasjonskomite LOOC Elvegt. 19 N-2600 LILLEHAMMER NORWAY	+47-62-71 994		
John B.G.A. Havermans	TNO Centre for Paper and Board Research 97, Schoemakerstraat NL-2826 VK DELFT THE NETHERLANDS	+31-15-69 69 00 +31-15-69 65 11	A3	STEP CT 90-0100
Sigurd Heimdal	Jotun A/S P.O. Box 305 N-3201 SANDEFJORD NORWAY	+47-34-57 000 +47-34-61 144	D2	EU 455 EUROCARE PROWOOD
Jan F. Henriksen	Norsk institutt for luftforskning P.O. Box 64 N-2001 LILLESTRØM NORWAY	+47-6-81 41 70 +47-6-81 92 47	C3,D3	EU 640 EUROCARE WETDRYDEP EU 615 EUROCARE WETCORR EU 455 EUROCARE PROWOOD
Frank Henning Holm	Entreprenørbygg Eiendom A/S P.O. Box 128 Bryn N-0611 OSLO 6 NORWAY	+47-2-56 09 09 +47-2-56 16 88		
Jan Holmberg (NORDCOM Dalagatan 78B S-113 24 STOCKHOLM)	NORDCOM LTD. New Sweden House Hindon SALISBURY SP3 6ED UNITED KINGDOM	+44-747-89 410 +44-747-89 621 (+46-8-34 47 56)	C5	EC-25 EUROCARE AIMS
Ingmar Holmström	Kungliga Tekniska Högskolan Arkitektur S-100 44 STOCKHOLM SWEDEN	+46-8-790 60 00 +46-8-790 85 39		
Sverre B. Holøs	Mycoteam A/S P.O. Box 113 Blindern N-0314 OSLO 3 NORWAY	+47-2-96 55 00 +47-2-46 55 52	D4	EU 455 EUROCARE PROWOOD
Per Jostein Hovde	Norges tekniske høgskole Inst. for husbyggingsteknikk N-7034 TRONDHEIM - NTH NORWAY	+47-7-59 45 47 +47-7-59 45 51		

NAME	ORGANIZATION/COMPANY & ADDRESS	TELEPHONE & FAX	POSTER NO.	PARTICIPATING IN PROJECTS * = PROJECT LEADER
Øivind Høidalen	Norcem A/S FoU N-3950 BREVIK NORWAY	+47-3-57 01 11 +47-3-57 14 00	D12	EC-48 ENACCOUNT
Svein Erik Høst	Norsk Teknisk-Naturvitenskapelige Forskningsråd P.O. Box 70 Tåsen N-0801 OSLO 8 NORWAY	+47-2-23 18 65 +47-2-18 11 39	A13	Royal Norwegian Counsil for Scientific and Industrial Research
Svein Haagenrud	Norsk institutt for luftforskning P.O. Box 64 N-2001 LILLESTRØM NORWAY	+47-6-81 41 70 +47-6-81 92 47	A11,B1	NBS-MK EU 454 EUROCARE DATA*
Harald Ibenholt	Riksantikvaren P.O. Box 8196 Dep. N-0034 OSLO 1 NORWAY	+47-2-94 04 00 +47-2-94 04 04	D11	EC-45 EUROLIME
Per Jernberg	Statens Institut før Byggnadsforskning P.O. Box 785 S-801 28 GAEVLE SWEDEN	+46-26-14 78 82 +46-26-11 81 54	D5	EU 455 EUROCARE PROWOOD
Manfred Koller	Bundesdenkmalamt Wien Objekt 15, Tor 4 A-1030 VIENNA AUSTRIA	+43-222-78 21 46 +43-222-78 21 45	E6,7,8	EU 440 EUROCARE NONNBERG EU 491 EUROCARE PARZ EU 442 EUROCARE WALLPAINT
Knut Korsæth	Statsetatenes hus Gudbrandsdalsvn. 170-172 N-2600 LILLEHAMMER NORWAY	+47-62-66 000 +47-62-66 167		
Truls Korsæth	VIAK Info P.O. Box 1049, Skurva N-2601 LILLEHAMMER NORWAY	+47-62-55 055 +47-62-58 288	B4	EU 454 EUROCARE DATA
Arild Kubberød	Coating A/S P.O. Box 30 N-1361 BILLINGSTADSLETTA NORWAY	+47-2-98 20 92 +47-2-98 24 40	D13	EC-51 ELKINETT

NAME	ORGANIZATION/COMPANY & ADDRESS	TELEPHONE & FAX	POSTER NO.	PARTICIPATING IN PROJECTS * = PROJECT LEADER
Vladimir Kucera	Swedish Corrosion Institute Roslagsvägen 101, Hus 25 S-104 05 STOCKHOLM SWEDEN	+46-8-790 98 34 +46-8-16 72 70	A10	ECE ICP ON EFFECTS ON MATERIALS
Bosse Lagerqvist	University of Gothenburg Institute of Conservation Bastionplatsen 2 S-411 08 GOTHENBURG SWEDEN	+46-31-63 47 02 +46-31-63 47 03	B9	EU 598 REFRAN
Wolfgang Lanz	Bundeswirtschaftskammer/Österreichisches Sekretariat für EG-Forschungs- und Technologieprogramme und EUREKA Wiedner Hauptstrasse 63 A-1045 VIENNA AUSTRIA	+43-222-505 90 59 +43-222-505 90 54		
J. Owen Lewis	University College Dublin School of Architecture Richview, Clonskeagh IRL-DUBLIN 14 IRELAND	+353-1-269 27 50 +353-1-283 89 08	A5	STEP. Condition assessment of historic building facades.
Ulf Lindborg	Riksantikvarieämbetet P.O. Box 5405 S-114 84 STOCKHOLM SWEDEN	+46-8-783 93 60 +46-8-660 72 84		
Clifford Long	Riksantikvaren P.O. Box 8196 Dep. N-0034 OSLO 1 NORWAY	+47-2-94 04 00 +47-2-94 04 04		
Angelo Lucchini	Dipartimento di Ingegneria dei Sistemi Edilizi e Territoriali Politecnico di Milano Via Bonardi, 15 I-20133 MILANO ITALY	+39-2-239 96 018 +39-2-239 60 20		

NAME	ORGANIZATION/COMPANY & ADDRESS	TELEPHONE & FAX	POSTER NO.	PARTICIPATING IN PROJECTS * = PROJECT LEADER
Francis Lyons	Trinity College Dublin College Green DUBLIN 2 IRELAND	+353-1-702 18 95 +353-1-679 37 99		
Martin Mach	Bayerisches Landesamt für Denkmalpflege Hofgraben 4 D-8000 MUNICH 1 GERMANY	+49-89-228 52 93	E14	EU 316 EUROCARE COPAL
Vittorio Marchesi	Leica SpA Via Quintiliano 41 20138 MILANO ITALY	+39-2-50 64 441 +39-2-50 23 53		
Nils Marstein	Riksantikvaren P.O. Box 8196 Dep. N-0034 OSLO 1 NORWAY	+47-2-94 04 00 +47-2-94 04 04		
Jonathan Martin	National Institute of Standards & Techn. Building Materials Division United States Department of Commerce Bldg. 226, Room B348 GAITHERSBURG, MARYLAND 20899 USA	+1-301-975 67 17 +1-301-975 40 32		
Sandro Massa	CNR Conservazione Opere d'Arte Via Monte d'Oro 28 00186 ROMA ITALY	+39-6-68 73 451 +39-6-68 71 462		
Larry Masters	National Institute of Standards & Techn. Building Materials Division United States Department of Commerce Bldg. 226, Room B348 GAITHERSBURG, MARYLAND 20899 USA	+1-301-975 67 07 +1-301-975 40 32		
J. Mathews	Digipress 18 Rue Bailey F-14050 CAEN CEDEX FRANCE	+33-31 47 25 06 +33-31 47 25 01	E1	EU 390 EUROCARE LAST

NAME	ORGANIZATION/COMPANY & ADDRESS	TELEPHONE & FAX	POSTER NO.	PARTICIPATING IN PROJECTS * = PROJECT LEADER
A.C.A. Mechelen	TNO Building and Construction Research P.O. Box 49 NL-2600 AA DELFT THE NETHERLANDS	+31-15-84 21 05 +31-15-84 39 90		
Olav Myrholt	Naturvernforbundet P.O. Box 454 N-2601 LILLEHAMMER NORWAY	+47-62-63 045 +47-62-60 858		
Olaug Hana Nesheim	Riksantikvaren P.O. Box 8196 Dep. N-0034 OSLO 1 NORWAY	+47-2-94 04 00 +47-2-94 04 04	B5	EU 454 EUROCARE DATA
Dag Nilsen	NAVF - FOK-PROGRAMMET NTH - Avd. for Arkitekturhistorie N-7034 TRONDHEIM - NTH NORWAY	+47-7-59 50 84 +47-7-59 50 94		
Rolf Näslund	Riksantikvarieämbetet Fornminnesavdelningen/Runverket P.O. Box 5405 S-114 84 STOCKHOLM SWEDEN	+46-8-783 30 00 +46-8-783 25 15	B2	EU 454 EUROCARE DATA
Sylvi Ofstad	Miljøverndepartementet P.O. Box 8013 Dep N-0030 OSLO 1 NORWAY	+47-2-34 57 14 +47-2-34 95 62	A14	
Thor Ofstad	Norsk institutt for luftforskning P.O. Box 64 N-2001 LILLESTRØM NORWAY	+47-6-81 41 70 +47-6-81 92 47		
Jean Oger	Directeur de Service Recherches de la Societe Sicof 9, rue Marcel Sembat BP 138 F-44005 NANTES CEDEX 01 FRANCE	+33-40 43 32 55 +33-40 43 46 46	E13	EU 594 EUROLITH
Hákon Olafsson	The Icelandic Building Research Institute Keldnaholt IS-112 REYKJAVIK ICELAND	+354-1-67 60 00 +354-1-67 88 11	D9	EU 664 CON-COAT

NAME	ORGANIZATION/COMPANY & ADDRESS	TELEPHONE & FAX	POSTER NO.	PARTICIPATING IN PROJECTS * = PROJECT LEADER
Paolo L. Parrini	Syremont S.p.A. Via Camperio 9 I-20123 MILANO ITALY	+39-2-6270 5351 +39-2-6270 5413		
Margarete Patzak	EUROCARE Secretariat SFB 315 Universität Karlsruhe Parkstrasse 17 W-7500 KARLSRUHE 1 GERMANY	+49-721-60 63 08 +49-721-69 61 68	D10,E4	
Eliza Pawlak	Kjessler & Mannerstråle AB Korsgatan 7-9 S-411 16 GØTEBORG SWEDEN	+46-31-17 63 60 +46-31-13 04 89	D1	EU 341 EUROCARE FOUNDATION
Jacques Philippon	Ministere de la Culture Mission de la Recherche 3, rue de Valois F-75042 PARIS CEDEX 01 FRANCE	+47-33-1-4015 846 +47-33-1-4015 838	A9	French-German Research Programme
Enrico Aliverti Piuri	Italcad Technologie e Sistemi SpA Via Inverigo 6 20151 MILANO ITALY	+39-2-3340 0150 +39-2-3800 0874		
Hans Ponnert	Riksantikvarieämbetet P.O. Box 5405 S-114 84 STOCKHOLM SWEDEN	+46-8-783 92 26 +46-8-783 92 61		
Johannes Rasmussen	Norges Teknisk-Naturvitenskapelige Forskningsråd P.O. Box 70 Tåsen N-0801 OSLO 8 NORWAY	+47-2-23 76 85 +47-2-18 41 37		
Liisa Rautiainen	Technical research centre of Finland Betonimiehenkuja 3 SF-02150 ESPOO FINLAND	+358-0-4561 +358-0-4567 006		

NAME	ORGANIZATION/COMPANY & ADDRESS	TELEPHONE & FAX	POSTER NO.	PARTICIPATING IN PROJECTS * = PROJECT LEADER
Enrico Reggiani	Italcad Technologie e Sistemi SpA Via Inverigo 6 20151 MILANO ITALY	+39-2-3340 0150 +39-2-3800 0874		
Arild Rode	Norsk institutt for luftforskning P.O. Box 64 N-2001 LILLESTRØM NORWAY	+47-6-81 41 70 +47-6-81 92 47		
Jan Rosvall	University of Gothenburg Institute of Conservation Bastionplatsen 2 S-411 08 GOTHENBURG SWEDEN	+46-31-63 47 02 +46-31-63 47 03	B9	EU 598 REFRAN
Kim Ruberg	EUREKA Secretariat International Avenue des Arts 19H B-1040 BRUSSELS BELGIUM	+32-2-217 00 30 +32-2-218 79 06	A1	
Gotfred Rygh	Statens kartverk Monsrudveien N-3500 HØNEFOSS NORWAY	+47-67-18 100 +47-67-18 101	B6	EU 454 EUROCARE DATA
Ingemar Samuelson	Swedish National Testing and Research Institute P.O. Box 857 S-501 15 BORÅS SWEDEN	+46-33-16 51 59 +46-33-11 39 41	JA	EU 455 EUROCARE PROWOOD
Christina Sandström	Riksantikvarieämbetet P.O. Box 5405 S-114 84 STOCKHOLM SWEDEN	+46-8-783 90 06 +46-8-783 92 61		
Hans Sandström	Riksantikvarieämbetet P.O. Box 5405 S-114 84 STOCKHOLM SWEDEN	+46-8-783 92 52 +46-8-783 92 61		
F. de Santis	CNR - 1st Ing. Atm. Via Salaria km 29.3 - C.P. 10 I-00016 MONTEROTONDO STAZIONE ROMA ITALY	+39-6-9002 0263 +39-6-9002 0660		

NAME	ORGANIZATION/COMPANY & ADDRESS	TELEPHONE & FAX	POSTER NO.	PARTICIPATING IN PROJECTS * = PROJECT LEADER
Sam C. Saunders	Washington State University Dept. of Pure & Applied Mathematics Pullman, WA 99164-3113 USA	+1-509-335 4122 +1-509-335 1188		
Manfred Schreiner	Akademie of Fine Arts Vienna Institut für Farbenchemie Schillerplatz 3 A-1010 VIENNA AUSTRIA	+43-1-58816/241 +43-1-587 79 77	E9,10	EC-42 MED-GLASS EC-41 NDA-ART
Stefan Simon	Inst. F. Aug. u. Angen Geologie Luisenstr. 37 D-8000 MUNICH 2 GERMANY	+49-89-228 52 93	E8	EU 496 EUROCARE EUROMARBLE
Christer Sjöström	Statens Institut för Byggnadsforskning P.O. Box 785 S-801 28 GÄVLE SWEDEN	+46-26-14 78 77 +46-26-11 81 54	A8, C2,7,8	CIB/RILEM EU 640 WET DRY-DEP* EC-54 PHOTOCHEM UV* EC-53 PHOTOGRAM*
Tenho Sneck	Sneck-Consulting Oy P.O. Box 58 SF-02601 ESBO FINLAND	+358-0-51 59 51 +358-0-135 76 70	C9	EC-43 SERVLIFE
Frederique Spannenburg	EUREKA Secretariaat Grote Marktstraat 43 NL-2511 BH DEN HAAG THE NETHERLANDS	+31-70-36 10 311 +31-70-36 10 355		
Andrew I. Sors	Commission of European Communities Environment Research Programme 200, rue de la Loi B-1049 BRUSSELS BELGIUM	+32-2-35 76 59 +32-2-23 63 024		
Per Storemyr	SINTEF Avd. for Bergteknikk N-7034 TRONDHEIM - NTH NORWAY	+47-7-59 49 22 +47-7-59 47 78	C4	EC-50 ACOUSTICS

NAME	ORGANIZATION/COMPANY & ADDRESS	TELEPHONE & FAX	POSTER NO.	PARTICIPATING IN PROJECTS * = PROJECT LEADER
Ellen-Birgitte Strømø	Lillehammer kommune Gudbrandsdalsvn. 170-172 N-2600 LILLEHAMMER NORWAY	+47-62-66 500 +47-62-66 474		
Marit Støre	Norsk institutt for luftforskning P.O. Box 64 N-2001 LILLESTRØM NORWAY	+47-6-81 41 70 +47-6-81 92 47	C1	EU 618 EUROCARE WETCORR
Christian Sulheim	Norwegian Heritage Foundation/ Conservation Centre for Traditional Rural Culture N-2680 VÅGÅMO NORWAY	+47-62-32 000 +47-62-32 000	E12	EC-49 NORHER
Bjørn Sund	Lillehammer Olympiske Anlegg AS - LOA Bryggerigt. 68 N-2600 LILLEHAMMER NORWAY	+47-62-60 521 +47-62-60 994		
Tor Sæther	Hedmarksmuseet og Domkirkeodden P.O. Box 1053 N-2301 HAMAR NORWAY	+47-65-31 166		
Ole-Gunnar Søgnen	Norges Teknisk-Naturvitenskapelige Forskningsråd Produktutvikling og forsøksbygging Rosenkrantzgt. 3 N-5003 BERGEN NORWAY	+47-5-32 82 03 +47-5-31 34 36	A12	Royal Norwegian Council for Scientific and Industrial Research
Lisbeth Saaby	Miljøministeriet Planstyrelsen Haraldsgade 53 DK-2100 COPENHAGEN Ø DENMARK	+45-39 27 11 00 +45-39 27 12 66	A5,6	STEP PL 900512 STEP CT 90-015
Sverre Tiltnes	Norges Teknisk-Naturvitenskapelige Forskningsråd P.O. Box 70 Tåsen N-0801 OSLO 8 NORWAY	+47-2-23 76 85 +47-2-18 41 37		

NAME	ORGANIZATION/COMPANY & ADDRESS	TELEPHONE & FAX	POSTER NO.	PARTICIPATING IN PROJECTS * = PROJECT LEADER
J.H.S. Timmler-Doornekamp	Rijksdienst voor de Monumentenzorg P.O. Box 1001 NL-3700 BA ZEIST THE NETHERLANDS	+31-3404-83 290 +31-3404-16 189	E11	EC-46 PAPERMEC
Anders Tjønneland	Lund & Slaatto Arkitekter A/S Drammensvn. 127 N-0277 OSLO 2 NORWAY	+47-2-55 48 00 +47-2-44 80 53	E2	EU 446 EUROCARE CAREBUILD
Claude Tripette	Laboratoire de Recherches Cray Valley - Total Groupe Centre de Developpement et Recherches de Vernfull Parc-Alata - BP 22 F-60550 VERNEUIL EN HALATTE FRANCE	+33-44 55 67 05 +33-44 55 68 24	E13	EU 594 EUROLITH
Audun Tron	Lillehammer kommune Gudbrandsdalsvn. 170-172 N-2600 LILLEHAMMER NORWAY	+47-62-66 500 +47-62-66 474		
Åsmund Ueland	Lillehammer OL '94 AS P.O. Box 300 N-2601 LILLEHAMMER NORWAY	+47-62-71 994 +47-62-63 175		
Maria-Angeles Vicente	C.S.I.C. (Espana) IRN-CSIC Apdo. 257 E-37080 SALAMANCA SPAIN	+34-23-21 96 06 +34-23-21 96 09	A4	STEP-CT 90-0101* Granitic materials and historical monuments
Alf Waldum	Norges byggforskningsinstitutt Høgskoleringen 7 N-7034 TRONDHEIM - NTH NORWAY	+47-7-59 33 90 +47-7-59 33 80	D11	

NAME	ORGANIZATION/COMPANY & ADDRESS	TELEPHONE & FAX	POSTER NO.	PARTICIPATING IN PROJECTS * = PROJECT LEADER
Markku Warras	EUREKA Secretariat International Avenue des Arts 19H B-1040 BRUSSELS BELGIUM	+32-2-217 00 30 +32-2-218 79 06	A1	
Johannes Weber	Lehrkanzel für Technisches Chemie Institut f.Silikatchemie u. Archaometrie Hochschule für angewandte Kunst in Wien Salzgries 14/1 A-1013 VIENNA AUSTRIA	+43-222-535 68 30 +43-222-535 68 29		
Gro Wester	Riksantikvaren P.O. Box 8196 Dep. N-0034 OSLO 1 NORWAY	+47-2-94 04 00 +47-2-94 04 04	B5	EU 454 EUROCARE DATA
Øivind Ødegaard	Norges Teknisk-Naturvitenskapelige Forskningsråd P.O. Box 70 Tåsen N-0801 OSLO 8 NORWAY	+47-2-23 76 85 +47-2-18 41 37		
Göran Åberg	Institutt for Energiteknikk P.O. Box 40 N-2007 KJELLER NORWAY	+47-6-80 60 00 +47-6-81 55 53	C10	Dept of Weathering deter- mined by C and O Isotops*
Inge Århus	Miljøverndepartementet P.O. Box 8013 Dep N-0030 OSLO 1 NORWAY	+47-2-34 90 90		
Kikki Aasarød	Norsk institutt for luftforskning P.O. Box 64 N-2001 LILLESTRØM NORWAY	+47-6-81 41 70 +47-6-81 92 47		

NAME	ORGANIZATION/COMPANY & ADDRESS	TELEPHONE & FAX	POSTER NO.	PARTICIPATING IN PROJECTS * = PROJECT LEADER
Svein Bjørberg	Multiconsult Oslo A/S P.O. Box 40 N-1324 LYSAKER NORWAY	+47-2-58 00 58 +47-2-53 38 72		
Odd Arve Lien Varaordfører	Lillehammer kommune Gudbrandsdalsvn. 170-172 N-2600 LILLEHAMMER NORWAY	+47-62-66 500 +47-62-66 474		
Mr. Vié	CEBTP Domaine de St. Paul F-78470 ST. REMY DES CHEVREUSE FRANCE	+33-1-30 85 21 16 +33-1-30 85 21 03		

APPENDIX 4

Papers presented at the conference

APPENDIX 4.1

Dr. Svein Haagenrud:
"The EUROCARE concept - aims and strategies"

THE EUROCARE CONCEPT - AIMS AND STRATEGIES

S.E. Haagenrud, Chairman EUROCARE
Norwegian Institute for Air Research
P.O. Box 64, N-2001 Lillestrøm, Norway

Mr. Chairman, Mayor, President, Ladies and gentlemen,

First of all, on behalf of the EUROCARE Board, it is a pleasure for me to welcome you all to this birth of a new EUROCARE child - the 1st EUROCARE Market Place Conference. As the name of the child tells - its main aim is to facilitate EUROCARE's market communication. Bearing in mind that the target group is mainly those that already have activities of relevance to EUROCARE, and not for those who have just interest, the response to the conference indicates a happy and promising childhood.

EUROCARE has worked hard to become a true EUREKA daughter, and before dealing with EUROCARE's challenges, aims and strategies, I therefore feel it is appropriate to dwell a little on EUREKA - what it is and what it has achieved. In this respect, I am particularly glad to welcome here our friends from the EUREKA Secretariat. The EUREKA Secretariat is very supportive and co-operative, and we thank them for bringing here the EUREKA exhibition, and giving the EUREKA workshop this morning, which allows me to be very short on this topic.

EUREKA is a joint European initiative between 19 European countries and the CEC as such. The initiative seeks to improve productivity through cross border co-operation in research and development of products, processes and services in advanced technologies and for the world market. The EUREKA project profile ensures international co-operation through at least two countries being involved. It is a "bottom-up" approach with partners from industry and R&D institutes, with projects not necessarily originating from any governmental programme. The projects aim to develop products close to market and is lead by industry, and the partners involved hold full ownership of results. It is complementary to other existing co-operation schemes such as the CEC programmes, where we have looked forward to have Dr. Andrew Sors from CEC to tell us more about this morning. Unfortunately, he had to make a last minute with-drawal due to serious illnes in family. Instead Paul Caluwaerts from the EUREKA Secretariat will give the main points of Sors's paper. And from EUROCARE I am glad to say that CEC is now member of EUROCARE and both parties strive to establish joint projects, taking advantage of this co-operation frame you can se here. In its 6 year history EUREKA has been able to involve more than 3 000 organizations, create more than 500 projects at the total cost of about 8 billions ECU, or 65 billions NOK. The EUREKA initiative covers 9 thematic fields of which environment is the fastest growing. For the environmental area, which is very interdisciplinary, some umbrella projects covering various fields have been established. EUROCARE, on safeguarding the cultural heritage and building stock, is one of them:

Starting out in 1986 with the caretaking of Europe's cultural heritage as its main aim, the EUROCARE umbrella as such found itself in serious crisis with 1989 coming up. With more than 50 project proposals, but no announced EUREKA project, and little industrial involvement, EUREKA's market requirements were not fulfilled and time were about to run out for the umbrella.

Looking at today's situation, with 22 EUREKA projects and ~20 more in the pipeline, and with more than 50% being lead by industry and with 15 countries plus CEC as members, the question can be asked: What has been done?

In 1989, in order to address the EUROCARE umbrella problem, the EUROCARE Board carried out a detailed strategic analysis, concluding that

1. The problem was far more comprehensive than just the traditional cultural heritage and therefore the EUROCARE concept

should be further developed in terms of aims, market and scientific quality.

and further:

2. Far more effort had to be put into a proper organization administration of the international umbrella, especially in terms of the communication system, in order to facilitate generation of quality EUREKA/EUROCARE projects.

In developing the new EUROCARE concept a bird's eye view was put on our built environment, and it was realized that not only are the materials from our old cultural heritage exposed to environmental degradation and at risk, but also the materials and constructions from yesterday, today and even tomorrow. This is also part of our cultural inheritance, as is, by the way, the Ekofisk platform, being also the responsibility of the Cultural Office for Historic Monuments and Sites, showing the hopelessness of this traditional division of tasks and response in society. The environmental degradation of materials and constructions has now become an enormous economic, cultural and environmental problem. The economic problem is illustrated by these examples and figures from, first Norway - with concrete damages of $\geq$ 1 B ECU and about 10 m ecu for balcony's damages in just one housing co-operative. Then from Germany, the costs of environmental degradation of materials and constructions are shown to be around 12-13 billions DEM per year. That was before the "Wiedervereinigung" and today it is, as we all know, very much higher. With that viewpoint the economic market is enormous. The building stock and infrastructure in each country constitute more than 50% of the each country's real capital, and the yearly maintenance costs amount to billions and billions of ECU per year. Looking at the challenges ahead it is therefore quite clear that society's approach towards safeguarding our built environment must change from todays "throw away" to a "react and cure" and further on to an "anticipate and prevent" attitude, in just the same way as for the environmental issue. In this change we will all have a lot of lessons to learn in the "react and cure" process we are just starting, and where the caretaking idea of conservation should be a very valuable driving force. From this problem and market analysis it is quite clear that

1. Actions needed now! There is no more time to lose, and such is the task that, in order to be effective, these actions must be
2. Joint efforts from industry, research and administration.

As illustrated by the quotation of the previous environmental slogans just shown, the new "green" EUROCARE market concept also closely links up with the "sustainable development" approach. Consistent with the Brundtland report phrase "states shall conserve and use the <u>environment</u> and <u>natural resources</u> for the benefit of present and future generations", considerable decrease of energy and materials consumption has to be pursued. The State of the World report for 1991 in its chapter 3 "Reducing waste, saving materials" states: "Industrial designers could undoubtedly uncover many opportunities for source reduction if they focused on the development of durable, repairable products", and "The overall aim is to reduce the amount of materials that enter and exit the economy".

This means that industry's view on environment have to change and that industry's slowly emerging environmental strategy of looking at the totality of the impact on the environment throughout the life cycle of a product, from raw material to waste, is included in the "green" EUROCARE concept. And we are very happy to welcome to EUROCARE the first project on this topic, namely the Norwegian project on Energy & Environment account for building material.

With all this in mind, EUROCARE's aims and strategies in the new "green" market concept have been developed as follows: "EUROCARE is a co-ordinated effort in fighting outdoor and indoor environmental degradation of Europe's cultural heritage, building stock and other objects and material structures. The ultimate goal is to increase the service life and decrease the yearly life cycle costs for conservation, restoration and maintenance. This is to be achieved by the development of new materials, technologies, infrastructures, norms and standards, and a sustainable environmental policy. Treating both the symptoms and causes, EUREKA project EUROCARE is the only international organization which puts industry in the lead in this partnership.

Concerning the second main strategy for motoring EUROCARE - the work for improvement of the international organization, the results are reflected in the EUROCARE structure, of which the working groups for organization, information strategy, supportive measures and scientific concepts are the cornerstones. That they will continue to be so is reflected in what the Board sees as the 4 main challenges for the 90'ies:

EUROCARE CHALLENGES 90'ies

1) A common scientific strategy for old and new materials - product life time methodology and data urgently needed

2) Networking R&D co-operation - must be established on a broadest possible basis in order to achieve substantial results

3) Maintenance and yearly life cycle costs - should be included into budgetting procedures

4) Communication of the "green" EUROCARE concept to the market in order to improve the project portfolio, and through that take actions and achieve results.

In dealing with these challenges, the EUROCARE Board will implement the following strategies. First, on the common scientific strategy, which is the business of WG4

- make use of RILEM recommendation for "prediction of service life" in EUROCARE project design, and we already have one in the PROWOOD, while EUROLIME will be another

- CEN and ISO standardization of RILEM recommendation (under way with the help of the EUREKA Secretariat as part of their Supportive measures)

- connect further development of the needed service life methods to ongoing work of CIB/RILEM
(of which we will be pleased to listen to the presentation of Masters/Sjöström),

- getting industry involved (Parrini),
(where we very much look forward to hear President Parrini of Syremont's view on this)

- integration of the important conservation requirements into the service life model by demonstration projects (Holmström).
Here I will like to quote the well known Italian conservator Dr. Tarraca: "academic and industrial research can provide support to the chronic weakness of specialized conservation research, provided that the connection between conservation requirements and industrial research is ensured", we are very much looking forward to the presentation by Dr. Holmström on this issue.

Concerning R&D co-operation the main strategies are:

2) Networking R&D co-operation

- networking through EUREKA system

- co-operation with CEC relevant programmes (Sors),
of which will be brief presented by Dr. Paul Caluwaerts

- linking to environmental research, both within CEC and ECE work, which has as its main aim to provide scientific background for policies to reduce pollution from present level, causing high degradation to lower level causing lower degradation. In this respect, the ECE materials exposure programme should be of special importance, and which is exhibited here by its project leader Dr. Kucera from the Swedish Corrosion Institute

- connection with CIB W80/RILEM 140 TSL work

Concerning life cycle costs
Although EUROCARE's topics of work are very much an environmental question, it has a serious economic impact on society. An all out implementation of the yearly life cycle cost model into administrative budgetting, to put "dollars and sence" on the issue, is therefore an absolute necessity in order to improve the situation. This will be pursued

- by making demonstration projects, where we from EUROCARE point of view are extremely content with the adoption of the EUROCARE concept to some of the new olympic arenas, and which will be presented to us tonight and tomorrow by Senior vice president Bjørn Sund.

- standardization of yearly life cycle cost model (the EUROCARE Board will together with the EUREKA Secretariat take initiatives for standardization of the yearly life cycle cost model). This Norwegian standard is now being promoted through ISO and is poster exhibited here.

Now concluding my talk with the last challenge:

The EUROCARE Board is confident of the EUROCARE concept as described and the main challenge now in order to improve the situation, which is a real ambitious task, is to communicate the concept to the market. These are the strategies being implemented by WG2 in a continuous row after decision at our last Board meeting in Paris January this year.

First, brochure, project info etc. which is shown at the EUREKA stand.

Workshops, seminars, exhibition, shown here is the EUROCARE exhibition at the Sunday Times Exhibition, of which EUROCARE is greatly indebted to the Norwegian Ministry of Environment, who invited EUROCARE, helped and paid about 80 000 ECU (shown outside here).

Of special importance would be the creation of national EUROCARE networking teams to help Board members in the marketing and generation of project in each country.

Looking at the results achieved so far in preparing for this conference - with all of you here, with the presentations of information lectures, EUROCARE and STEP projects, about 20 new proposals, we are enthusiastic about the potential of Market Place Conferences, and think they should be arranged regularly.

And last but not least: demonstration projects being linked to the enormously forceful marketing impetus of the Olympics We hope that the 1st EUROCARE Market Place Conference in the Olympic Lillehammer area and the demonstration projects linked with the Olympics '94 will turn out to be powerful catalysts for such a development of the market.

By this, ladies and gentlemen, I wish you a happy and prosperous Market Place Conference and thank you for the attention.

APPENDIX 4.2

Dr. Larry Masters:
"Suggestions for a logically-consistent structure for service life prediction standards"

Durability of Building Materials and Components

Proceedings of the Fifth International Conference held in Brighton, UK, 7–9 November 1990

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11 SUGGESTIONS FOR A LOGICALLY-CONSISTENT STRUCTURE FOR SERVICE LIFE PREDICTION STANDARDS

G. FROHNSDORFF, L. MASTERS
National Insitute of Standards and Technology, Gaithersburg, Maryland, USA

Abstract
Ability to predict the service life of building materials, components, and systems is needed to improve the selection process. Evaluation of durability using existing standards does not give adequate service life information. Because service life prediction is more complex than current durability evaluations, its standardization will require a new body of standards to be put in place. The standards must define a general methodology, and essential components of the methodology. These are environmental characterization, characterization of the item whose service life is to be predicted, identification of the mechanisms and kinetics of the degradation processes, development of mathematical models of degradation, application of the models in service life prediction, and reporting of the results. It is proposed that the needed standards must comprise a hierarchy with the highest level being the general methodology, the second level defining the essential components of the methodology, and the third and lower levels describing the application of the generic standards to specific materials, components, or systems. The development of the proposed hierarchy will require a well-coordinated activity which cuts across the interests of many different standards committees.

1 Introduction

We owe much to Sereda [Sereda and Litvan (1980)] for leadership in establishing the International Conferences on Durability of Building Materials and Components. His hope was that the conferences would promote the development of a literature covering the durability of non-metallic building materials analogous to that which the corrosion literature provides for metals. The success of the conferences and the usefulness of their published proceedings suggests that Sereda's hopes will become reality. But even more must be done if durability knowledge is to be used widely and effectively in selecting building materials and components.

In view of the important role of standards in construction decisions, and the rudimentary nature of durability standards, it is time to decide on the preferred structure of durability standards, particularly standards for prediction of service life. This should not be thought of as a dull or rather routine exercise. In fact, the necessity of coupling a wide range of scientific and engineering disciplines to the standards process will challenge the system and its participants. It will require knowledge of materials science and engineering, environmental characterization, engineering statistics, and techniques of mathematical modeling. Success in establishing a sound, standardized basis for service life predictions will be important in aiding conservation of the earth's resources and improving the competitiveness of organizations which use service life prediction most effectively. It will also provide a needed tool for use by product approval systems in evaluating new products.

As pointed out earlier [Frohnsdorff and Masters (1980)], because durability is a vague concept, it is more fruitful to think in terms of service life of a material or component under specific conditions. Prediction of service life [Masters (1985), Sjostrom (1985)] is knowledge intensive [Fagerlund (1985)] and will undoubtedly improve with growth in the knowledge base and ability to handle knowledge with computers. Possibilities for using computers in developing an integrated knowledge base for concrete technology, including service life prediction, have been discussed by one of us [Frohnsdorff, Clifton, Jennings, Brown, Struble, and Pommersheim (1988)]. The integrated knowledge system envisioned would consist of interfaced databases, image bases, mathematical models, and expert systems, with access to the system being provided by computer networks [Frohnsdorff (1989)]. The possibility of developing such systems for all building materials gives hope for significant improvements in service life prediction.

The new ways of handling knowledge brought about by computers will make possible great changes in the nature of standards. It is not just that standards can be distributed in electronic form, but that knowledge stored in computers, and ways of using it, will be able to be standardized [Frohnsdorff (1989)]. Whereas, in the past, standard specifications had to be simple because of the difficulty of passing on the available knowledge in a practical way, it is now possible to think of an intermediate product specification in terms of, for example, a complex mathematical model which calculates specification limits for use of the product in different end product applications. This possibility must be borne in mind where matters of service life are concerned. It may, in fact, be the essential element in making service life prediction viable. In a related matter, the growing recognition of the need for national and international product acceptance systems [Gross (1989)] will increase the need for durability criteria based on predicted service lifes under expected conditions of use.

In selecting a material, component, or system for almost any application, whether or not in buildings, durability (along with performance and cost) is a major consideration. Thus, it must always be asked, "Is there a high enough probability that the item selected will perform satisfactorily for its design life?" Unfortunately, it is often difficult to answer this question adequately. It will always be challenging, but it would be easier to deal with if a coherent body of standards for service life prediction were in place.

The purpose of this paper is to draw attention to the needed body of standards and to recommend actions which could help build it.

2 Elements of a General Methodology for Service Life Prediction

A general methodology for service life prediction should be applicable to any item, whether a material, component, or system. It should state, in general terms, what steps should be taken in any logical prediction of service life. The steps are likely to be roughly as follows:

1. Define the failure criteria which will be used to establish the end of the item's service life.
2. Define the environmental stresses to which the item is likely to be exposed in service.
3. Define the composition and microstructure of the item, and its parts, if any, in terms relevant to its degradation.
4. Determine the mechanisms and kinetics of the degradation of the item and its parts, if any, in sufficient detail to allow prediction of rates of degradation under likely exposure conditions.
5. Develop and validate models for predicting the service life of the item, and its parts, if any.
6. Using the knowledge of the environment, the composition and microstructure of the item and its parts, and the failure criteria, apply the models to predict the service life.
7. Report the predictions for the range of environmental stresses likely to be encountered, stating how the predictions were made, with explicit comments about the assumptions on which they were based.

The essential steps in prediction of service life can be described concisely in a single document. This was done in ASTM E-632, Standard Practice for Development of Accelerated Short-Term Tests for Prediction of Service Life of Building Materials and Components [ASTM E-632 (1982)] and, more recently, in the RILEM Recommendation No. 64, Systematic Methodology for Service Life Prediction of Building Materials and Components [Masters and Brandt (1989)]. However, because of the complexity of applying service life prediction principles to actual problems, no single, concise document, such as these, can give more than broad guidance on the approach to be taken. More detailed guidance is needed to assure that the approach is applied in a relatively uniform way to different items that might be in competition for a given application.

To standardize service life prediction, it appears that the most practical approach is to develop a hierarchical body of standards which, together, can provide logically-consistent, detailed guidance for the predictions. Referring to Table 1, the highest level (Level 1) in the hierarchy would only contain one standard -- a standard such as ASTM E-632 (1982)] or RILEM Recommendation No. 64 -- providing the most general description of a service life prediction methodology; standards in Level 2 would give generic guidance on how to carry out the various steps in the general methodology, without specifying any particular material, component, or system; standards in Level 3 and lower levels would give guidance on application of the various steps in the general methodology to specific materials, components, and systems. A standard in any lower level must, of course, be consistent with the standards in the levels above.

TABLE 1. The Levels in the Proposed Hierarchy of Standards for Service Life Prediction

Level	Content
1	General methodology
2	Item-independent standards amplifying the parts of the general methodology
3	Standards for applying the general methodology to to specific classes of item (materials, components and systems)
4	Standards for applying the general methodology and below to subsets of the next higher level

Our present body of durability standards is not coherent. For the most part, each standard has been developed independently to meet a need to compare the "durabilities" of items of a given type [Masters and Wolf (1974)]. The tests usually use somewhat arbitrarily selected exposure conditions. Their purpose is usually limited to ranking rates of degradation, as indicated by changes in some easily-determined property under the arbitrary exposure conditions; it is not to predict service life under expected in-service exposure conditions. The present standards are, of course, useful, and it is possible that many of them could be modified to fit in to a scheme such as that proposed in this paper. Examples to illustrate the scheme will be given in the following sections.

3 Service Life Prediction for a Specific Item (Material, Component, or System)

The methodology for service life prediction, ASTM E-632 (which was developed in ASTM Committee E06 on Performance of Building Constructions, and is now under the jurisdiction of ASTM G03 on Durability of Non-Metallic Materials), and RILEM Recommendation No. 64, are too general to give detailed guidance on their application to individual items (materials, components, or systems). Their importance is in providing a framework for a body of more detailed standards for use in predicting the service life of any item. For example, for concrete, the relevant, logically-consistent body of standards might include generic, material-independent, standards in Levels 1 and 2 of the hierarchy, with standards specific to concrete and concrete products being in Level 3 and lower levels. Similarly, the logically-consistent standards relevant to prediction of the service life of an organic coating would include the same Levels 1 and 2 standards as for concrete, or any other item, but would have coatings-specific standards in Levels 3 and lower. Thus, the standards relevant to concrete and organic coatings could be listed as in Appendix 1.

The examples of groups of standards to be included in Levels 3 and lower illustrate how a self-consistent body of standards to guide the prediction of the service life of any item could be developed. Whereas the lower level standards are the ones which normally get attention, a logically-consistent body of standards for use in service life prediction will not be developed unless higher-level standards are in place and consistency with the higher-level standards is sought. Thus, much depends on the willingness of standards-writing committees to recognize the importance of building a hierarchical structure and to produce standards which will become part of it.

With this as background, we shall now discuss what we think should be included in the standards of each type in the scheme illustrated by the examples in Appendix 1. Standards for environmental characterization, standards for characterization of microstructures, standards for determination of kinetics and mechanisms of degradation, and standards for mathematical modeling of degradation processes will be discussed in turn.

4 Standards for Environmental Characterization

The single Level 1 standard, which should describe the general methodology, should present the principles to be followed in identifying important environmental factors and list those which should generally be considered. The Level 2 standard on environmental characterization should provide more detailed guidance on what information on environmental characterization should be included in the Level 3 standards concerned with prediction of service life of specific items. The environmental factors to be covered at Level 2 should be all those that can, in any real way, affect the service life of a material, component, or system. The standard should provide guidance on how quantitative descriptions of environmental factors may be produced in terms relevant to service life prediction. These will almost certainly have to recognize the variability of the environments to which most items are exposed and suggest how such variability should be dealt with statistically. It should recommend use of meteorological data wherever this is practical; this is because it is available to all and because it provides a common starting point for all materials exposed outdoors. It seems obvious that those who draft or use the Level 2 standard should work with national weather services to make sure these services know what data will be needed by the building community.

In general, the Level 2 standard should indicate that information is needed on the temperatures and movements of all the fluids and solids with which an item under consideration will come into contact, and all the radiation that will fall on the item. It should also give guidance on ways of expressing the data in appropriate forms. For example, if frost action is likely to be an important degradation process, the data might be used to determine the number of air temperature excursions through the freezing point of water or, if thermal degradation is of concern, a more complete description of the likely history of surface temperatures of exposed surfaces of the item might be needed. Saunders, Jensen, and Martin [Saunders, Jensen, and Martin (1990)] have recently shown how the short- and long-term variations in the temperatures of exposed painted panels can be represented by a Fourier series.

A Level 3 standard for service life prediction should only require characterization of those environmental factors in the Level 2 standard that are relevant to the specific type of material, component or system it addresses. It should be specific in describing how suitable information can be obtained, whether from published data, including maps, or from measurements made specifically for the purpose at hand, with comments on the preferred approaches and the potential errors associated with each.

5 Standards for Characterization of Materials, Components, and Systems

The Level 1 standard, being the most general, should only indicate that the composition and structure of the item to be considered must be known if reliable predictions of service life are to be made. The Level 2 standard for characterization of materials, components, and systems should provide more detailed, but still general, guidance on what characteristics should be included in a Level 3 standard for prediction of the service life of a specific type of item. The characteristics to be included will differ depending on the item. For a material, the main factors to be considered will usually be the overall chemical composition, and the compositions and distributions of the bulk and interfacial phases present (i.e. the microstructure of the material, taking into account cracks and voids). For a component or system, the characterization will usually be more complex because of the need to consider the interactions between different materials and the greater number of geometric factors which must be taken into account. These include the shapes and dimensions of the item and its parts, and their orientations (and movements, if any).

The appropriate description of a material may be in relatively simple terms, assuming uniformity of composition as for homogeneous materials, or it may be in such detail as to require information on spatial variations in composition, as for a composite such as concrete or a fiber-reinforced plastic. The Level 2 standard should comment on this and provide guidance on different approaches which might be used. For a porous material likely to be exposed to frost action or chemical attack, information on the pore system would probably be needed. The Level 2 standard should indicate types of microstructural features which may be important for service life prediction. It should also indicate ways of obtaining quantitative information about the microstructure for various types of material. Level 3 and lower level standards for service life prediction should give detailed guidance on preferred ways of characterizing the type of item to which each standard applies, with comments on the precautions to be taken to get valid results and minimize the possible errors.

6 Standards for Determination of Mechanisms and Kinetics of Degradation

The Level 1 standard should only mention the need for information on the mechanisms and kinetics of degradative processes in the items under consideration as being essential for service life prediction. The Level 2 standard for determination of mechanisms and kinetics of degradation will provide guidance as to what information on mechanisms and kinetics should be included in a Level 3 or lower-level standard for prediction of the service life of a specific type of item The mechanisms will be different for different materials, including the different materials in a composite. The Level 2 standard must, for example, include corrosion of metals, photochemical and thermal degradation of organic materials, fatigue effects, and cracking due to localized stresses resulting from differential volume changes in the item.

7 Standards for Mathematical Models of Degradation

The Level 1 standard should indicate the need for mathematical models of degradation in service life prediction without stating what the models should be like. Standardization of the modeling of degradative processes will be particularly challenging. At this stage in the evolution of degradation modeling as a component of service life prediction, only broad generalisations can be made. Much will depend on developments in computer hardware and software, and in telecommunications. The models needed will have to provide scientifically and technically sound representations of the relevant chemical, physical and mechanical processes leading to degradation. This implies complexity but, as for any standard, the standards for developing mathematical models should be neither more, nor less, complex than necessary. A standard practice for the development and use of models of degradation should probably provide recommendations on:

- formats of statements of objectives of individual models and submodels
- symbols to be used in flow charts and program code
- programming language(s) to be used
- program structure
- qualifications of developers and users of models

- o selection of data for use in model calculations
- o methods for testing the models
- o documentation of models and assessment of their limitations
- o format and content of reports on model outputs.

Insight into the needs is being obtained through operation of the Cementitious Materials Modeling Laboratory in the NIST Center for Building Technology. The Laboratory, which is a step towards a more broadly-based Building Materials Performance Modeling Laboratory, is linked to other participants in the Center for Advanced Cement-Based Materials (ACBM) headquartered at Northwestern University to provide for the sharing of models among the ACBM members. It seems likely that, because of the complexity of models of degradation, some will be so complex that sharing through a central computer may be the most practical way of providing the support needed for service life prediction.

8 Standards for Service Life Prediction

The standards outlined in Sections 4 through 7 should provide the basis for service life predictions. The predictions themselves should be carried out and reported in standard ways. The Level 1 standard should give general guidance, and the Level 2 standard should give more detail on generic aspects of how predictions should be made. As usual, Level 3 and lower-level standards for service life prediction should apply the guidance of the higher-level standards to various types of items. Because of the many steps in making predictions, it is important that the reporting of the results should be standardized to aid interpretation. Other obvious requirements are that the assumptions should be clearly stated, and that the errors should be estimated.

9 Recommendations for Standards Development

In view of the importance of improving the reliability of service life predictions, and the large demands the required activities would place on research resources, several actions are recommended to the organizers and sponsors of these conferences:

a) the scope of the Conferences should be broadened to include "Developments in Standards for Service Life Prediction" as an explicitly-stated topic;

b) standards and prestandards organizations, such as ASTM, CIB, and RILEM, should establish, or strengthen, committees dealing with generic aspects of service life prediction, including characterization of environments, and encourage their interaction, at least on an advisory basis, with committees dealing with specific materials and components;

c) national building research organizations, should cooperate in planning and implementing the development of models of degradation of building materials and components suitable for standardization, and the development of the needed databases.

10 Summary

It has been pointed out that, if it is to be widely accepted as an aid to selection of building materials, service life prediction must be standardized. Because of the complexity of service life prediction, a large and logically-consistent body of interrelated standards is needed. Present standards do not have such a structure.

A possible structure for a body of service life prediction standards is outlined to promote discussion about the direction of future developments in durability standards. It is recognized that development of the proposed standards structure would require an unusual degree of coordination of the scientific and technical efforts of interested parties, preferably on an international scale. This would include improvements in characterization of environments and in mathematical modeling of degradation processes. However, benefits to be obtained from more reliable performance of building materials and components appear to warrant the effort being made.

11 Acknowledgements

The authors gratefully acknowledge the many contributors to our thoughts regarding standards for service life prediction, including the members on ASTM E06.22 on Durability Performance of Building Constructions, members of CIB W80/RILEM 71-PSL and 100-TSL on Prediction of Service Life, and our colleagues at NIST.

12 References

ASTM E-632, Standard Practice for Developing Accelerated Tests to Aid Prediction of Service Life of Building Components and Materials, ASTM, Philadelphia, PA (1982).

Fagerlund, G., Essential Data for Service Life Prediction, in Masters, L.W. (ed.), Problems in Service Life Prediction of Building and Construction Materials, pp. 113-138.

Frohnsdorff, G., Integrated Knowledge Systems for Concrete Science and Technology, in Skalny, J.P. (ed.), Materials Science of Concrete, American Ceramic Society, Columbus, OH (1989).

Frohnsdorff, G., Clifton, J.R., Jennings, H.M., Brown, P.W., Struble, L.J., and Pommersheim, J.M., Implications of Computer-Based Simulation Models, Expert Systems, Data Bases, and Networks for Advancing Cement Research, Bull. Amer. Ceram. Soc., V. 67, pp. 1368-1371, 1988.

Frohnsdorff, G., and Masters, L.W., The Meaning of Durability and Durability Prediction, in Sereda, P.J. and Litvan, G.G. (eds.), Durability of Building Materials and Components, STP 691, ASTM, Philadelphia (1980), pp. 17-30.

Gross, J.G., International Harmonization of Standards: Done With or Without Us, The Building Official and Code Administrator, Sept./Oct. 1989, pp. 46-47.

Masters, L.W. (ed.), Problems in Service Life Prediction of Building and Construction Materials, NATO ASI Series E: Applied Sciences No. 95, Martinus Nijhoff, Dordrecht, 1985.

Masters, L.W., and Brandt, E., Systematic Methodology for Service Life Prediction of Building Materials and Components, Materials and Structures, v. 22, pp. 385., 1989.

Masters, L.W., and Wolfe, W.C., The Use of Weather and Climatological Data in Evaluating the Durability of Building Components and Materials, NBS Technical Note 838, NIST, Gaithersburg, MD 20899 (1974).

Saunders S., Jensen, and Martin J.W., A Study of Meteorological Processes Important in the Degradation of Materials through Surface Temperature, NIST TN (in press), NIST, Gaithersburg, MD 20899 (1990).

Sereda, P.J., and Litvan, G.G., (eds.), Durability of Building Materials and Components, STP 691, ASTM, Philadelphia, PA (1980).

Sjostrom, C., Overview of Methodologies for Prediction of Service Life, in Masters, L.W. (ed.), Problems in Service Life Prediction of Building and Construction Materials, pp. 3-20.

Appendix 1. PROPOSED HIERARCHY OF STANDARDS FOR SERVICE LIFE PREDICTION

Level 1 (Generic to all items)

1. Standard practice for prediction of the service life of any item (material, component, or system).

Level 2 (Generic to all items)

2.1 Standard practice for characterizing the environment to which any item (material, component, or system) will be exposed in service.

2.2 Standard practice for characterizing any item (material, component, or system).

2.3 Standard practice for determining the dominant degradation processes of any item (material, component, or system), and their mechanisms and kinetics.

2.4 Standard practice for developing mathematical models for predicting rates of degradation of any item (material, component, or system).

2.5 Standard practice for using knowledge of the service environment, the characteristics of the item (material, component, or system) and its parts, degradation models, and the failure criteria, for predicting the service life of the item and reporting the results.

Level 3 (for concrete)

* 3.1.1 Standard practice for characterizing the environment to which a concrete item (material, component, or system) will be exposed in service.

3.1.2 Standard practice for characterizing a concrete item (material, component, or system).

3.1.3 Standard practice for determining the dominant degradation processes of a concrete item (material, component, or system), and their mechanisms and kinetics.

[Footnote: * The numbering system used in this appendix is for convenience in showing relationships. The first number designates the level in the proposed hierarchy and the last the relationship to the parts of Levels 2. The middle number (or letter) is used to distinguish between different sets of standards at a given level.]

3.1.4 Standard practice for development of mathematical models of degradation processes of a concrete item (material, component, or system).

3.1.5 Standard practice for using knowledge of the service environment, the characteristics of a concrete item (material, component, or system) and its parts, degradation models, and the failure criteria, for predicting the service life of the item and reporting the results.

Level 3 (for an organic coating)

3.2.1 Standard practice for characterizing the environments to which an organic coating will be exposed in service.

3.2.2 Standard practice for characterizing an organic coating.

3.2.3 Standard practice for determining the dominant degradation processes of an organic coating, and their mechanisms and kinetics.

3.2.4 Standard practice for development of mathematical models for prediction of service life of an organic coating.

3.2.5 Standard practice for using knowledge of the service environment, the characteristics of an organic coating, degradation models, and the failure criteria, for predicting the service life of the coating and reporting the results.

It has already been implied that the item-specific standards will not all be in Level 3. For example, waterproofing membranes for roofing must be viewed as part of the larger category of organic-matrix sheet materials. It is logical to put the standards for prediction of the service life of organic-matrix sheet materials in Level 3, with any additional standards specific to roofing membranes going in Level 4 or lower levels. Thus, the relevant Level 3 standard, and some Level 4, 5, and 6 standards, for roofing membranes might be:

Level 3 (for organic-matrix sheet materials)

3.3.1 Standard practice for characterizing the environment to which an organic-matrix sheet material will be exposed in service.

3.3.2 Standard practice for characterizing an organic-matrix sheet material.

3.3.3 Standard practice for determining the dominant degradation processes in an organic-matrix sheet material, and their mechanisms and kinetics.

3.3.4 Standard practice for development of mathematical models for degradation of an organic-matrix sheet material.

3.3.5 Standard practice for using knowledge of the service environment, the characteristics of an organic-matrix sheet material, degradation models, and the failure criteria, for predicting the service life of the material and reporting the results.

Level 4 (for roofing membranes)

4.x.1 Standard practice for characterizing the environment to which a roofing membrane will be exposed in service for use in service life prediction.

4.x.2 Standard practice for characterizing a roofing membrane for service life prediction.

4.x.3 Standard practice for determining the dominant degradation processes in a roofing membrane, and their mechanisms and kinetics.

4.x.4 Standard practice for development of mathematical models for prediction of service life of a roofing membrane.

4.x.5 Standard practice for using knowledge of the service environment, the characteristics of a roofing membrane, degradation models, and the failure criteria, for predicting the service life of the membrane and reporting the results.

Level 5 (for built-up roofing membranes)

5.y.1 Standard practice for characterizing the environment to which a built-up roofing membrane will be exposed in service for use in service life prediction.

5.y.2 Standard practice for characterizing a built-up roofing membrane for service life prediction.

5.y.3 Standard practice for determining the dominant degradation processes in a built-up roofing membrane, and their mechanisms and kinetics.

5.y.4 Standard practice for development of mathematical models for prediction of service life of a built-up roofing membrane.

5.y.5 Standard practice for using knowledge of the service environment, the characteristics of a built-up roofing membrane, degradation models, and the failure criteria, for predicting the service life of the membrane and reporting the results.

Level 5 (for single-ply roofing membranes)

5.z.1 Standard practice for characterizing the environment to which a single-ply roofing membrane will be exposed in service for use in service life prediction.

5.z.2 Standard practice for characterizing a single-ply roofing membrane for service life prediction.

5.z.3 Standard practice for determining the dominant degradation processes in a single-ply roofing membrane, and their mechanisms and kinetics.

5.z.4 Standard practice for development of mathematical models for prediction of service life of a single-ply roofing membrane.

5.z.5 Standard practice for using knowledge of the service environment, the characteristics of a single-ply roofing membrane, degradation models, and the failure criteria, for predicting the service life of the item and reporting the results.

Level 6 (for elastomeric roofing membranes)

6.w.1 Standard practice for characterizing the environment to which an elastomeric roofing membrane will be exposed in service for use in service life prediction.

6.w.2 Standard practice for characterizing an elastomeric roofing membrane for service life prediction.

6.w.3 Standard practice for determining the dominant degradation processes in an elastomeric roofing membrane, and their mechanisms and kinetics.

6.w.4 Standard practice for development of mathematical models for prediction of service life of an elastomeric roofing membrane.

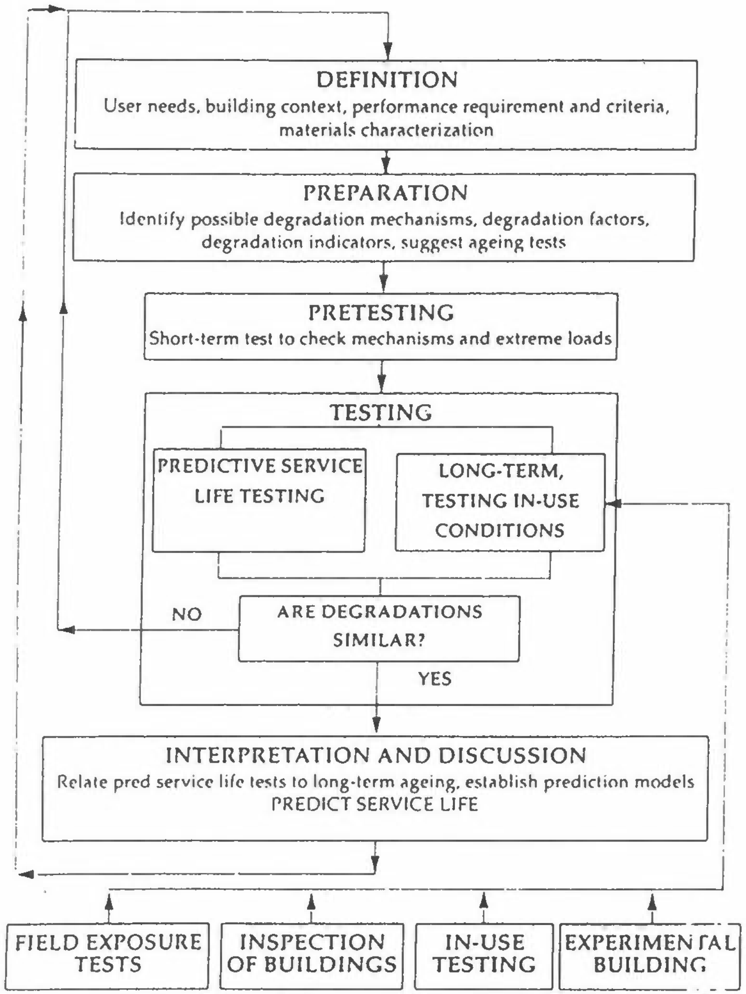
6.w.5 Standard practice for using knowledge of the service environment, the characteristics of an elastomeric roofing membrane, degradation models, and the failure criteria, for predicting the service life of the item and reporting the results.

APPENDIX 4.3

Dr. Christer Sjöström
"Generating knowledge for prediction of service life.
A presentation of work by W80 in co-operation with
RILEM"

Generating knowledge fc· prediction of service ˈife A presentation of work by W80 in cooperation with RILEM

By Christer Sjöström, Dr Eng, coordinator/chairman CIB W80/RILEM 140-TSL,
Materials and Structures Div, Nat Swedish Institute for Building Research



Methodology for Prediction of Service Life

Background

In 1982 W80 and RILEM 71-PSL started a joint programme on the Prediction of Service Life of Building Materials and Components

The work is concentrated on questions related to the methodological development of the research area Prediction of Service Life.

In 1983 - 1986 the commission described the state-of-the-art and proposed a generic methodology for the prediction of service life.

In 1987-1990 W80 and RILEM 100-TSL studied methodologies for generating data from long-term ageing under in-use conditions, and the commission specifically focused on feedback from practice of durability data by inspection of buildings.

The research area

Service life is the period of time after installation during which essential properties of a material or component meet or exceed minimum acceptable values (figure 2). Service life analysis aims at establishing and explaining the performance over time functions.

Service life predicition demands knowledge on the degradation environment and on the resistance of the materials to the degradation factors (figure 3).

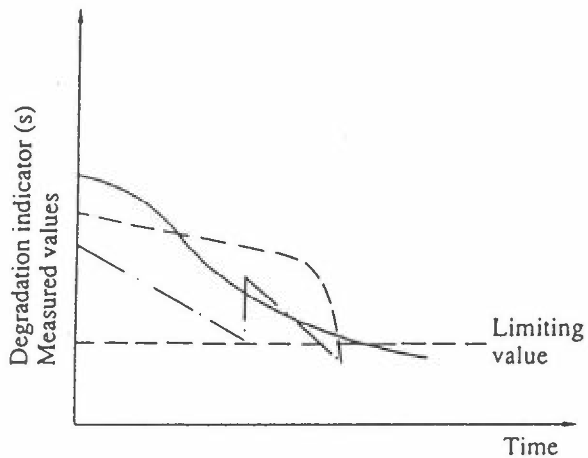


Fig.2 Hypothetical performance over time functions

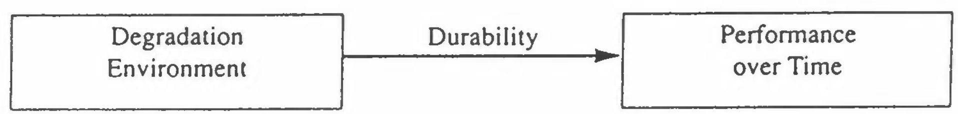


Fig. 3 Relation between degradation environment, materials durability and performance time

Generating knowledge for prediction of service life
A presentation of work by W80 in cooperation with RILEM

By Christer Sjöström, Dr Eng, coordinator/chairman CIB W80/RILEM 140-TSL,
Materials and Structures Div, Nat Swedish Institute for Building Research

Examples of publications

Masters L W (ed)
"Prediction of Service Life of Building Materials and Components",
CIB Report, Publication 96, CIB, Rotterdam 1986

Masters L W
"Prediction of Service Life of Building Materials and Components",
Materials and Structures, Vol 19, No 114, 1986

Masters L W, Brandt E,
"Systematic Methodology for Service Life Prediction of Building materials and Components",
Materials and Structures, 1989:22, pp 385 - 392

Sjöström Ch (ed),
"Feedback from Practice of Durability Data. Inspection of Buildings",
CIB Report, Publication 127, CIB Rotterdam 1990

Brandt E (ed),
"Feedback from Practice of Durability Data. Appendix. Examples of Field Investigations",
CIB Report, Publication 128, CIB, Rotterdam 1990

Generic methodology for prediction of service life

The methodology - divided into five primary parts - is generic and applicable to all types of building materials and components. As it is founded on an iterative research approach the reliability of the service life prediction improves as the knowledge base increases.

The methodology was accepted as a RILEM Technical Recommendation in 1990.

Standardization of the methodology

On the request of the european research program EUREKA and its umbrella project EUROCARE, a standardization of the methodology has started within CEN.

CIB W80/RILEM 140-TSL programme 1991 - 1996

The programme aims at further detailing of the methodology and covers five subject areas. Five sub-groups are formed with the task to produce a handkook for each of the areas.

- **Data from Field Exposure Testing, In-Use Testing and Experimental Buildings in Service Life Prediction**
  Sub-group chairman: Mr Erik Brandt, Danish Building Research

- **Environmental Characterization including Equipment for Monitoring**
  Sub-group chairman: Dr Jonathan W Martin, NIST, USA

- **Materials Characterization including Monitoring of Degradation Processes**
  Sub-group Chairman: Dr Per Jernberg, SIB, Sweden

- **Mathematical Modelling**
  Sub-group chairman: Prof Sam C Saunders, Washington state Univ, USA

- **Design of Short-Term Test Methods**
  Sub-group chairman: Mr Larry W Masters, NIST, USA

APPENDIX 4.4

Dr. Ingmar Holmström
"EUROCARE. About standards for conservation products"

ROYAL INSTITUTE OF TECHNOLOGY, SCHOOL OF ARCHITECHTURE
S-100 44 STOCKHOLM
Ingmar Holmström:

"EUROCARE MARKET PLACE", LILLEHAMMER, NORWAY. OCTOBER -91

EUROCARE. About standards for conservation products.

Summary.

Architectural Conservation aims, roughly spoken, at illustrating history of man to present and future generations as it can be seen in the built environment. Conservation of objects has the same general goal and follows the same general principles.

A paramount demand according to conservation theory is the integrity and authenticity of the material substance of the object. The original substance is "carrier of the message" and thus has to be preserved without being falsified. It has further more to be preserved for "eternity". Architectural monuments thus should be treated with the same respect as rare ojects in museums, which are ment to be kept for ever without being destroyed or falsified.

Architectural Conservation is a matter also for the industry, especially the constructing industry, as almost every conservation activity is executed by that sector. Compared to constructing in general, conservation gives some additional demands on materials and methods, and also changes the priority order of others.
First of all the "time dimension" in conservation is immense. If buildings in general are supposed to have a service life measured in tens of years, the architectural heritage is supposed to stay for "eternity", which means hundreds or thousands of years. This affects the technical solution.
The demand on authenticity and integrity leads to minimum intervention, if possible no intervention at all, as every intervention means a change, a falsification, of the original.

To be meaningful EUROCARE should stand for quality products in conservation, and thus fulfill the demands in international agreements as expressed by ICOMOS, Unesco and in national laws. The Service Life Concept as developed by CIB/RILEM for constructing in general might be a useful tool also to express conservation criterias, if the Concept can be adopted to an immense service life of the object as a whole.

EUROCARE tries to develop an internal administrative process including apropriate quality control of all its projects.

The EUROCARE area.

When EUROCARE started, the aim was to promote materials, methods and processes for the conservation of cultural property, both buildings, monuments and artefacts. This is a very big, difficult and neglected task. During the last years the aim has widened to include the whole existing building stock and the problems are also focussed on the impact of polluted air and water referring to "A sustainable Development" by the Unesco Commission on Environment and Development..

This is an even bigger task, enormous, which needs a scientific approach, wide resources and above all a strict definition of the area to be treated: a scientific concept.

Present chairman of EUROCARE, dr Svein Haagenrud, has summarized the conclusion we have to draw from the Unesco Report mentioned: from THROW AWAY over REACT and CURE to ANTICIPATE and PREVENT.

From
Throw away
ower
React and Cure
to
Anticipate and Prevent

Ill. 1

A recycling society with a minimum of waste. This must be the new way of acting of mankind in order not to waste the limited resources of Earth. The Report stresses that to the building sector this means a strong decrease in the use of material and energy, which to a great deal could be achieved by giving the building stock, the whole built environment, a longer service life. From this follows that we must reduce consuming stresses like air pollution as well as choose material and technique which can last longer. They also pointed out the important role of research and industry in collaboration, to reach the goal.

Mr Haagenrud stressed that EUROCARE could be an important tool this process. The connection to CIB/RILEM Working Group "Service Life Concept and Standardization" will be a valuable increase of resorces. The growing interest from industry in EUROCARE projects is another valuable resorce. I agree.

The past chairman, Prof. Rosvall, has as meritoriously described the similarities between the preservation of cultural property and a general conservation attitude including all human property.

Both authors refer to very important UN Reports.

If we penetrate the question, we will find that the conservation of resources in the built environment is on the same line as the conservation of our cultural heritage. We will also find that the latter needs a more specific technique than the first. The choise is more restricted and in a way more extreme. Thus principles of general maintenance in fact can learn from architectural conservation. The latter has gained experience through many years. Especially the ageing is more educational when exposed in the extreme time conditions of cultural property.

In the following text I will try to show that the increased area of interest for EUROCARE means that one single scientific concept does not work for the whole area, despite that the technical solutions are to be found in the same

direction. The aim of conservation differs within the building stock as well as within movable objects. The critical factor, the turning point, is wether the object is regaded part of our cultural heritage or not.
A conservation product developed for bridges will probably not automatically be appropriate to historic monuments, it might be harmful or even destructive. On the other hand, a conservation technique for historic objects might be too much restricted to be economic on an ordinary bridge. There are distinct differences between cultural property and the general. . A comparison can be illustrated in the following scheme:

The technical solution depends on:

BUILDINGS IN GENERAL
- ☐ The technical behaviour of the actual building. Material and structural behaviour, pathology.
- ☐ The needs of the owner / user. Esthetics.
- ☐ Available materials / technique / knowledge.
- ☐ Building codes and norms.
- ☐ Economy.

HISTORIC BUILDINGS further restricted by
- ☐ Heritage values. (..as a testimony of..)
- ☐ Immense service life. (Conserve ..)

Ill. 2.

One serious difficulty is that most people have a very vage idea of the aim of the conservation of cultural property and thus know still less about the technical consequenses.

The growing EUROCARE increases the demand of on quality in all the projects. With the diversified field of activity of EUROCARE, it is obvious that the quality control will be more difficult. Many actors with different background need relevant information.

What does Conservation of our Cultural Heritage stand for?
The general expression Conservation of our built environment used above, has a more specific meaning in the Conservation of our Cultural Heritage, although the latter is a part of the first.
Conservation of material resorces in general can be done within a fairly wide range of techniques with few restrictions. The ethics of Cultural Heritage Conservation on the other hand, gives very specific restrictions to the techniques which can be used. These ethics are expressed in a number of documents, both international and national. The one most referred to, is probably The Venice Charter by ICOMOS, given 1964. Like the others it is written in a general political language with a strong poethical feeling:

INTERNATIONAL CHARTER FOR THE CONSERVATION AND RESTORATION OF MONUMENTS AND SITES.

Imbued with a message from the past, **the historic monuments** of generations of people remain to the present day **as living witnesses** of their age-old traditions. People are becoming more and more concious of the unity of human values and regard ancient monuments as a common heritage. The common responsibility **to safeguard them for future generations** is recognized. **It is our duty to hand them on in the full richness of their authenticity.**

....

DEFINITIONS.

Article 1. The concept of an historic monument embraces not only the single architectural work but also the urban or rural setting in which is found the evidence of a particular civilization, a significant development or an historic event. This applies not only to great works of art but also to more modest works of the past which have acquired cultural significance with the passing of time.

Article 2. The conservation and restoration of monuments must have recourse to all the sciences and techniques which can contribute to the study and safeguarding of the architectural heritage.

Article 3. The intention in conserving and restoring monuments is to safeguard them no less as works of art than as historical evidence.

CONSERVATION.

Article 4. It is essential to the conservation of monuments that they **be maintained on a permanent basis.**

....

RESTORATION.

Article 9. The process of restoration is a highly specialized operation. Its aim is to preserve and reveal the aesthetic and historic value of the monument and is based on **respect for original material as authentic documents.** ....

Article 10. Where traditional techniques prove inadequate, the consolidation of a monument can be achieved by the use of any **modern technique** for conservation and construction, the effiency of which has been **shown by scientific data and proved by experience.**

....

ICOMOS International Council for Monuments and Sites. **Venice 1964.**

Ill. 3.

There seems to be no corresponding international document on historic artefacts, the movable objects, but the general idea is the same.

To most technicians or industrialists it is not fully clear how to interprete the Charter in technical terms, in adequate materials and methods.
To strengthen weak parts, in order to make the materials and structure more durable, is a common reaction. Impregnations and invisible structural reinforcement are thus often used. By using "strong, durable" new materials the non specialist is mostly convinced to have the object saved for the future. Unfortunatly this misunderstanding has by time often resulted in increased damage and even serious destruction.
Very simplified one could caracterize an apropriate technique to be more like the opposite: instead of using stonger materials, one should aim at weaker, instead of invisible reinforcements the visible ones are more often adequate.

The reason is simple: In a combination where a strong and a weak material (or component) are directly connected, the weaker will always suffer when they age together. To not sacrifie the original substance, the object to be saved, all additions or new treatments thus must be somewhat weaker, more likely to be sacrified first.
The same principle is valid also for reinforcements. A stronger part, say a metal rod or a beam, must be applied in such a way that the original can be supported without being fixed to internal termal expansion et.c. If so, the original substance will suffer due to the fixing, and the reinforcement thus had a negative impact. A supporting reinforcement is mostly more easy to design correct if it is allowed to be visible.

The main reason for mistakes is usually a lack of understanding of the immense time dimension imbued in conservation of historic objects, the long term ageing.

"Durable" and "service life" is dependant of a time dimension being defined, but such figures almost never exists. Generally we only referre to our individual perception.

The perception of that time dimension differs a lot between individuals though, depending on their background.

THE PERCEPTION OF TIME.

The dimension of time differs between individuals, groups et.c. What is "long time"?

This

Today

1980 **1990** ***** **2000**

---

or this

1900 ***2000** **2100**

---

or maybe this

5000 BC ***2000** **9000**

Ill. 4.

Expressions like "durable", "resistant", "maintenance free" as well as "long time" are mostly used in terms of a time dimension of maximum some tens of years, a perception like the first line above.
Antiquarians, curators and conservators think in terms of hundreds and thousands of years, more like the third line above.
Astronomers think in light-years and billions of years, still more difficult to imagine, to fully understand.

It really takes a lot of training to interprete an unaccustomed time dimension into adequate practice and acting.
There is also a good chance of misunderstanding between individuals using expressions like "durable" and "resistant" if they have different time perception. The chemist, used to chemical reactions of a duration of seconds, might seriously think of a chemical being "durable" as long as it is stable for ten years. The conservator listening to the chemists "durable" might think in terms of hundreds of years. They both use the same expression, durable, and think they are of the same opinion.
By time both will most probably be disappointed when unexpected ageing happens, causing negative side effects, maybe destruction.

THE DIMENSION OF TIME.

Common ideas on technical service life differs:

Building constructing in general		**2 - 10 - (50)**
Preservation of historic buildings		**20-100-500-5000**
Industry:	**Mechanical**	**1 - 5 - 10**
	Chemical	**1 - 5 - (10)**
	Electronic	**1 - 5 - 7 ?**

Ill. 5.

When talking about historic objects, about architectural conservation, there is no such thing as "durable". All substances are aging. Everything have to be repeatedly maintained, repaired, replaced. Little by little, but by time, in the end, almost everything is probably replaced.
The service life of the historic object as a whole is expected to be immense, hundreds or thousands of years, but the single parts have limited service lifes although they might last long compared to materials in general.
In conservation repeatability thus is a must.

I think we can all understand that by time everything ages, deteriorates more or less fast (or slow) and that in due time something has to be done to it: dispose it or save it. If we decide to save a deterirated substance, it needs some help, some kind of supportive measures to keep standing. It needs conservation. With an object in general the normal action would probably be to replace deteriorated parts with new to get the funktion back, to get it useful again. It would not be the same object but with the same funktion.
In an object with high cultural heritage value, a complete or even partial replacement of deteriorated parts is not at allself-evident. It can be discussed if such a replacement would be characterized as a falsification, if the authenticity of the object is lost. Is it the original, authentic object or not? "It is our duty to hand them on in their full richness of their authenticity" says Venice Charter and other ethical recommendations.

How much "conservation" can a historic object stand? Would an invisible

strengthening impregnation affect the authenticity to the same extent? An impregnated material is not the authentic one, but how much falsifying would it be? What would the technical concequences be? Would the object survive longer or would it increase the deterioration? Maybe it would be visibly sound for another years and then lead to complete collaps. Would that be preferred to a much slower, but in both cases inevitable destruction?
I think there is no single or even simple solution to the problem.

Our task is "to safeguard ..... the historic monuments..... as living witnesses.....for future generations.....in the full richness of their authenticity" to quote Venice Charter. It is not so easy. To keep a cake intact though Time is consuming it slowly. And to keep it "for future generations", to keep it for "ever".
It must be easier to prolong the traffic capacity of a bridge or whatever, where there is no demand either of "authenticity" or "eternal" service life. The technical solution might be sought in the same direction, but it is probably not the same.

I will again stress that in conservation of cultural property there are two factors to be fully understood:

¤"Infinite preservation", an "eternal" time dimension.

¤"The message from the past" must not get lost (as this is the very reason for the safeguarding).

These factors certainly affect the technical solutions to be used in conservation.

In the following i will try to explain these factors separatly and also how they interact.

<u>The aim of conservation.</u>

I think that almost everybody has at least a vauge idea of the aim of conservation: old artifacts and buildings are kept for us and the future because they are interesting in some way or another.
There are professionals in conservation: conservators, curators, antiquarians, architects, architectural conservators et c. but by tradition very few engineers, technicians or technical scientists.
The professionals try to follow the recommendations published: international recommendations made by Unesco, Council of Europe, ICOMOS, et c, as well as national and institutional ones in the form of laws and recommendations. They are supposed to be followed by the experts, interpreted by them and applied to the objects being conserved.

The italian conservation expert Cesari Brandi was one of the leading in developing the ideology of today. An attempt to summarize his recommendations could look as follows:

Principles of Cesari Brandi (Italian conservation expert, philosofer):
- ☐ Know the object
- ☐ Respect original material
- ☐ Accept history of the object
- ☐ Attempt to balance aesthetic and historical values
- ☐ Restore aesthetic unity without falsifying

Ill. 6.

All the international recommendations aim at being general and applicable to most situations. This also means that they are fairly vauge and have to be interpreted, which in turn means that different persons often come to different results depending on experience, knowledge and background.
The ideology behind the recommendations varies with time, is slowly changing from the start in the late 1800 towards (up to now) more respect for buildings in general as well as more aspects of history than arcaeology, art, and architecture. There has also been a tendency to more respect for the technical aspects of conservation, probably due to more and more negative experience of earlier methods used. The long term ageing of the early conservations tend to be increasingly obvious. And scaring. This evolution of the ideology will most probable continue
The general aim as expressed by e g the Venice Charter is to preserve the authenticity and integrity of our architectural heritage, historic objects, as a witness of our past.
This "witness" has many different aspects, of which many affects the treatment of the actual object. I have tried to list the most used significant heritage values as follows in illustration 7.
As can be seen here the technical consequence differs over a wide range: From "don't touch" to "restore to original" over "a certain decay" et.c.
This means that it is very important to have the object thoroughly analyzed by a competent curator, historian and architect, because the correct treatment is completly dependant of the significant values defined. It is of the same importance that these values, significant to the actual object, are described by the historians in such a way that they are operative.
This means that they without being misunderstood can be the base for all decisions to be taken by the practicioners: architects, engineers of all branches, contractors, craftsmen and, not to forget, the owners.
To my opinion an appropriate description of the significant heritage values of an object is the very key to a succesful conservation.

Significant Heritage Values

Value		Aim with object	Technical consequence
Scientific		**Document**	**Conservation**
Archeology		"	"Freezing","Don´t touch
Ethnography		"	"
History of Art		"	"
" " Architecture		"	"
" " Building		"	"
Technique		"	"
" " Economy		"	"
" " Social Science		"	"
" " Defence			
Et.c.		"	"
Statistics	Rareness	"	"
	Representativity		
Emotional		**Emotional exitement**	**Differs**
Art	Painting	Authors aim	Restore to original
	Sculpture	"	"
	Architecture	"	"
Time	Patina	"Time has passed"	A certain decay
	Continuity	Long evolution	Continuous additions
	Tradition	Lasting ideas	Traditional design et.c.
Symbol	Identity	Recognition	Maintenance
	Spiritual	"	"
	Political	"	"
Wonder	Horror	Feelings	?
	Happiness	"	
	Beauty	"	
Et.c.			
Use		**Use**	**Differs**
Function		"	Adjustment to function
Technical resorce		"	Regular maintenance
Economy		"Banc security"	Adjustment to market
Additional		**Differs**	**Differs**
Authenticity		"Authentic, no fake"	"Freezing"
Pedagogic		Clear to the audience	Adjustments, additions et.c.

Ingmar Holmström

Ill. 7.

Conservation and long term ageing.

Another key to success in conservation (or at least an insurance against irreversible technical mistakes) is a thorough knowledge in the long term ageing of the materials and components of the actual object and an ability to analyse the destructive forces.

As this is a difficult task it happens (a bit too often) that destructive mistakes are made. If some simple rules are followed, the catastrophies due to these mistakes can be avoided. Conservators call it ”reversibility”, a term not fully adeqate, but it means that every treatment must be able to be remowed without any affect to the object: A glue or an impregnation must be fully soluble without affecting the substrate or any part of the object.

This is a safety precaution if something goes wrong: you can re-start from the beginning wihout any substance losses. But it is also the pre requisite for the repeated maintenance: as everything ages and will be deteriorated. Also the maintenance has to be maintaned, the repair be repaired and replaced, all in an ever repeated action.

”Reversibility” and ”multi repeatability” thus is the key to not only eleminating destruction due to mistakes, but to ”eternal” safeguarding, to an ”immense service life”.

As mentioned abowe we are used to think of buildings in terms of tens of years, to think of materials and components in terms of a few years, or at the most in tens of years. We are not used to think in repeated maintenance and repair but in durability and lasting quality.

"Lasting" means usually years or tens of years.We rely on accelerated tests to judge the quality, the durability, tests lasting for hours or days to predict years or tens of years.

The time-dimension in conservation, as mentioned abowe, is totally different. Instead of tens of years it is a matter of at least hundreds, possibly thousands. The time-dimension is immense. Objects already hundreds and thousands of years are to be kept for at least as long a future. The immense time-dimension is very difficult to understand for the non-trained specialist. It is difficult also for the specialist to understand in all its consequences. It means for example that nothing is durable, no part will last as long as the object as a whole. Everything has to be repeatble maintained and repaired. A maintenace repeated over and over again, a repair of the repair of the repaired repair.

A durability of ten years, a good durability in the every-day situation, means a repetition ten times per hundred year,a hundred times per thousand. A durability of tventy years means five times per hundred, fifty per thousand and so on.

The ability for repetition thus is very important, more important than durability. A material or method which makes the following repair or maintenance more difficult is useless, as this means that the problem will accelerate by time and thus be destructive. A material or method used in

conservation thus has to be fully repeatable, a demand very rare in the market today, non-existant in building constructing.
In the conservation of artefacts this general demand is called reversibility, the ability of complete removal of a product applied, without affecting the original substrate.
The immense time-dimension also affects the prediction of ageing,also of the long term ageing, the very slow processes. To predict that ageing by the normal accelellerated test methods is almost impossible. To extrapolate the artificial ageing during a few days intense exposure to a few factors into tens and hundreds of years of the natural complex exposure is almost meaningless. It gives a completly false image of safety. Hundred years of natural exposure can only be compared to hundred years of natural exposure. This makes new materials and components unsafe. They can work well or they can as well destroy the original historic substance.

There are many examples of treatments widely used and used for years in conservation resulting in irreversible destruction, partial or total. The future solubility of a new organic chemical, a resin or impregnation, is really vital but almost impossible to predict with a decent certinty. Experienced chemists say for example that the extensivly used dissolved acrylics sold under different names, seriously decrease their solubility by time, especially outdoors. At the same time conservators use them on almost every important historic monument only because of its future "safe and well tested" solubility. If the critics are right, it is a catastrophy.

A conservation treatment or method must never be destructive or make a negative impact on the historic substance. The ability of harmless and complete removal is mentioned above. Another criterion for a suitable conservation sytem is a ”positive ageing”. A treatment must never turn from protecting to promoting destruction, from being positive to negative by its ageing. It must give a certain protection also when deteriorating. Regular inspections and manintenance are not realistic in all places, so one must trust a treatment not being dependant on prfect conditions or a perfect state.
Protective systems dependant on impervious layers or coatings are unsuitable as they will never be without imperfections, especially when ageing. Sacrifying systems are more safe. We can compare the protection of steel from corrosion with a chrome layer compared to zink layer.
The chrome layer will give a good protection as long as it is intact, but by the smallest scratch the chrome will promote korrosion of the steel and the destructive process vill accelerate. A layer of zink on the other hand will protect the steel also in an imperfect state. It will never turn negative as the zink sacrifies and thus protects the steel.
Protective systems must thus be weaker than the substance to be protected, have an active or at least passive protective ability which is not affected by the ageing processes. Sacrifying, buffering systems are more safe than impervious inert systems. Epoxi coatings on marble for example can never

be suitable as a protection against acidic pollution: It can never be removed without destruction to the marble, it is totally dependant on perfect, complete covering and salts can not pass from inside out without destructive deterioration. A layer of lime would be better from all aspects: buffering, sacrifying, completly pervious and would thus neutralize the acidity, without closing possible saltmigration and could be removed without harm, easily repeatable. On top of that it has proven effective as protecting layer for hundreds and thousands of years. It has three negative properties: visible (like epoxi), old and inexpensive.

How to preserve without falsifying?

The aim of conservation, characterized by the significant heritage values, gives very different technical consequences depending on the value as shown above. The immense time dimension have also been discussed above, and it leads to still other conseqenses.
Could they be combined or do they counteract?
The scheme in illustration 8 is an attempt to conclude the consequences of the two main factors.
As can be seen there are both counteraction and cooperation between the two. Most of it can well cooperate and leads to a minimum of interventions, due to different arguments. The demand for interventions due to protection against destructive climate et.c. and the demands due to new funktions et.c. are the only ones in direct conflict
They can above all be negative to the heritage values, but they can always be made in a repeatable "reversible" techniqe, which minimizes the technical risks imbued in all interventions.

To predict the Service Life of Building Materials and Components.

The two joint international associations of building research organizations CIB and RILEM have in their working groups CIB W80 / RILEM 140-TSL started a very important work which can lead to a new way of looking at materials and components in the building sector. Until now the ageing and the service life have not been an important factor in the design. There is simply no relevant way of describing the degradation factors or the resistance to different stresses. This will now be standardized and put into the testing systems. The main aim is to be able to predict the ageing when the degradation factors are known. By this better knowledge the degradation process can be decreased and the service intervals can hopefully be increased. To the normal buildings this will increase the service life and thus save resources, a conservation of the built environment.
The interest is focussed on the degradation process and how to predict and affect it. This will also bring knowledge to the ageing processes in historic

ARCHITECTURAL CONSERVATION, Technical consequences.

.....the **historic monuments** of generations of people remain to the present day as living **witnesses** ...... The common responsibility to **safeguard them for future** generations....It is our duty to hand them on in **the full richness of their authenticity.** (The Venice Charter -64)

1. To safeguard, preserve
UNLIMITED SERVICE LIFE
A technical demand

Is affected by the heritage value

* Never damage
* Decrease consuming stresses
* Also slow ageing will develop fully
* Repeated maintenance

TECHNIQUE

* Protect against consuming stresses (Outdoor climate, pollution, vibration, et.c.)
* Don´t change a construction that works.
* Use original materials (known ageing !).
* If a substitute: documented technical properties.
* "Reversible" technique, a multi-repeatable technique (replace without damage).
* Record and motivate new interventions.

Cooperation / Restrictions

2. To bear witness
RESPECT AUTHENTICITY
An antiquarian demand

Depends on the heritage value

* Respect original substance
* Historically accurate
* Emotional experience

TECHNIQUE

* Minimize interventions.
* Better add than remove.
* Use original materials and design.
* If a substitute: similar appearance.
* An addition must be possible to remove.
* Distinguish or record interventions.

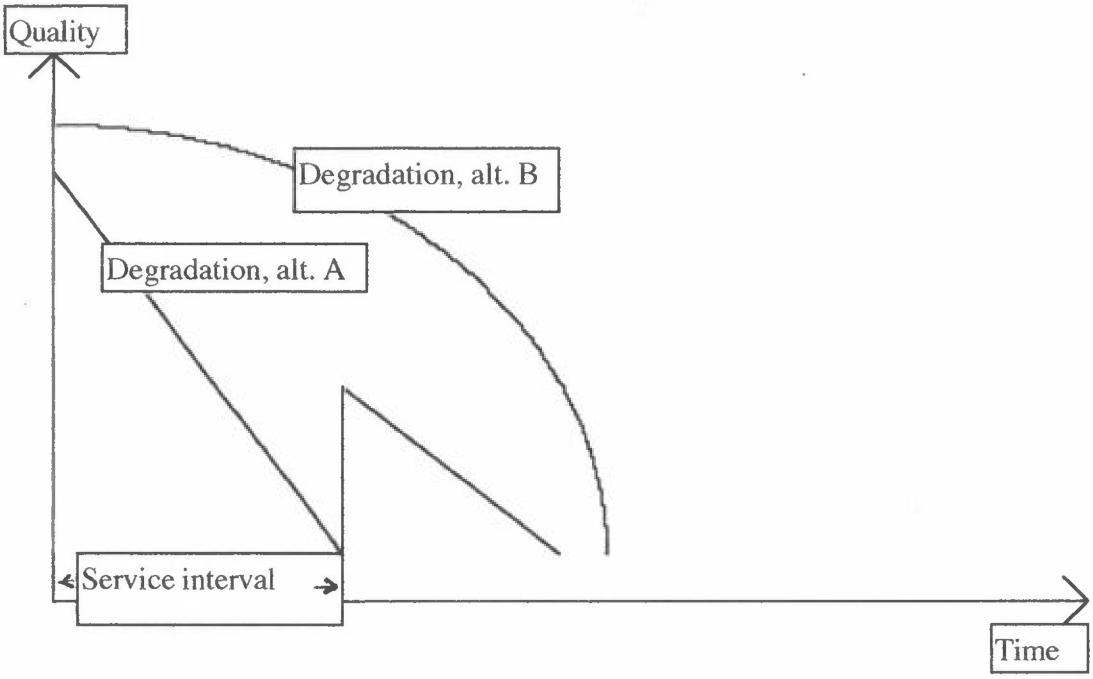
Ingmar Holmström

Illustration 8.

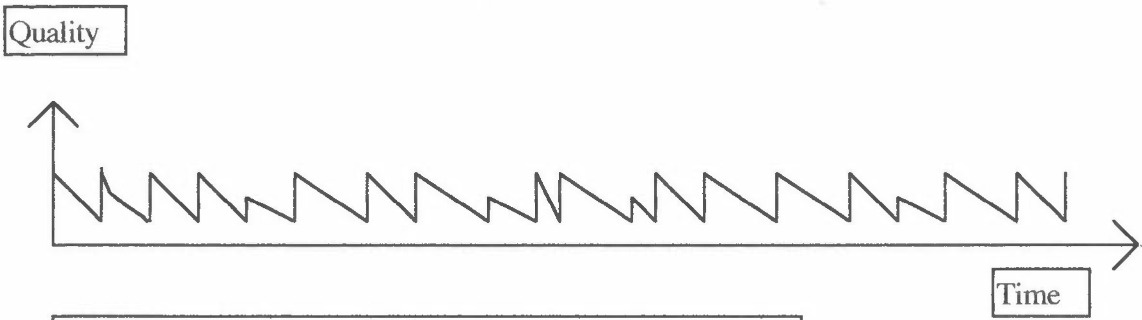
buildings, hopefully decreasing the speed of their deterioration.
But the most destructive process in conservation of historic buildings is the impact of the repairs themselves, as they normally are not designed to minimize the impact of rinsing, cleaning, removal and other means to preparare for the new coating, the new material or component replacing the worn out. The "reversibility" and the ability of repeated repair in modern constructing is close to zero. Things are not meant to be easy dismantled or replaced. The general idea in modern building design and constructing is to avoid repairs by prolonging the service life of the components with no or single repairs. This idea does not fit if the service life of the buildings exeeds 50-100 years. In historic buildings the durability is positive but less important than the multi- repeatability of the repairs. The Service Life Concept is not so well suited to promote less impact by these repeated actions. This factor must be given first priority in a system promoting the real long term conservation.
I have tried to illustrate the difference in the "maintenance- free" system and the "multi repair" system of thinking in illustration 9.

Products appropriate for conservation.
In Europe it could be argued if more damage has been done to our architectural heritage by wrong materials and methods than by neglect. This despite good will and sufficient economy but mainly because of lack of technical knowledge and historic understanding. The result is irreversible destruction of historic substance.
In my opinion the main problem is, that unlike in medicine there is no defined demand from the society to force the manufacturer to prove that conservation products are appropriate and with a minimum of negative side-effects, which in turn have to be carefully described. Until this happens the problem is to have both the practical and theoretical man to understand the difference in time-dimension between historic buildings and every-day-techniques.
As industry is not used to think in the immense time-dimension of conservation they can easily fool themselves by thinking in terms of "durable" meaning durable for the next ten, fifteen, thirty years. A snooze in conservation, a blink.
In architectural conservation there is also the problem of the scale. The behavior of, and the means of treating, some hundreds or thousands of square meters of stone differs a lot from the treating of a small stone object in a laboratory.

As told above a conservation action must never make any damage to the historic object, even when the treatment is in an imperfect state. This excludes certain systems e.g. those who are dependant on perfect surfaces without cracks, naked or deteriorated spots et.c. A treatment must never turn from positive to negative by aging.



Buildings in general.



Historic buildings: Multi repeated maintenance and repair. Thus repeatability is more important than durability.

Illustration 9

The special demands in conservation have to be given to industry in advance to avoid them spending a lot of money on false tracks. Having invested a lot in a product, appearing in a late stage to be doubtful in use, easily leads to a temptation to sell it despite its negative impact. There has to be a profit to pay back the investment.

Conservation and medical care.

There are many similarities between conservation and medical care: the repeated need of care, the necessity to avoid negative side-effects, the need of combining historic sources (the patients journal, his own story) with investigations on the site (palpeting et c) as well as in laboratories (blood tests, x-ray et c), the aiming at a long and healthy life in full integrity, and so on.

Unlike in medicin, in conservation there is no such a thing as "proven knowledge" in a written form, and above all a social demand on the manufacturer to prove that his medicine is apropriate before it is allowed to be used. Some medicines need a doctors examination and prescription to be sold, some not. There is an examination and authorisation of doctors in all countries but of conservators not.

The result of an inappropriate treatment is the same: damage or destruction. Most of these problems could be avoided by using products/methods which are reversible or at least fully repeatable without affecting the original substance. Like medicines, conservation products should be proved by the manufacturer to fulfill certain demands with a minimum of side-effects, which in turn should be declared.

Products should at least be declared to ansver questions like:
Which are the positive effects? Which are the negative?
Where and when can it be used? Where and when should it not be used?
How does it age? In which way? In what time?
Is it reversible or not? Is it repeatable or not, and for how many cycles?
How to take it away? Can it be done without affecting the original substrate?
How can you prove your case? And so on.

The cultural property as part of property in general.

There are two main factors defining the three groups of property: The cultural heritage value and the service life.

Objects of high cultural heritage value are mostly protected by the society in order to illustrate our history to present and future generations. They are

protected from normal daily use not to be changed. They are meant to be preserved for the future as authentic as possible. Artefacts are normally preserved in museums.
Objects of this category are ment to be kept for ever. The older they grow the more rare they are, and thus of higher historic interest.
Objects of high cultural value thus also will have a very long service life. Ideally they should be kept for ever, get an immense service life.

Objects without specific cultural heritage value are normally not protected by the society, they are the ones in normal daily use. They are kept as long as they are useful, which affects their service life. The service life is normally dependant of the usefulness, and normally regarded fairly limited. The industrialized society has during decades had the idea that not fully useful objects should be thrown away or be demolished.
This way of looking at objects is the one critizised in the international reports mentioned above: We have to prolong the service life and vaste less resorces to keep them going.

We thus have three categories:

A. Objects with an undefined limited service life and no specific cultural heritage value.
B. Objects vith a very long service life and no specific cultural heritage value.
C. Objects with an immense service life and a specific cultural heritage value.

A. The normal concept of handling objects belongs to category A.
This is the way we are used to act in our daily life either we are producers of objects or consumers:"Use and dispose". When maintaining we "react and cure". Thinking of service life in terms of some decades, leads to neglection of regular mainte-nance. We think in terms of either "disposable" or "free of maintenance". It has by time been so strong a paradigm that it is almost impossible to think in another way. "Long lasting" or "durable" stands for anything between months and one or two decades.

B. Changing concept to category B will be difficult and take time until it becomes natural. It means thinking in service life, in regular maintenance, even in multi-repeated maintenance, in multi-repeated repair, in partial replacements, in rehabilitation and repair to keep an object in use. In this concept there is no material being called "free of maintenance". An approach of "anticipate and prevent" has to replace the present "react and cure".
This concept could be called conservation.
This is the direction we have to follow not to destruct our environment and our given resorces. We have one earth, one world.

Products appropriate to category B could be described by technical criterias like maintainable, repairable, partly replaceable, repeatable et.c. To understand the ageing processes and be able to predict service life will be important issues
for every technician.
Hopefully will EUROCARE be one of our foras to reach that general goal and to create appropriate products.

C. Typical objects belonging to category C are those protected by society because of their cultural heritage value: our museum objects, our monuments and historic buildings of all kinds.
By definition they are all existing, which not necessary is the case for cathegory A and B.
Like objects in category B they are categorized by having a very long service life. They are supposed to be preserved "for future generations" which means no limit, we are supposed to aim at "eternity". Buildings still standing since birth of Christ are supposed to stay another two thousand years. At least. The expected future service lfe in this cathegory is in the same direction as in B, but with a time dimension hard to understand. Multi-repeated actions of maintenance, repair, partly replacements et.c. are more than obvious. The problems of ageing and the prediction of service life are related to category B but still more difficult to solve by using accelerated tests.
The Service Life Concept, in its present form, is hardly fully relevant.
The Cultural Heritage Value is the very reason to protect these objects, it is <u>not</u> the normal, daily use. On the contrary they are protected against normal use because of the tear and wear and the risk of adoption to new use, new demands. The normal use is not determinant for the care of theese objects, they might not even be useful (but it increases the economy) or even beautiful(!) but still of a very high heritage value.
The ultimate aim of protection is to preserve the authenticity and integrity of the object: it must not be falsified.
This means that the original material substance must not be affected, lost or changed in any respect.
This means in turn that unlike objects of category A or B you are not free to choose material or methods from a pure technical evaluation: you must respect the original substance.
The concept of conservation of cultural property thus is <u>not</u> the same as conservation in general. This means also that the technical criterias for conservation products in general are <u>not</u> enuogh, or even relevant for the preservation of cultural property.

Talking about the EUROCARE Concept or the Service Life Concept
as the scientific base for EUROCARE projects, thus is not relevant as long as we are dealing with inconsistant cathegories of objects and without proper definition.

Appropriate product criterias for preservation.

Objects of high cultural value are, as mentioned above, often protected by national and/or international regulations (laws, recommendations et.c.). This means that they are meant to be treated in such a way that their heritage values are not affected and that their service life is "eternal". Told in other words: the objects must not be falsified and should be preserved for "eternity".

The autenticity and integrity of the object must not be decreased by the conservation work.

Authenticity is close connected to the original material substance. Any substance loss or change in the substance properties should thus be avoided. A thorough evaluation of the heritage values of every single object can give the answer to the caracter, strength and priority of the different values in question. This evaluation is the base for the restrictions in the conservation actions.

Appropriate conservation products thus should fulfill some main criterias:

A. No damage to the object by the treatment.

B. No material loss of the object.

C. No change of material properties, design, setting et.c..

D. The object should be preserved for eternity ("eternal service life").

E. Conservation is a repetitive measure based on regular maintenance.

This leads to some technical concequences to be checked:

1. A conservation action, a treatement, must be the minimum necessary. (Prove it!)
2. The time dimension of service life, of ageing, of repetitive measures et.c. is "eternity". (This means hundreds or thousands of years ahead instead of the usual singles or tens.) (Declare the time dimension used! Relevant?)
3. Evaluate the ageing passed to all relevant materials and components and predict future short term as well as long term ageing.(Original materials has a known ageing and thus should be preferred in conservation. New materials will create a different technical balance together with the existing ones, which is difficult to predict.)
4. Reduce consuming stresses, if possible exclude them.
5. Work <u>with</u> nature, not against it.
6. As material loss must be avoided only additive actions can be done.

7. Treatments changing the material properties of the object should be avoided, and if they have to be done must be fully reversible and multi repeatable.
8. Deterioration can not be fully stopped unless the stresses are excluded, but the speed and rate of deterioration can be decreased by approriate conservation action.
9. Durability of the single materials or components does not exist. It is more a question of the speed of the deteriora tion and thus repeated maintenance, repeated repair and replacement. This demands full reversibility and a multi repeated maintenance.
10. Strengthening of a deteriorated material or surface is a temporary solution and does not stop future deterioration. An appropriate sacrificing layer can stop future deterioration of the substrate by reducing the consuming stresses and thus has to be repeated as soon as consumed.
11. The technical solution is restricted by the heritage values of the object in question.

Every conservation product (material or method) should fulfill the demands stated above and also answer questions like:

Describe the relation to the Ethical Criterias of Conservation! (If it does not fit completely, describe how and why!)

What is the principal technical idea behind the proposed method? The technical process used? Limits for this process?

Where and when can it be used? Where and when should it not be used?

Which are the positive effects? Which are the negative?

How does it age? In which way? In what time?

Which are the criterias for success? (Must it be used by trained specialists? Sensitivity to worksite conditions? Criterias! Sensitivity to deviations in the actual object? Criterias! Sensitivity to storing and handling? Criterias! And so on.)

Is it reversible or not? Is it repeatable or not, and for how many cycles? Prove!
How to remove it? Can it be done without affecting the original fabric/substance?

How to plan for future maintenance and repair? Describe!
How to plan for future altering and removal? Describe!
How to know when it is time to maintain, repair, remove?
How does these actions affect the original fabric/substrate?

What happens when it does not work the way planned?
(Possible negative effects?!)

How can you prove your case? And so on.

For example a protective coating (impermeable, semipermeable or repellant) aiming at excluding penetration of agressive liquors, gases et.c. is a risky treatment as it is dependant of the full covering. A crack or a fault as well as the future deterioration leads to local penetration of the agressive agents which can cause deep local deterioration. Such a coating on a porous material leads to local penetration which spreads sidewards, which in turn can produce accelerated damage also to surfaces still protected, by affecting the coated area from beneath.
The planned way of working, the ageing and the reversibility are in this example essential to declare.
A weak, porous coating, fully permeable, acting as a buffering sacrificing layer would not give the same problems when it fails.
Nothing can be trapped behind the still existing coating. If it is fully reversible and repeatable the risk of damaging the original is at minimum.

Every product should be given a full technical declaration relevant to Conservation, with no secret components. This is necessary to be able to predict future ageing et.c. in different conditions and to be able to cure unexpected side effects which might occur in the future.

Test methods should be non destructive. If not, the damage done must be the very minimum. (Motivate!)

Proposal.
I wish we had the same principles of approval of products and methods in conservation as we have in medical care. I can see no principal objection to create it, it is mainly a matter of will and knowledge. It ought to be both a national and international interest to create such a system. To gain resorces it could be done by Unesco (e g through ICCROM) and adopted by nations interested. One result might be a graded list.
What would be the role of EUROCARE ? As far as I can understand EUREKA is a way of promoting the free creation of new clever products needing intensive research, and so is EUROCARE. It is also my strong opinion that

EUROCARE-products <u>have</u> to be appropriate for conservation, and that EUROCARE has that responsibility. As EUROCARE is a free organization, not an authority, we have to decide on our own rules for approval as long as there is nothing done by the authorities.
But how to organize it? And how to finance it? EUROCARE has as we all know no money of its own.

Ingmar Holmström
Pilot Wood, member of EUROCARE WG4: Scientific Concepts

APPENDIX 4.5

President Paolo Parrini
"Application of new technologies,
conservation processes and materials:
An industrial view-point"

PAOLO L. PARRINI
SYREMONT - MILANO, ITALIA

APPLICATION OF NEW TECHNOLOGIES, CONSERVATION PROCESSES AND MATERIALS: AN INDUSTRIAL VIEWPOINT

for
EUROCARE I MARKET PLACE
LILLEHAMMER 1-3 OCTOBER 1991

Ladies and Gentlemen,
first of all I wish to thank the organizing Committee of this Eurocare meeting for giving me the possibility to speak about the role played by industry in the new challenge set by the conservation of our Cultural Heritage.

Artworks, monuments, archaeological finds are, in their majority, of public property (at national, regional or civic level). Therefore, some people believe that public authorities should be charged not only with their protection but also with their ordinary and extraordinary maintenance, while for private artworks it should be the opposite.

These people then believe that finding new processes, new technologies and new products is a task for Universities or Public Research Centers. In their view, industrial companies should be kept aside, because of their profit-oriented character, as if this lawful, natural purpose could not suit such a culturally outstanding field.

This way of thinking, rather frequent among some specialists, is questionable and indeed not correct at all as it neglects the role that industry has played and still plays in the scientific and technological development of our countries.

As far as Research, the most delicate and innovative field, is concerned, statistics from the E.E.C. and from the most advanced countries, such as the U.S.A. and Japan, show that industrial and private research are weightier than the public one and are quite predominant in some fields, like, for example, drug manufacturing.

Where does this view then derive from?

One of the original reasons might be the situation actually existing until some decades ago. Before World War 2 many

appreciated artworks but those who took care of them were few, mainly experts from public institutions.
The academic community, both the humanistic and the scientific one, virtually ignored the conservation of cultural heritage and the same can be said for the industrial world, whose main goal was the manufacturing of new products which could meet the needs of the people, eager to achieve the material well-being that many countries actually achieved later on.
But after these products glutted the market, in the last twenty years industries strove to surpass their own results and to face new technological challenges. This brought to an industrial reconversion never seen before and to a stronger technological impact on all production processes. It is enough to mention the widespread use of computer and the global automation, the use of continuously improving methodologies, the synthesis of new, high-performance materials.
In the meantime, as money, interests and forces shifted towards new goals which, unlike the so-called "Rush to the Moon", presented other aspects than profitability, a renovated interest for nature, art, and the past has arisen in the new generations.

This trend, combined with the new political situation in Europe and, afterwards, in the rest of the world, has led not only to an all-embracing fruition of museums, monuments and art cities but also to a channeling of technological and artistic efforts towards a sole objective: the long-term conservation of the cultural heritage. Fruition is now so massive that it can even endanger artworks on exhibition.
(Fig.1: Scheme of the historical process that drew near industry, science and artworks conservation).

Prompted by the continuous innovations and by the critical environmental conditions of our countries, art historians, archaeologists and architects are creating close contacts with chemists, physicists, engineers. The aim is to detect new diagnostic and restoration methodologies and new products to employ in the huge efforts made for the scientific recovery of artworks.
These are at last given the value they deserve and, in marketing terms, the demand for them is constantly rising also in the wake of a widespread sensation that deterioration is proceeding rapidly and unceasingly.
Such trend is so impressive that it required not only the intervention of those who have always been institutionally charged with the protection of artworks (but with the same poor means as before) but also the huge knowledge on materials that industries have gained over the last decades.

Industries, in their turn, have well understood the importance of this field, and have started a continuous, fruitful cooperation, trading know-how, products and a new course of research, aimed at the development of new, tailor-made products.
The philosphy of image, and the perspective of a indirect, but not immediate, financial return, are the driving forces of this course of action.
They are thus engaged in a still arduous, unripe frontier field where they are to convey most of their know-how. The results might influence other markets, this time wide and profitable, such as that of building materials which might produce the long-awaited improvement in quality.

The role played by industry in the Cultural Heritage and, especially, in the conservation of those materials which constitute artworks, is then more significant than we could assume.

The know-how, the equipments and especially the products concerning the science of materials are developed and manufactured in industrial companies which have been working for many years on the conservation and protection of materials as well as on the synthesis of new ones.

The conservation and the protection of common objects, even of large ones, are dealt with by a whole industrial area, whose leading position is held by the Research Centers of big companies which are developing materials and technologies for the future. They borrow advanced data and the basic knowledge from Universities but the number of Industrial Research Centers also undertaking fundamental studies is increasing (for example on electronics, or on high-temperature conductivity).

Materials are one of the main current industrial objectives, and it is not surprising that in order to achieve this goal, new, less invasive diagnosis techniques, are being developed.

Industrial companies cannot indeed spend time and money carrying out quality controls, as currently required, destroying a number of pieces for each production line. Also art conservators have been demanding new techniques for their precious objects. A solution satisfying all needs could be the use of techniques developed for the non destructive quality controls as those formerly developed for the safety of chemical or nuclear plants, or for the study on chemical catalysis.

Initially, this is an easy task, but it grows increasingly arduous if new, tailor-made analytical methods must be designed for artworks. It is possible to do this, but it is costly, (as it always happens when prototypes are developed). Furthermore, new techniques do not only need costly equipments (which are, after all, easily accessible) but, above all specialized staff. Their training and employment is really hard in terms of efforts and money.

The quality and quantity of the technical and financial efforts vary when, after diagnosis, we must undertake the real restoration and conservation.
Restoration techniques based on ancient recipes are rapidly evolving because some of the old materials do no longer respond to modern needs and because the knowledge to produce them is now partially lost. Besides, new products are definitely better.
Certain industrial processes must then be taken into consideration, studying their possible applications in restoration. In this case, even though we start from well-known chemico-physical principles and use partially available materials (for example, ion-exchange resins or semipermeable membranes) their application in restoration requires finalized research, investments and, quite often, specific variations in the products, to make them appropriate for tailor-made interventions.
(Fig.2: A practical example of the use made of industrial products and processes in the field of conservation).
Research applied to restoration is now following the trend towards chemical "return" reactions and towards soft, but more decisive modification processes. A typical example is the fundamental reaction of the cleaning of frescoes in the Cappella Brancacci, the cleaning of Verrocchio's statues in the Florence Church of S.Lorenzo. Today new materials, developed by restoration-finalized research are finally becoming available. (It is worth mentioning structural-type

re-lining canvas, predetermined splitting papers and composite-based substrates).

For such interventions we should uncontroversially determine the kind of performance that the required materials must provide, and conservators should point out what we can expect from the new methodologies. (See Fig.3: An example of the properties required from a protective product for lithoid or cellulosic materials. Differences are clear, so it is not possible to use one instead of the other).
Conservators have now become more aware that, in order to make proper, scientifically tested interventions, technical and scientific aids are needed.
It is also necessary, however, to lay the basis of the "validity control" principle, which can be verified also through simulations; this means that, with the aid of the most advanced methodologies, controls must verify the immediate results of the interventions as well as their performances.
If still too many restorations seem accurate, but already bear the seed of deterioration, this is only thanks to hasty or "ignorant" techniques.
We must remember that today industrial products (even the simplest ones) undergo a strict monitoring of their performances over the years and in all the predictable conditions. (See Fig. 4: it shows how many times we must carry out simulations and property controls during the development of a new product).
This change of "modus operandi" is even more outstanding when referred to conservation and conservative products in the case that the "chemical" solution is the only one possible.

Here, both industrial research and industrial activities are deeply involved, as the latter are entrusted with the manufacturing and distribution of chemicals for the most varied applications.

Efforts for the development of new products, in terms of studies, time and financing, are justified only by concrete goals and by a financial return which, for special, high-technology products, might even come in the long term, but should nonetheless be tangible.

(Fig.5: it shows the time necessary to develop a new products or a new material).

It is now clear that Conservation needs tailor-made products, especially when the protection from environmental attacks is concerned. Indeed, we cannot expect, as we have done so far, that the substances conceived for industrial use or for the trade market can also be adopted for objects which are, because of their nature, an "exception".

Some obstacles must be overcome before industrial involvement becomes complete and fruitful.

First of all, it is necessary to determine which requirements the products to develop must fulfill for each single class of artworks and of environmental conditions. Also, industrial research must indicate the technical limits we can achieve with the current technologies during the whole conservation-restoration process, as it is called today (Fig.6: The various steps of a modern restoration process).

For example, all the well-known Restoration Charts point out that such products must still be reversible years after application.

According to what the chemical studies on materials and products have shown so far, these requirements cannot easily be met; therefore, this problem must be analyzed again in its "technical" and "methodological" aspects.

As far as technique is concerned, the performances of products are, thanks to the simulation systems available, a great deal more reliable than they used to be until a few years ago.
Moreover, materials must no longer be conceived as something to replace as soon as possible with products still to be discovered. Obviously, it is not easy to conceive a protective agent which could outlive the materials it is to protect; on the contrary, the former can be sacrificed in order to conserve the latter.
As far as methodology is concerned, we must realize that restoration can be either predominantly "functional" or "artistical". Restoring a painting, rather than a violin or a book, is not quite the same thing.
In the first case, restoration must bring back and preserve the readibility and the colors of the painting which passively suffers the mechanical or physical stress of the surrounding environment, whereas the restoration of objects whose function is practical and not merely aesthetical, demands a completely different treatment.
Violins must be played; to read the texts, books and documents must be handled, their pages turned over.
If the materials employed are really effective, some of their features might even be only partially reversible and have a well-known, monitored life.

The development of a brand new product can even take an extremely long time boosting costs proportionally as we have just said. Obviously, though not so expensive and time-demanding as the development of a new drug or a new pesticide, the manufacturing of a protective or of a consolidating agent for lithoid materials requires similar

working plans and is extremely demanding in terms of time, expertise and financial resorts.
Thus, if a company undertakes such a research with reasonable hopes to succeed and to start producing and selling later on, it must envisage a proportionate financial return. Given the importance of this research, the financial support of public bodies, as the Economic European Community, would be quite welcome, but quality products are equally very costly, as companies must cover research expenses, and sales, at least quantitatively, are necessarily limited. Congruous savings and higher chances of success are possible if companies can exploit the research guidelines set to develop other products.
This explains why the new materials are produced by Companies which have long been engaged in product "families", like those deriving from silicon, fluorine, polyolefines, etc.
Also, it should be pointed out that, while something has been done and is still being done to find products suitable for lithoid materials, research is still sluggish on the conservation of paper, books, documents, which represent a priceless heritage too.

For a substantial improvement restoration should lose the connotation of "extraordinary event" performed under the influence of various spurs, not always merely cultural ones. It should on the contrary be considered as a maintenance step planned in advance after consulting the data obtained from a continuous, "clever" monitoring.
Technically speaking, maintenance is less invasive than restoration, since interventions are performed before deterioration begins or, at the most, in its first stages.

The use of preserving or protective agents is automatically repeated at regular intervals.

From an economic and social point of view, maintenance should involve larger, better trained staffs, and so modify the dynamics of costs. Indeed, the demand for products would rise reducing expenses.

(Fig.7: it shows how we can reduce the costs of a tailor-made product for artworks conservation).

This change in the way maintenance is considered in Europe will shortly become necessary and its effects will continue at least as long as the problems of widespread pollution (which is falling in some European countries) and fruition (whose upward trend is estimated to reach and maintain very high levels) are solved.

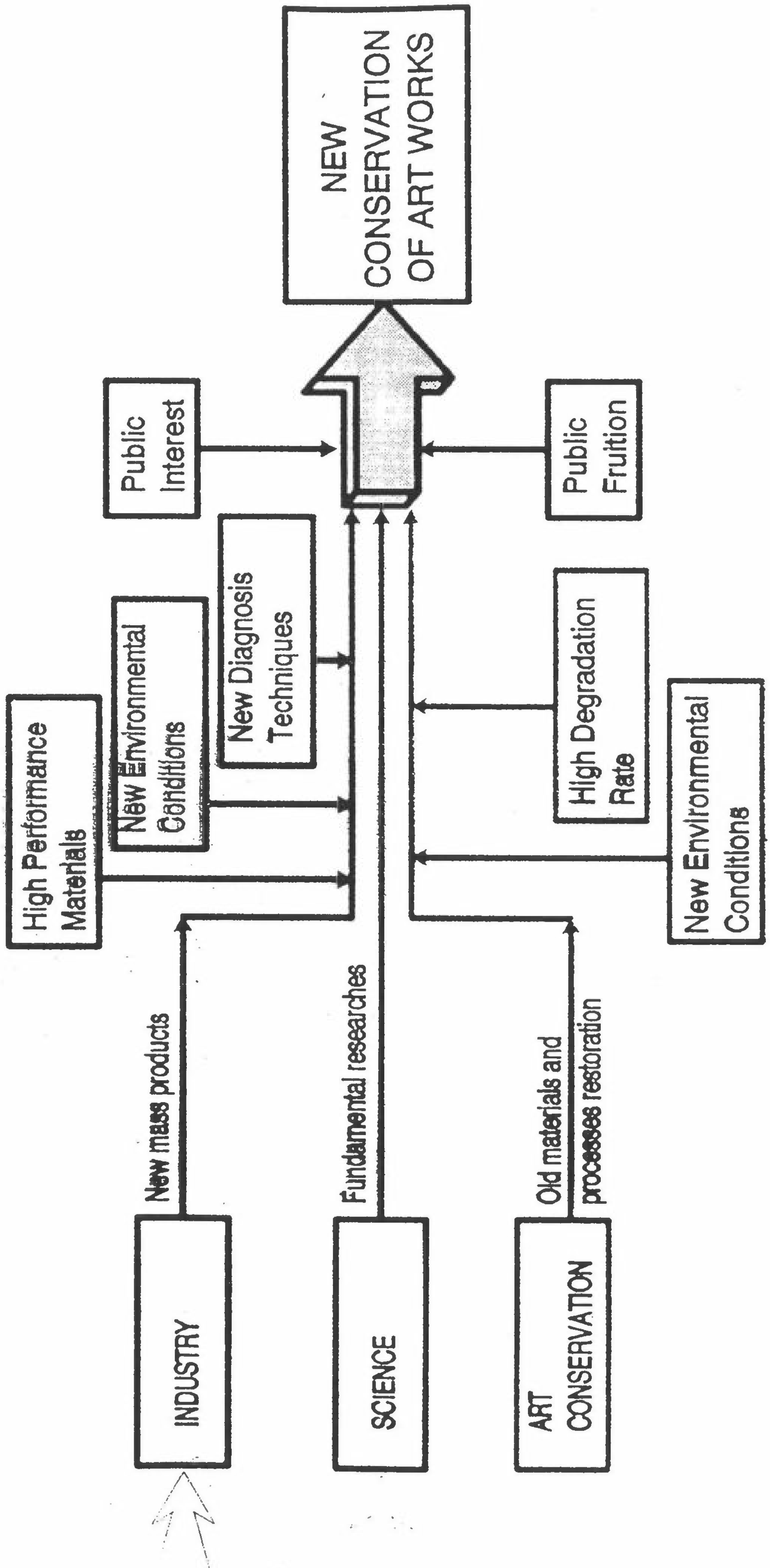

NEW CONSERVATION OF ART WORKS
Public Interest
Public Fruition
New Diagnosis Techniques
New Environmental Conditions
High Performance Materials
High Degradation Rate
New Environmental Conditions
New mass products
Fundamental researches
Old materials and processes restoration
INDUSTRY
SCIENCE
ART CONSERVATION

Fig. 1

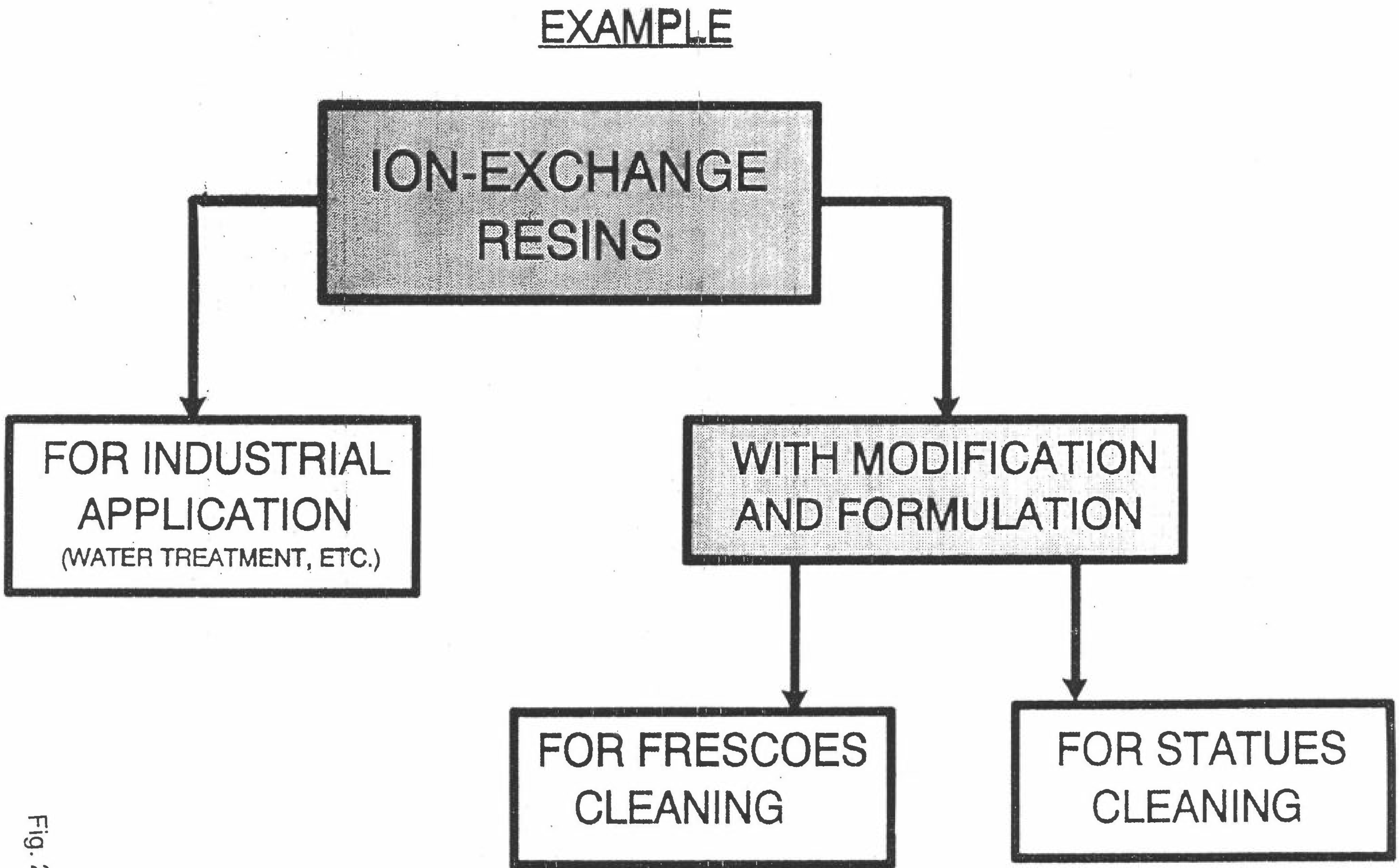

EXAMPLE
ION-EXCHANGE RESINS
FOR INDUSTRIAL APPLICATION
(WATER TREATMENT, ETC.)
WITH MODIFICATION AND FORMULATION
FOR FRESCOES CLEANING
FOR STATUES CLEANING

Fig. 2

PROPERTIES OF IDEAL PROTECTIVE AGENTS

LITHOID MATERIALS		CELLULOSIC MATERIALS
CHEMICAL INERT		INERT FOR ALL MTL.S OF SHEET
	ATMOSPHERIC RESISTANT	
	LIGHT RESISTANT	
	TRANSPARENT, NO COLOR	
HEAT STABLE		O_2 BARRIER
LIQUID, LOW VOLATILITY		SOLID FROM VAPOR
NO-SOLUBLE IN H_2O-SOLVENT		NEUTRAL pH
		FLEXIBLE
PERMEABLE AIR, H_2O VAPOR		HUMIDITY PERMEABLE
REVERSIBLE		REVERSIBLE

Fig. 3

PRODUCTION STEPS OF A NEW MATERIAL

MATERIAL PLANNING

DATA BANKS | LITERATURE PATENTS

LABORATORY

1st SIMULATION | 1st CHARACTERISATION

PROTOTYPE

COST ASSESSMENT | CONTROLS ENDURANCE TESTS

DEVELOPMENT

2nd SIMULATION | CONTROLS

IN SITU TESTS

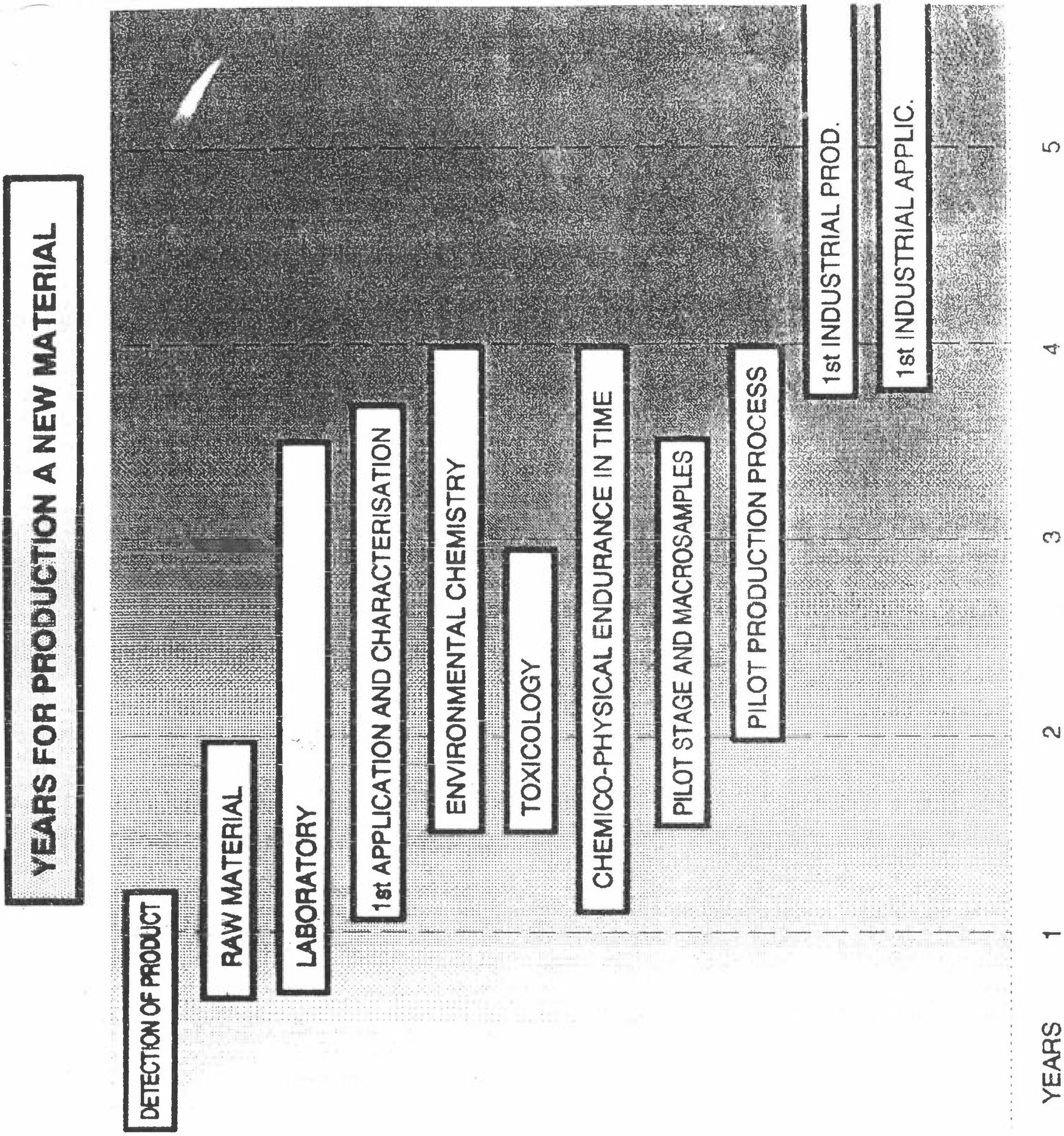
PROCESS STUDY | MACRO-PRODUCTION

APPLICATIONS

VALIDITY CONTROL | MARKETING ASSESSMENT

PRODUCTION

Fig. 4



YEARS FOR PRODUCTION A NEW MATERIAL
DETECTION OF PRODUCT
RAW MATERIAL
LABORATORY
1st APPLICATION AND CHARACTERISATION
ENVIRONMENTAL CHEMISTRY
TOXICOLOGY
CHEMICO-PHYSICAL ENDURANCE IN TIME
PILOT STAGE AND MACROSAMPLES
PILOT PRODUCTION PROCESS
1st INDUSTRIAL PROD.
1st INDUSTRIAL APPLIC.
YEARS
1
2
3
4
5

Fig. 5

THE STEPS OF MODERN CONSERVATION OF ARTWORKS

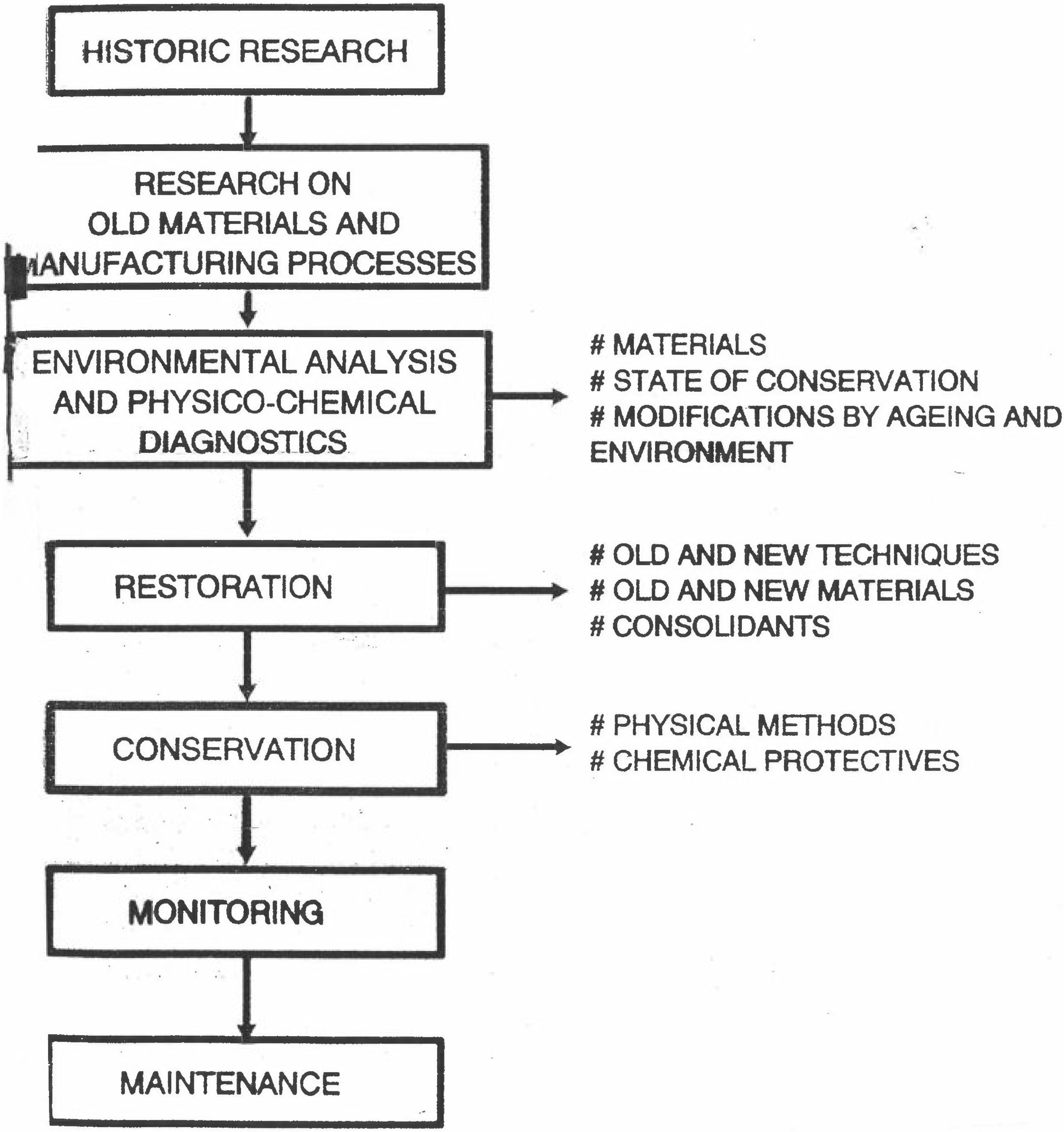


Fig. 6

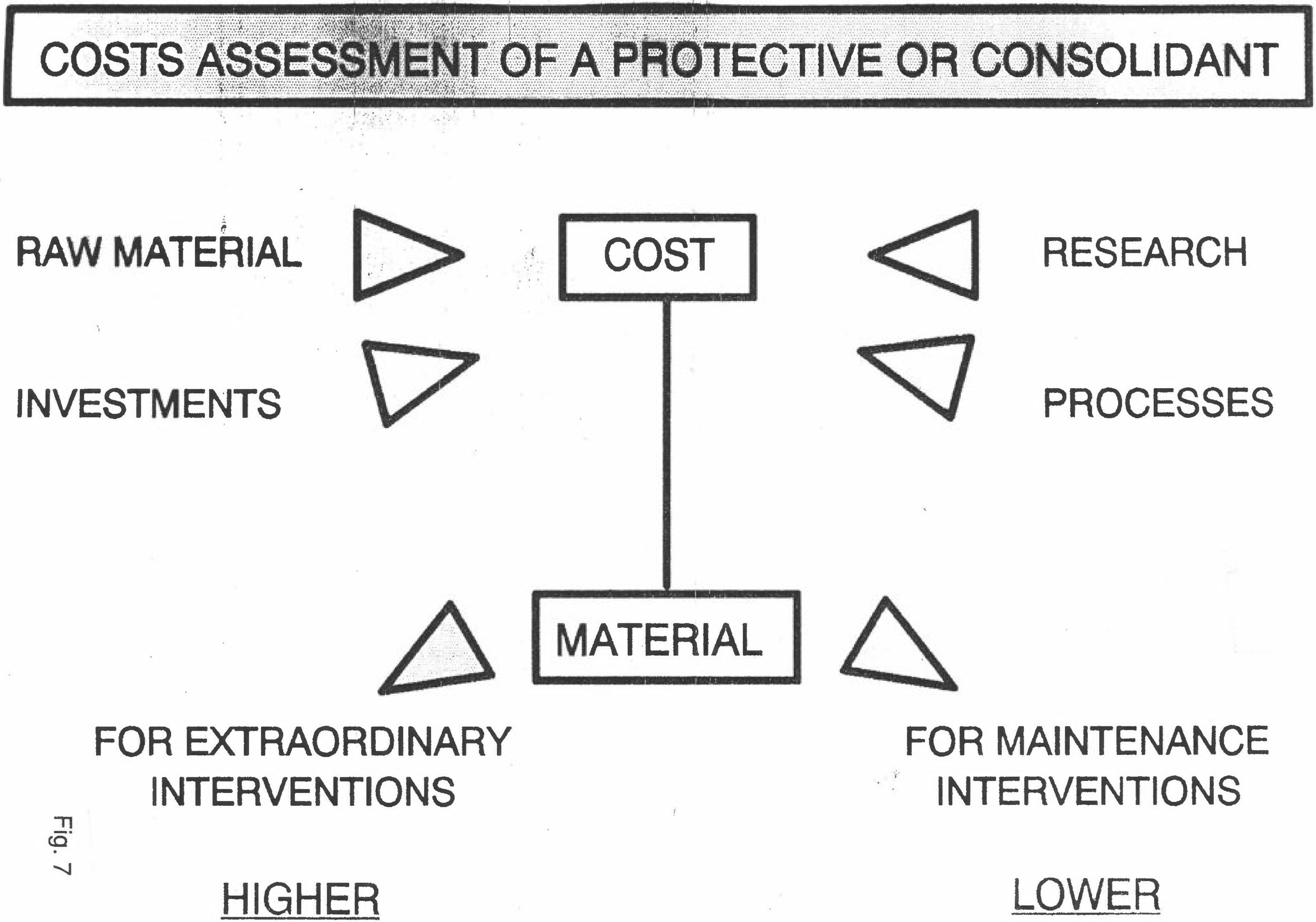

COSTS ASSESSMENT OF A PROTECTIVE OR CONSOLIDANT
RAW MATERIAL
COST
RESEARCH
INVESTMENTS
PROCESSES
MATERIAL
FOR EXTRAORDINARY INTERVENTIONS
FOR MAINTENANCE INTERVENTIONS
HIGHER
LOWER

Fig. 7

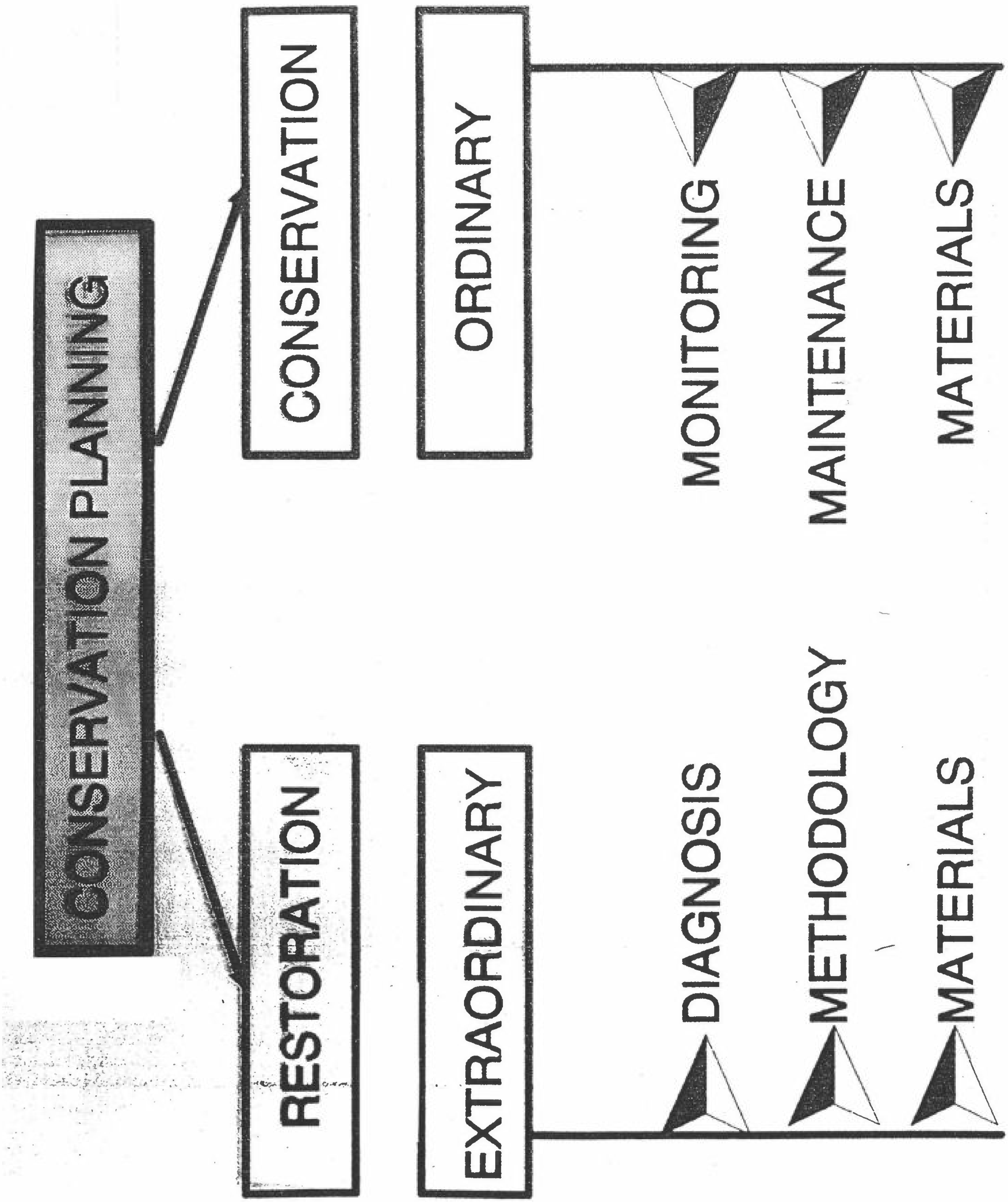

CONSERVATION PLANNING
RESTORATION
EXTRAORDINARY
DIAGNOSIS
METHODOLOGY
MATERIALS
CONSERVATION
ORDINARY
MONITORING
MAINTENANCE
MATERIALS

Fig. 8

APPENDIX 4.6

Mr. Paul Caluewaerts
CEC's Research Programmes STEP and BRITE/EURAM
and co-operation with EUROCARE

SYNERGY

(see Pandolfi)

(CASE by CASE)

CEC

1) Joins indificual projects (JRC)

2) Joins umbrellas (co-ordination - see Hannover)

3) take care of requests from EUREKA projects for precompetitive research
   - at level of progr. def.
   - at level of ind. proj. (co-funding)

4) transfer results of precomp. research
   → EUREKA projects (conseq. funding)

5) support in stand. of logist. work (support. measures)

6) organize collaborative promot. efforts
   common workshops ...

THIRD FRAMEWORK

PROGRAMME

<u>'90 - '94</u>

15 R&D areas

- environment (former STEP)
- ind. & mat. technologies (former BRITE/EURAM)
-
-
-
-
-
-
-

ENVIRONMENT

I GLOBAL CHANGE

II TECHNOLOGIES & ENGINEERING FOR ENVIRONM. → !

III ECON.& SOCIAL ASPECTS OF ENVIRON. ISSUES

IV TECHNOL. & NAT. RISKS

BRITE
EURAM

INDUSTRIAL AND MATERIALS
TECHNOLOGIES (1990-1994)

AREA 1: MATERIALS AND RAW MATERIALS

RAW MATERIALS

RECYCLING

NEW & IMPROVED MATERIALS & THEIR PROCESSING

AREA 2: DESIGN AND MANUFACTURING

DESIGN

MANUFACTURING

SEE: COM (90) 673 FINAL SYN 261 14.12.1990
"AMENDED PROPOSAL FOR A COUNCIL DECISION"

BRITE
EURAM

INDUSTRIAL AND MATERIALS TECHNOLOGIES PROGRAMME 1990 - 1994

INDICATIVE FINANCIAL BREAKDOWN

	(M. ECU)
AREA & MATERIALS - RAW MATERIALS	
1. PRIMARY MATERIALS - RAW MATERIALS	80
2. MATERIALS	228.8
AREA 2. DESIGN AND MANUFACTURING	301.5
AREA 3. AERONAUTICS RESEARCH	53 (a)
	663.3 (b)

(a) over 3 years

(b) including - administration 35

- "results awareness" 6.7

BRITE
EURAM

INDUSTRIAL AND MATERIALS TECHNOLOGIES
PROGRAMME 1990 - 1994

ACTION LINES (under discussion)

RESEARCH PROJECTS

- Industrial Research (former "Type 1")
- Fundamental Research (former "Type 2")
- Targetted Research

COOPERATIVE RESEARCH - CRAFT -

- SMEs plus research centres

CONCERTED ACTIONS

- Possibly in stages, 400 000 ECU maximum

ACCOMPANYING MEASURES

- Organisation of Workshops
- Coordination of similar projects
- Targetted training : multidisciplinary
- Information exchange
- Promotion and diffusion of results
- Evaluation of programme
- Feasibility Awards for SMEs (30 000 ECU, 9 months)

BRITE
EURAM

INDUSTRIAL AND MATERIALS
TECHNOLOGIES (1990-1994)

AREA 1: MATERIALS-RAW MATERIALS

RAW MATERIALS

- IMPROVEMENT OF EXISTING PROCESSES

- METHODS FOR IMPROVING YIELD

- INTEGRATED TECHNIQUES FOR THE EXPLORATION OF MINERAL DEPOSITS

- ADVANCED EXPLORATION METHODS FOR HIDDEN DEPOSITS

- SAFETY CONDITIONS AND ENVIRONMENTAL IMPACT

BRITE EURAM

INDUSTRIAL AND MATERIALS TECHNOLOGIES (1990-1994)

AREA 1:MATERIALS-RAW MATERIALS

RECYCLING

- ANALYSIS FROM THE RAW MATERIAL TO RECYCLING
- ECONOMIC AND ENERGY ASPECTS
- ENVIRONMENTAL PROBLEMS
- EXPLOITING RESIDUES CONTAINING PRECIOUS AND STRATEGIC METALS
- RECYCLING COMPOSITE AND ADVANCED MATERIALS

BRITE
EURAM

INDUSTRIAL AND MATERIALS
TECHNOLOGIES (1990-1994)

NEW AND IMPROVED MATERIALS AND THEIR PROCESSING

- DEVELOPMENTS IN MATERIALS AND PROCESSES
- CONVENTIONAL MASS COMMODITY MATERIALS
- MATERIALS WITH SPECIFIED PROPERTIES
- METALLIC MATERIALS
- TECHNICAL CERAMICS
- POLYMER MATERIALS
- COMPOSITE ENGINEERING
- SUPERCONDUCTORS
- BIOACTIVE AND BIOMEDICAL MATERIALS
- PRENORMATIVE WORK
- IMPACT ON HEALTH AND THE ENVIRONMENT

BRITE
EURAM

AREA 2: DESIGN & MANUFACTURING

DESIGN

- IMPACT ON PRODUCT PERFORMANCE
- ORGANIZATIONAL PROCEDURES
- HUMAN FACTORS
- FAILURE MODES AND DEFECT ANALYSIS
- MANUFACTURING QUALITY CONTROL
- RECYCLING OR REUSE
- REDUCING WHOLE LIFE COSTS
- RAPID PROTOTYPING
- GENERATION AND DEVELOPMENT OF STANDARDS
- GOOD DESIGN PRACTICE

BRITE
EURAM

INDUSTRIAL AND MATERIALS
TECHNOLOGIES (1990-1994)

AREA 2: DESIGN & MANUFACTURING

MANUFACTURING

→ REDUCE COSTLY AND ENVIRONMENTAL DAMAGING WASTES

- CHEMICAL ENGINEERING THROUGH INTEGRATED APPROACHES

- PROCESS MODELLING

- SEPARATION TECHNOLOGY

- MIXING AND STIRRING

- PARTICLE AND POWDER TECHNOLOGY

- SOFTWARE TAILORED TO PARTICULAR NEEDS

BRITE EURAM

INDUSTRIAL AND MATERIALS TECHNOLOGIES (1990-1994)

AREA 2: DESIGN & MANUFACTURING

MANUFACTURING

- EFFICIENT AND COST-EFFECTIVE MANUFACTURING PROCESSES

- FLEXIBLE SMALL-BATCH PRODUCTION TECHNOLOGIES

- MASS PRODUCTION TECHNOLOGY

- PRECISION ENGINEERING, SPECIALITY MATERIALS

- SHAPING, MACHINING AND ASSEMBLY

- ADAPTATION OF ESTABLISHED CIM SYSTEMS

- NEAR NET SHAPING AND FORMING

BRITE
EURAM

INDUSTRIAL AND MATERIALS
TECHNOLOGIES (1990-1994)

AREA 2: DESIGN & MANUFACTURING

- ALL FORMS OF INDUSTRIAL PRODUCTION ARE PART OF A SYSTEM

- HIGH QUALITY, EASY TO MAINTAIN

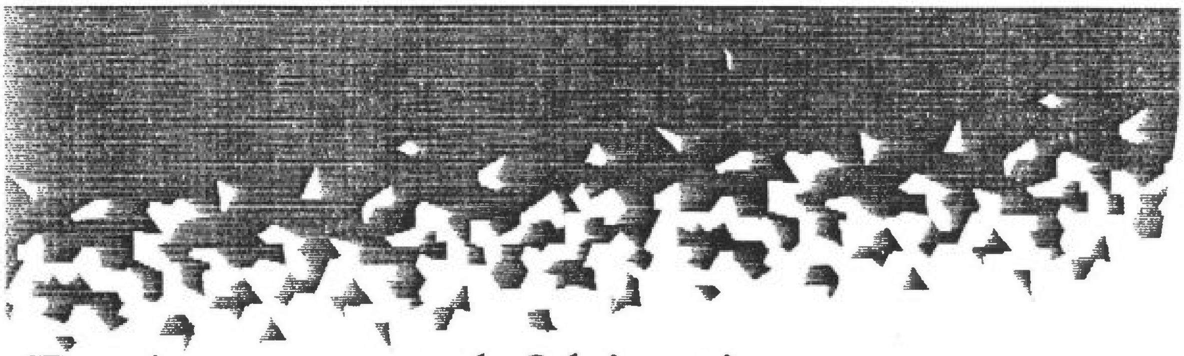
- COORDINATION WITH CIM

- APPLICATION OF ADVANCED ENABLING DISCIPLINES

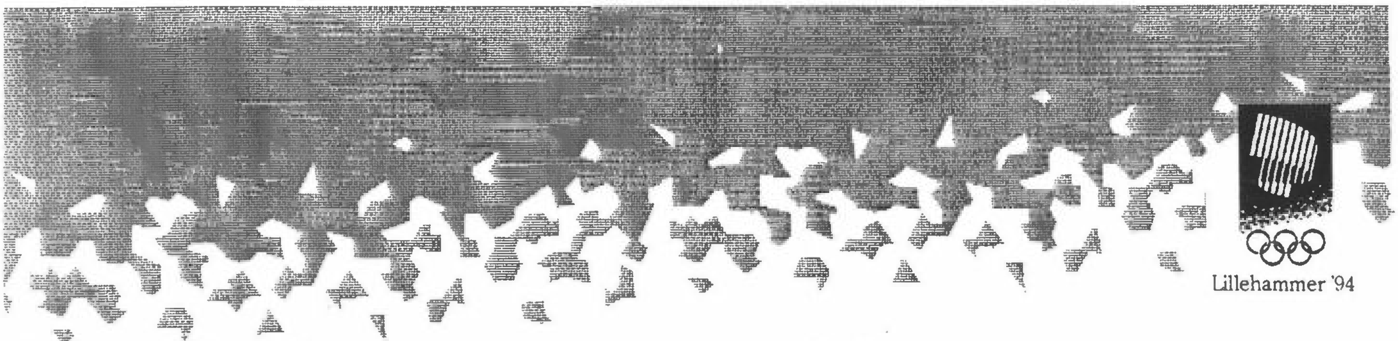
- ACTIVE INVOLVEMENT OF SMEs

APPENDIX 4.7

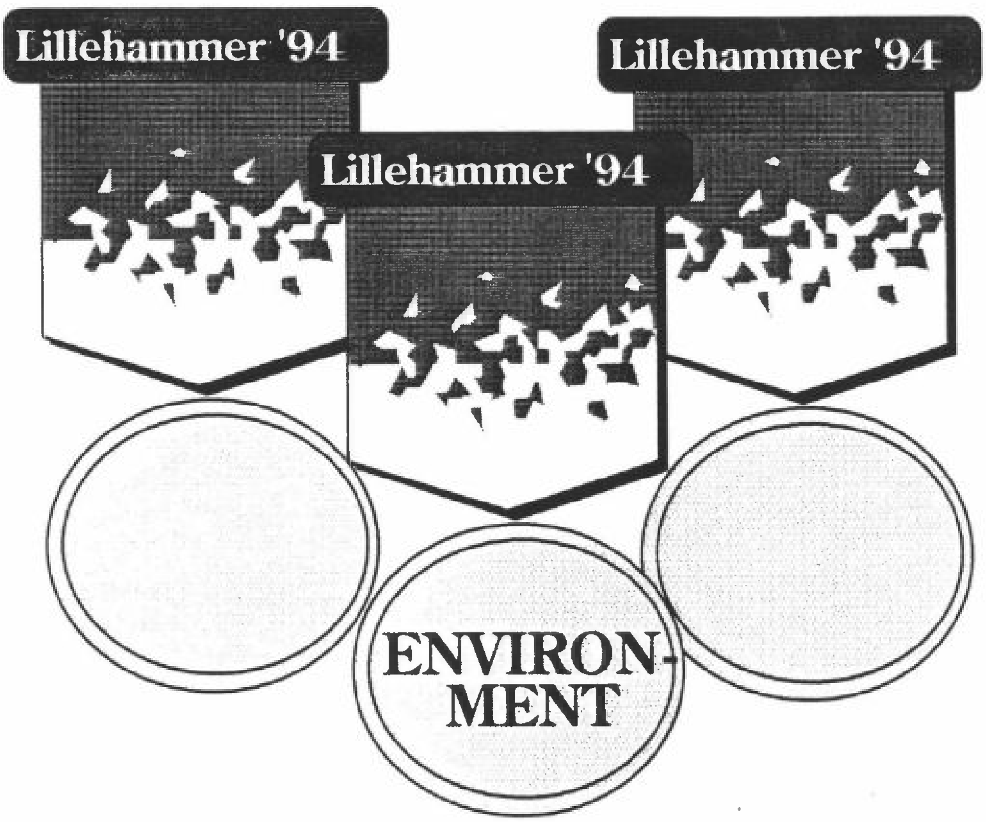
Senior vice-president Osmund Ueland: CEC’Environmental Olympics

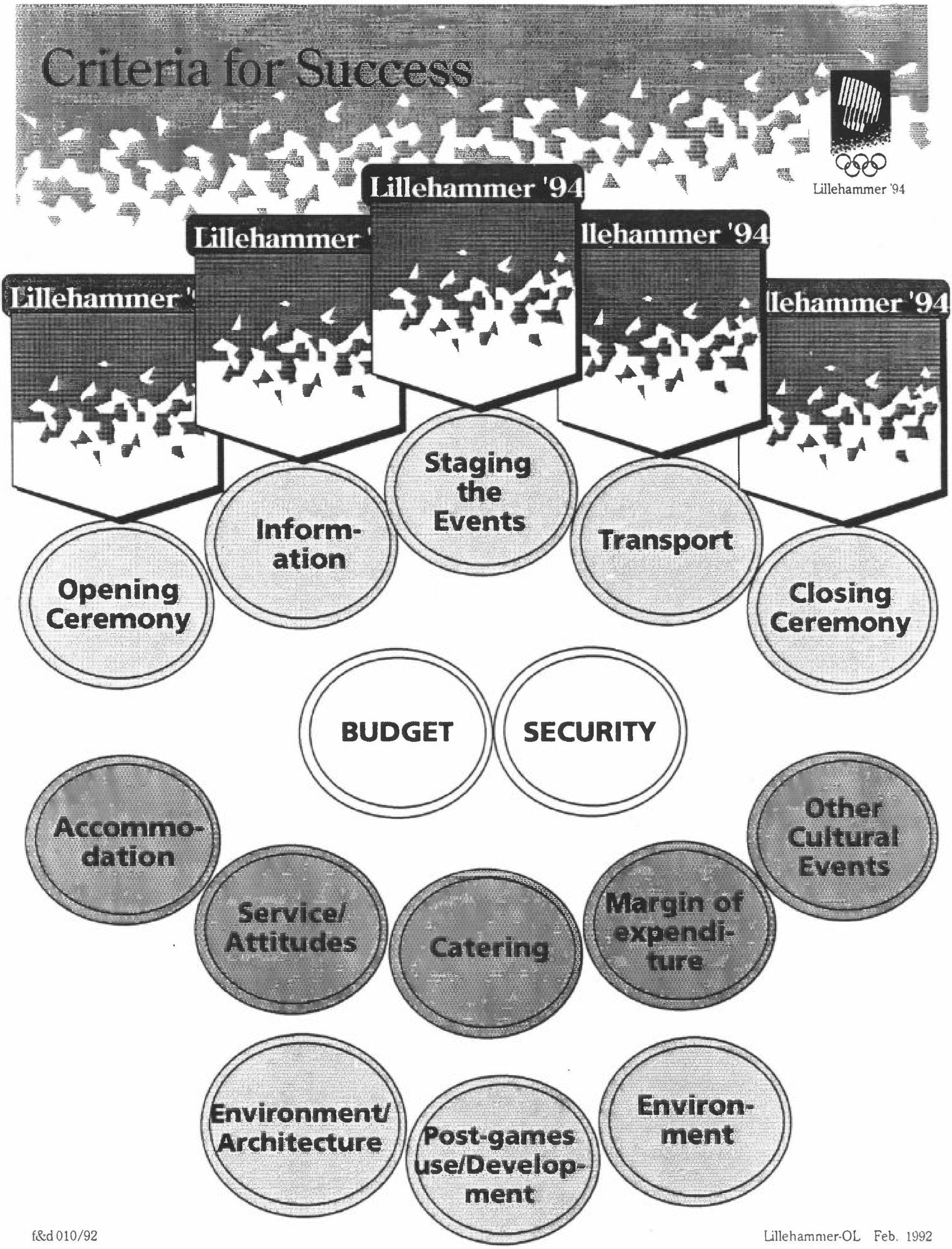


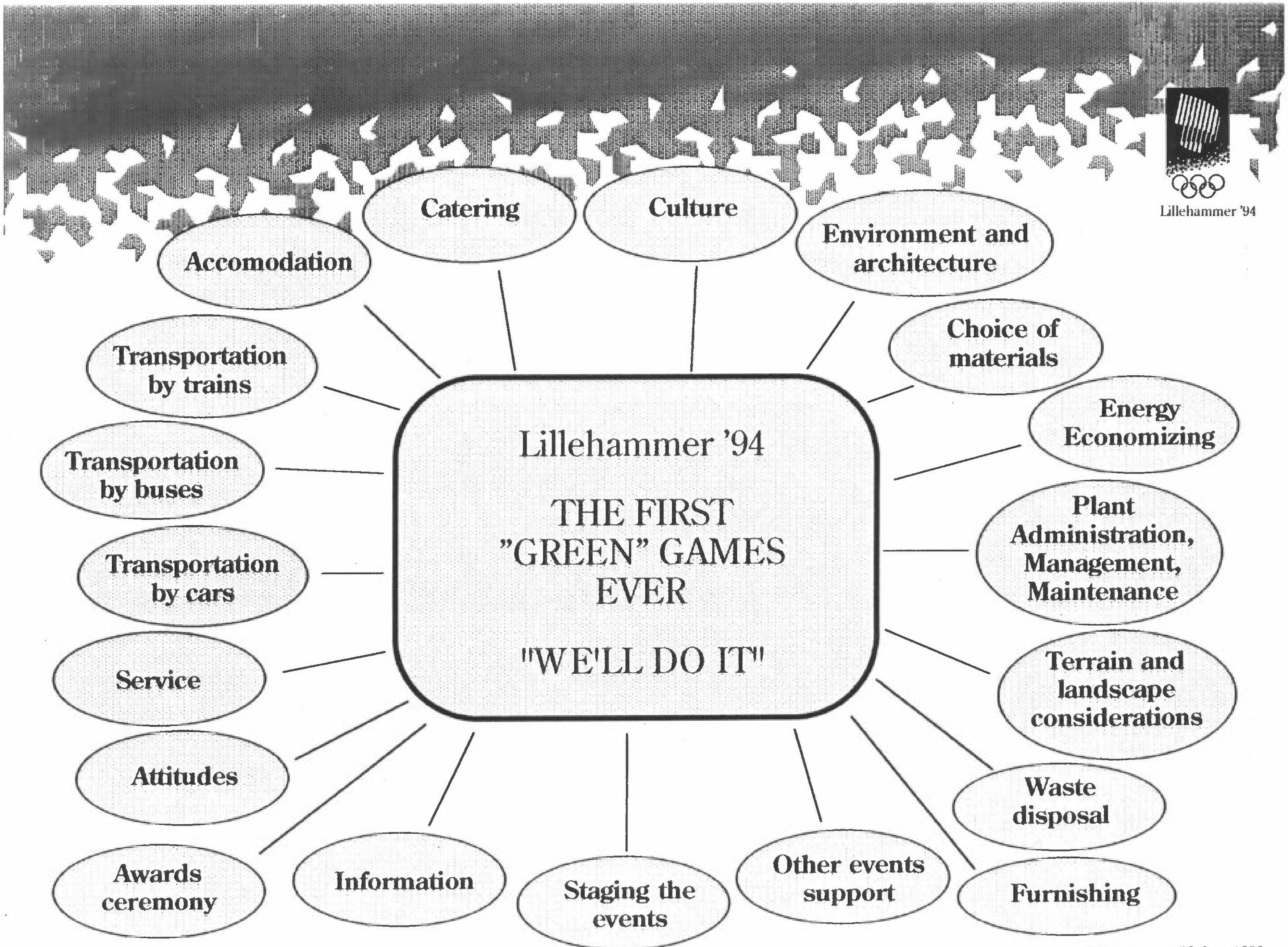
Environmental Objectives for Lillehammer '94



The Environment - one of the major criteria of success for the Winter Games




Criteria for Success
Lillehammer '94
Lillehammer '94
Lillehammer '
Lillehammer '94
Lillehammer '
llehammer '94
llehammer '94
Opening Ceremony
Inform-ation
Staging the Events
Transport
Closing Ceremony
BUDGET
SECURITY
Accommo-dation
Service/ Attitudes
Catering
Margin of expendi-ture
Other Cultural Events
Environment/ Architecture
Post-games use/Develop-ment
Environ-ment



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Lillehammer-OL Jan. 1992

Lillehammer '94

Environmental objectives for the XVII Winter Olympic Games - Lillehammer '94

- Attitudes
- Societal Considerations
- Growth in Business and Industry
- Construction of Facilities
- The Olympic Event

55 gr
71 "
77 "

Lillehammer '94

Environmental Objectives for Lillehammer '94

The XVII Olympic Winter Games at Lillehammer in 1994 will be a sports and cultural event that will receive national and international attention. It offers Norway the opportunity to present itself as a nation that gives priority to the environment and to quality of life. Lillehammer '94 has therefore set itself the following environmental objectives:

- to make people aware of their attitudes in dealing with the environment,
- to be considerate of regional societal considerations,
- to encourage sustainable development and growth in industry and business,
- to build facilities friendly to the environment,
- to assure environmental quality in all facets of the olympic event.

Environmental Objectives cont.

In the total budget-proposal for Lillehammer '94 no funds have been earmarked for environmental objectives as such. It is presupposed that environmental objectives are intrinsic to the attitudes that constitute the basis for preparing and accomplishing the Games. This implies that the environmental objectives for Lillehammer '94 are to be achieved within budget guidelines set for the organiced event, construction, and operation.

Environmental Attitudes

When encouraging awareness in dealing with the environment in accordance with objectives set for Lillehammer '94, it is important:

- that awareness with regard to environmental and safety concerns be developed within the Olympic organisation,
- that the environmental profile of Lillehammer '94 be promoted among the general public, industry, authorities and media,
- that sponsors, contractors and suppliers of merchandise and services be submitted to environmental constraints,
- that environmental-friendly solutions and products be preferred,
- that environmental care be an integral part of the objectives of Lillehammer '94.

Regional Societal Considerations

An event like Lillehammer '94 is a challenge for a small society. It is therefore a challenge:

- to cooperate with local authorities in developing solutions for minimizing the burden of environmental waste,
- to make arrangements for sorting garbage and recycling waste,
- to promote transportation that is friendey to the environment,
- to aim at an adequate use of land areas in accordance with long-range local interests,
- to give special attention to adverse social effects caused by large-scale temporary changes in population figures, demand, etc.

Sustainable Development and Economic Growth

To assure development and growth also after Lillehammer '94, it is important:

- to contribute to the development of quality and competence in business and industry as well as in public affairs by focusing on the environmental aspect,
- to support environmental research and development of products oriented to the future,
- to make available to schools, society, business and industry the environmental experience and knowledge gained through the Olympics,
- to make national and international consumers familiar with solutions and products friendly to the environment,
- to assist in developing regional business and industry through competition and stimulation of initiatives aimed at the future.

Environmental Soundness in Constructing Facilities

The Olympic region will undergo big changes before, during and after Lillehammer '94. It is therefore inportant:

- to pay sustained attention to the cultural values of the region and to existing business/industry,
- to adapt architectural designs to what is regionally distinctive or unique,
- to aim at environmental soundness in mass disposal, landscaping, and the placement of buildings and facilities in the terrain,
- to encourage energy efficiency and recycling of materials,
- to carry out construction of facilities and concurrent traffic and transportation patterns in accordance with national objectives for work environment, health and safety.

Lillehammer '94

Environmental Quality in All Facets of the Olympic Event

To show in practice that environment and quality of life are given priority during the Games, it is important:

- to operate Lillehammer '94 in accordance to national objectives for work environment, health, and safety,
- to promote an effective, safe, and environmental-friendly flow of transportation and traffic,
- to assure good sanitary installations and effective disposal and treatment of waste friendly to the environment,
- to encourage the use of environmentally approved consumer goods and packaging,
- to encourage the use of environmentally approved consumer goods and packaging,
- to establish high-grade safety and preparedness plans to assure that spectators, participants and organisers may enjoy a good atmosphere and quality of life during the Games.

Target Groups

Environmental soundness and quality of life before, during and after Lillehammer '94 can be achieved only in cooperation with:

- spectators and the general public
- suppliers of goods and services
- international business industry
- authorities and public administration
- organisers and participants.

Lillehammer '94

Lillehammer '94 wants to signal

TOGETHER FOR A LIVING EARTH

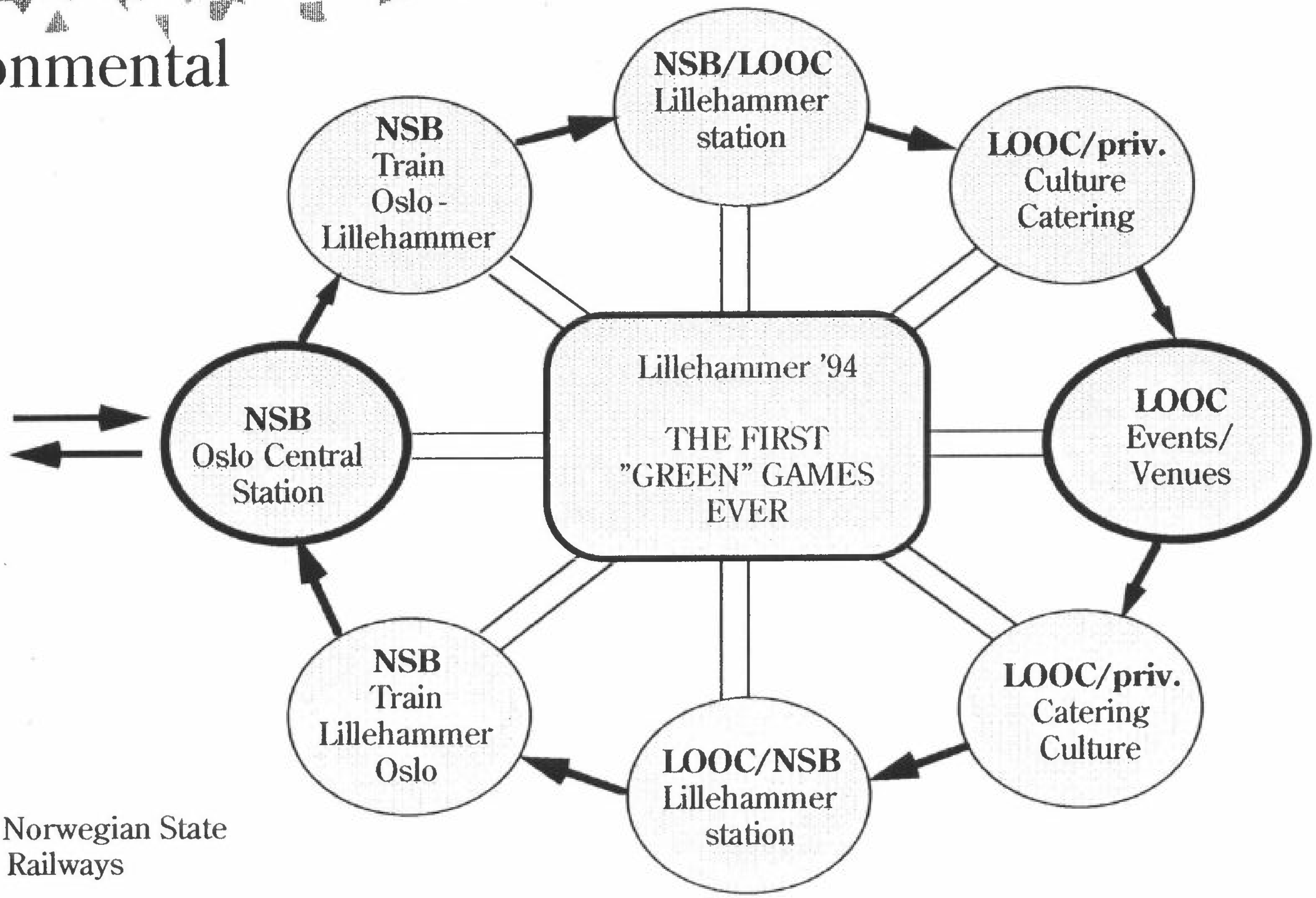
We want, on a local level, to show that we take on the responsibility for the environment!

Aims for the environment - Olympic Games '94

- Attitude
- Social considerations
- Industrial growth
- Development
- Arrangement

A DEVELOPMENT THAT IN THE LONG TERM IS BENEFICIAL FOR BOTH NATURE AND MANKIND

Environmental wheel



NSB = Norwegian State Railways

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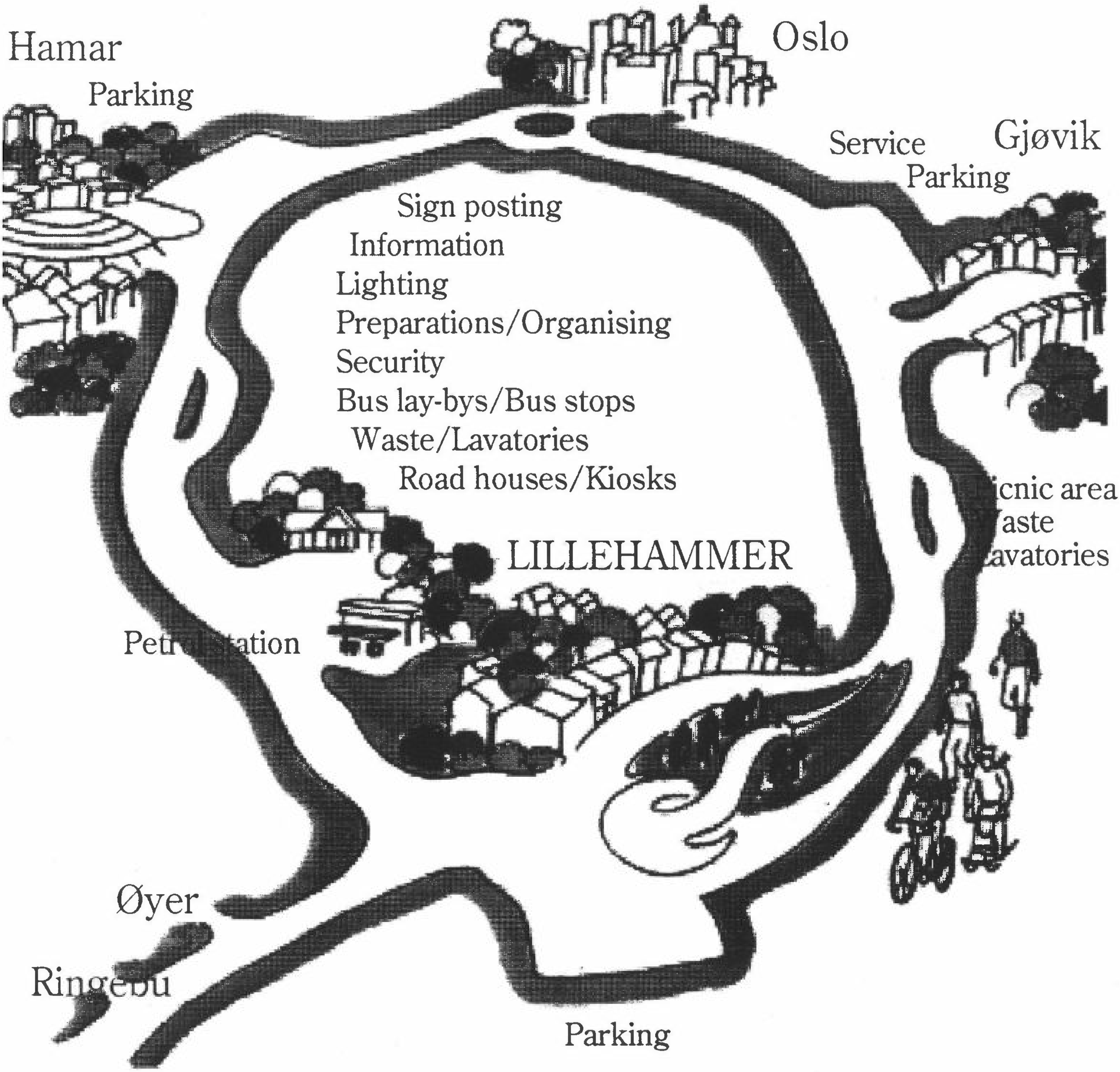
Lillehammer-OL Jan. 1992

Lillehammer '94

The Environmental road

Important factors: Service
Organising Experience



Lillehammer '94

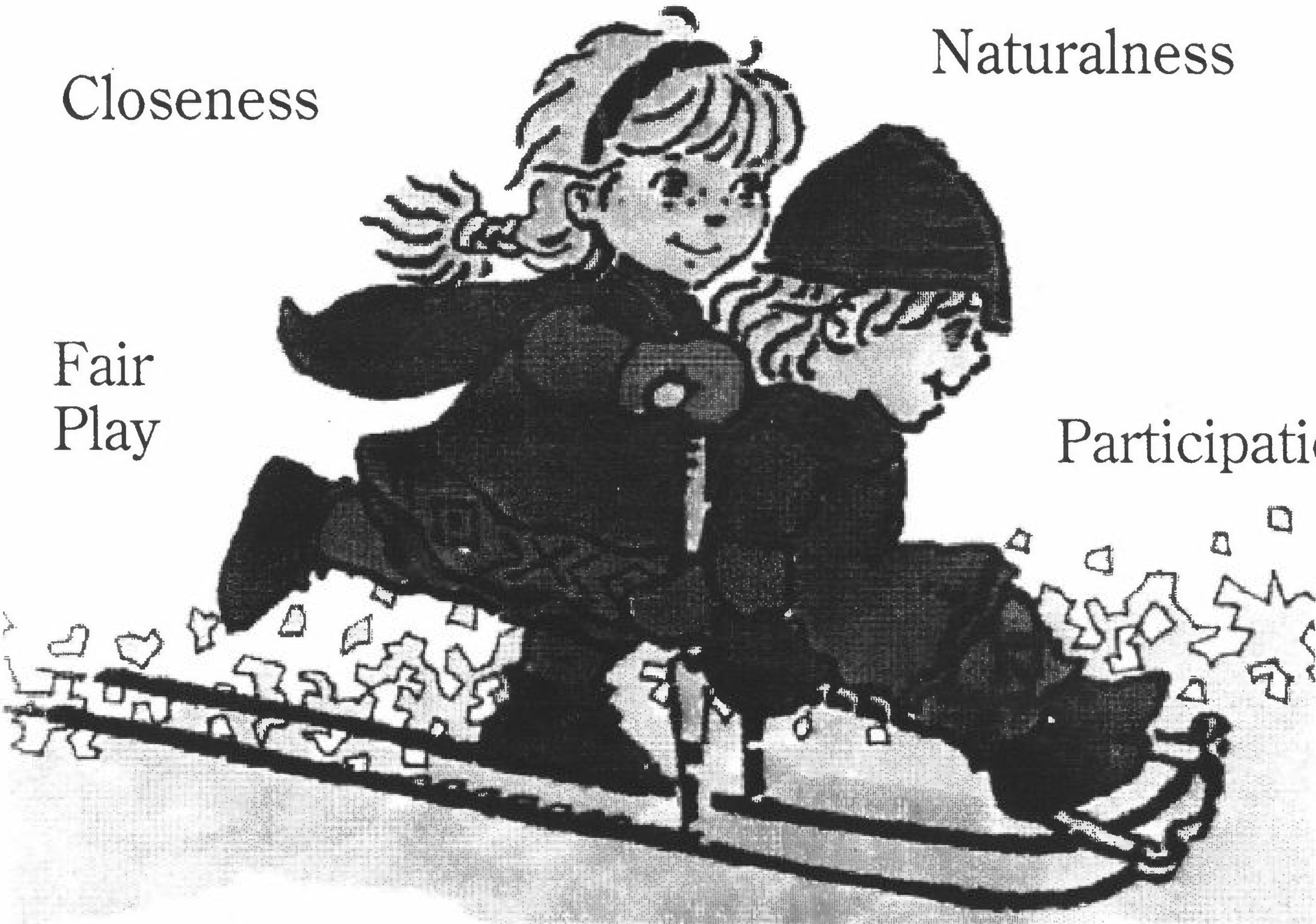
wants to characterize the relationship between people and between mankind and nature by:

Closeness

Naturalness

Fair Play

Participation



Joy

APPENDIX 4.8

Dr. Svein Haagenrud:
EUREKA Lillehammer '94

EUREKA LILLEHAMMER '94

S.E. Haagenrud, Chairman EUROCARE
Norwegian Institute for Air Research
P.O. Box 64, N-2001 Lillestrøm, Norway

Ladies and gentlemen,

Two extraordinary great events take place in Norway in 1993-94:

1) As you all know by now, the Winter Olympics is being arranged here in Lillehammer area in February 1994.

2) Norway is chairing EUREKA from June 1993 till June 1994.

From Director Henrik Andenæs we have just heard that Norway's aim with the Olympics is not just to reach peak performance concerning arrangement and gold medals in sports, but also for the first time in history make "environmental Olympics", that means: let Olympics be a show-case for implementation of environmental politics and actions. Knowing then that Norway's EUREKA chairmanship allows for the following:

1) Norway governs all political initiatives (and can promote its own) that are promoted through the EUREKA system in this period.

2) The chairmanship offers a unique possibility for international promotion of Norway and as well its advanced technological basis.

The various meetings being arranged by Norway in this period, - the five project co-ordinating NPC meetings, the five high-level-group meetings and especially the concluding Ministerial Conference with announcement of new projects in this period, - all offers unique possibilities for international marketing.

From what we heard from yesterday's presentations of EUREKA, its aims and strategies and the environmental project portfolio, the conclusion is obvious: that EUREKA initiative is an enormously well suited vehicle for joint environmental initiatives.

With the converging aims and possibilities of Lillehammer '94 and EUREKA, especially the chairmanship, a preproject was launched by NTNF and the Olympic organization in spring this year, to investigate possible synergistic effects on goal achievements if these two arrangements are linked together in any way. The preproject group has been led by EUROCARE management in Norway. The conclusions of the work, which was reported to the Steering group in mid August and has since then been endorsed, I will now present to you:

It is quite clear that if Norway are to link the Winter Olympics in Lillehammer '94 and the EUREKA chairmanship together, then of course the first and decisive issue is whether the outcome of the environmental R&D projects and actions in this area have substance and is worth promoting. If not, EUREKA better stay out of Olympics and vice versa. So therefore, the project groups first task was to evaluate the potential EUREKA project portfolio for this area. In order to conclude on a project possibility, we have evaluated in the spirit of EUREKA four issues, namely for each project aims, R&D needs, actors in terms of industrial and international partners, and market possibilities.

The result was as follows: At least 11 EUREKA Lillehammer '94 projects could be developed in order to enforce and facilitate the implementation of the "Environmental Olympics". I will briefly mention them, dwelling a bit more in detail with a couple of them.

The two EUROCARE projects CAREBUILD and EUROCARE DATA you know already from the conference exhibition, while the three next projects, of which the rock stadium in Gjøvik is already EUREKA project 686, will be dealt with by Senior vice-president Bjørn Sund, the concept of the energy roof is not yet decided to be used anywhere. The next three projects could be categorized under the EUROENVIRON umbrella, namely

7 waste disposal and reuse
8 clean transport
9 environmental surveillance and information systems.

The transport and traffic of the Olympics constitute an enormous challenge, and success of the Olympics is heavily dependent on a solution to this problem. As you see from this slide, around 100 000 persons will be transported in and out of the Olympic area each day for two weeks. The system development in order to have an environmentally acceptable transport, also in terms of impact on the cultural heritage, is a tremendous challenge in the real EUREKA spirit.

Now concerning project 10, Olympic environmental institute. There is a great interest in having all coming Olympics designed as "environmental Olympics". The possible implementation of this idea will rely to a great extent on success of Lillehammer '94. However, it is already a great interest and the idea behind the Olympic institute is to establish five Olympic institutes, one in each part of the world, and being symbolized by the five Olympic rings. The task of these institutes will be to help the planning and implementation of environmental Olympics whereever it is arranged. In our opinion, and I hope the EUROCARE Board will agree with me here, the EUROCARE concept and its implementation in the Olympics should be a backbone on the activities within these institutes, and it would really mean a golden opportunity for EUREKA and EUROCARE.

Now to the last project, Norwegian Heritage, which has as its main aim for the whole Olympic region

- Education, restoration, maintenance and use of cultural landscape and cultural heritage.

Well, this was a short overview of the potential project portfolio EUREKA Lillehammer '94. So what is the situation per day? As I said, formal decisions have been reached to link together the EUREKA chairmanship and Lillehammer Olympics, and to establish what we could call an umbrella project EUREKA Lillehammer '94, The project management, which is about to be appointed soon, will be employed both by the Olympic organization as the main user, and the NTNF chairmanship organization. The main tasks of this project management will be to help initiating, facilitating and monitoring of the EUREKA Lillehammer '94 project portfolio. It is necessary to underline and emphasize that all these fields already have a firm basis of existing activities and the main task will be to convey supportive measures in EUREKA spirit. Let me also say, on behalf of EUROCARE, that it is easy to see from the indicated project portfolio that this is a golden opportunity for EUROCARE and that EUROCARE will be happy to support this work in all possible ways.

Now, I will conclude this presentation by presenting to you a few viewpoints and possibilities concerning the marketing strategy. The market plan will have three cornerstones.

1) First of all, each project's own target-group-oriented market plan according to EUREKA principles.

2) Market activities linked to Lillehammer '94's market strategy and resources.

3) Market activities linked to the EUREKA system:
   - This needs to be further developed and the possibilities are enormous, but specificly we plan to have one of the high level group meetings on Friday 11 February, the day before the opening of the Olympics.

Further, it has been decided to have the Ministerial Conference concluding Norway's chairmanship in Lillehammer in June 1994, and that the chairmanship and conference should be concluded by a great technology congress. This congress should focus on technology, environment and energy and synergy between environment EUREKA and Olympics.

Ladies and gentlemen, in concluding I hope I have been able to present to you visions and possibilities of an extraordinary character. Some of you might doubt it and even be reluctant, but we think it is possible and that it can be done. However, we realize it is a real ambitious task, but then Olympics has always meant an all out effort of determination, strength, creativity and endurance to reach peak performance, and that is what we are striving for together with the EUREKA team.

Thank you for your attention.

APPENDIX 4.9

Managing director Bjørn Sund: Olympic arenas

STATUS – FACILITIES
LILLEHAMMER '94

February 1992

Lillehammer '94

Lysgårdsbakkene Ski Jumping Arena and Kanthaugen Freestyle Arena.

Lysgårdsbakkene Ski Jumping Arena

Location: Olympic Park, Municipality of Lillehammer.
Events: Special jumping and Nordic Combined.
Completion: Autumn 1992.
Before the Olympics: World Cup Special jumping and Nordic Combined, March 1993.
Spectator capacity: Approx. 50.000.

Kanthaugen Freestyle Arena

Location: Olympic Park, Municipality of Lillehammer.
Events: Moguls.
Completion: 1 January 1993.
Before the Olympics: World Cup, March 1993.
Spectator capacity: Approx. 15.000.

Lillehammer Olympic Bobsleigh and Luge Track, Hunderfossen

Location: Hunderfossen, Municipality of Lillehammer.
Events: All bob and luge events.
Completion: 1 November 1992.
Before the Olympics: World Cup bob February 1993.
World Cup luge February 1993.
Spectator capacity: 10.000.

Håkon Hall

Location: Olympic Park, Municipality of Lillehammer.
Events: Ice hockey.
Completion: 1 January 1993.
Before the Olympics: International tournament for national teams, November 1993.
Spectator capacity: 10.000.

Lillehammer '94

Lillehammer Olympic Alpine Centre, Kvitfjell

Location:	Municipality of Ringebu.
Events:	Downhill Men, Combined Downhill Men, Super G Men and Ladies.
Completion:	December 1991.
Before the Olympics:	European Cup Downhill and Super G 6 - 10 March 1992. World Cup Super G and Downhill, first quarter of 1993.
Spectator capacity:	25.000

Lillehammer Olympic Alpine Centre, Hafjell

Location:	Municipality of Oyer.
Events:	Slalom and Giant Slalom Men and Ladies. Downhill Ladies. Combined Slalom Men and Ladies. Combined Downhill Ladies.
Completion:	Opened 1988. Further development completed 1991.
Before the Olympics:	World Cup Slalom, Giant Slalom and Downhill Ladies, first quarter of 1993.
Spectator capacity:	25.000.

Birkebeineren Ski Stadium

Location:	Olympic Park, Municipality of Lillehammer.
Events:	All cross-country and biathlon events.
Completion:	Autumn 1992.
Before the Olympics:	World Cup cross-country and World Cup biathlon, March 1993.
Spectator capacity:	Cross-country: 27.000. Biathlon: 18.000.

Gjøvik Ice Rink

Location:	Municipality of Gjovik, rock-encased hall.
Events:	Ice hockey.
Completion:	1 August 1993.
Before the Olympics:	Tournament for national teams 4th quarter 1993.
Spectator capacity:	4.800.

Lillehammer '94

Hamar Olympic Stadium

Location: Municipality of Hamar.
Events: Speed Skating, all events.
Completion: 1 December 1992.
Before the Olympics: World Championship February 1993, and World Cup December 1993.
Spectator capacity: 8,000 during the Games. 10,000 after.

Hamar Ice Rink

Location: Municipality of Hamar.
Events: Figure Skating and Short track speed skating.
Completion: 1 December 1992.
Before the Olympics: Junior World Championship, ice hockey at the turn of the year 1992-1993.
Spectator capacity: 6,000.

International Broadcasting Centre, Main Press Centre and Media accommodation

International Broadcasting Centre

Location: Storhove, Municipality of Lillehammer.
Dimensions: 26,300 sq.m.
Completion: September 1993.

Main Press Centre

Location: Close to the International Broadcasting Centre, Municipality of Lillehammer.
Dimensions: 15,000 sq.m.
Completion: 1 September 1993.

Media accommodation

Location: Close to the International Broadcasting Centre and the Main Press Centre.
Capacity: A total of 6,600 beds.
Completion: At the end of 1993.

Lillehammer 94

The cultural centre Banken

Location: Centre of Lillehammer.
Dimensions: 2.193 sq.m.
Used for: Dramatic art and music. Reception rooms for the LOOC during the Olympics.
Completion: Opened on 31 December 1991.

The Sandvig Collection, Maihaugen

Location: Municipality of Lillehammer.
Dimensions: New building: 5.800 sq.m. Concert and theatre hall with 730 seats.
Used for: The official opening ceremony for the IOC session. Museum exhibitions, concerts and theatre.
Completion: At the turn of the year 1992-1993.

Lillehammer Art Museum

Location: Stortorget, Lillehammer.
Dimensions: Approx. 3.100 sq.m.
Used for: Exhibitions of pictorial art during the Games. After the Games the building will house Lillehammer's abundant art collection.
Completion: 1 October 1992.

Olympic Village

Location: Skårsetlia, Municipality of Lillehammer.
Completion: December 1993.
Capacity: Approx. 3 000 beds. The remaining athletes will be accommodated in Hamar.

Aker Hospital - doping laboratory

Location: Oslo.
Used for: Doping controls.
Completion: In operation since December 1991. Approved by the IOC.

APPENDIX 4.10

Dr.techn. Kristoffer Apeland:
Project EU 446 EUROCARE CAREBUILD

EU 446 E U R O C A R E C A R E B U I L D

by

professor, dr.techn. Kristoffer Apeland

1.0 BACKGROUND

Our materials grow old and deteriorate through the ravages of time.
Our cultural heritage consists mainly of our built environment in wood, stone and masonry. Our monuments are primarily made of stone or metal (bronze).
In other countries, e.g. the Mediterranean and Central Europe, the cultural heritage primarily consists of buildings and monuments in stone, masonry and metal.

Wooden buildings have normally been preserved by periodic maintenance, whereas stone edifices in general have been left to a natural deterioration in the respective environment. In view of the robustness of the stone material the degradation process has been very slow. In the last decades, however, an accelerated degradation of stone has started, see Fig. 1.
The reason for this increased rate is primarily a combination of air pollution with the natural climatological factors rain, frost and wind.

It is well known that for some time extensive endeavours have been directed towards the development of protection measures in order to extend the service life of the constructions.

Extension of service life is of general importance for our whole built environment. For our cultural heritage, however, the question of service life has an extra dimension, since replacement of parts of the object is unwanted. Conservation is to a great extent connected with the age and the originality of the object.
This has brought up the topic of protection buildings for some of our cultural heritage. As an example a proposal about a protecting roof over the Parthenon on Acropolis has been presented, see Fig. 2.

2.0 THE RUIN OF THE ANCIENT CATHEDRAL AT HAMAR

The ancient cathedral at Hamar, which was constructed in lime stone with a timber roof structure, dates back to early 13th century. In 1567, during the Nordic seven year war, the Church was set afire by the Swedes.
In the 17th century the tower fell down, and after that stone was taken from the ruin and used for other building purposes in the region.

Over the years the ruin has been under a constant degradation process, primarily frost bursting, Fig. 3A.
In the mid-1980s the Norwegian Central Office of Historical Monuments and Sites decided that unless the ruin was protected, it would soon be lost.
An architectural competition was arranged to find a suitable design for an envelope building to protect the ruin.
The winning scheme, by architects Lund and Slaatto is now under detail design, see Fig. 3B.

3. EU 446 EUROCARE CAREBUILD

3.1 Establishment of the research program

In the period after the architectural competition, when we were discussing how to proceed with the project, I realized that a number of the problems which we encountered, would be similar for other projects. At the same time the Eurocare Program was introduced in Norway, and it seemed very natural to propose a Eurocare research program with the objective of performing research and development for protection buildings for ruins, monuments etc, using the Hamar building as the primary case.

We did propose such a project, and were met with support from the Norwegian Council for Scientific and Industrial Research (NTNF) granting a preliminary support with the purpose of the development of a detailed program. This has been done, and a rather large group of participants has been established, see Fig. 4.

It should be stressed in this connection that since the Eurocare program is a subprogram of the Eureka program, which is an industrial research program, a project must have a commercial idea or concept.
In our case we have decided to produce a technology package, which may be purchased to any custodian having an object, which is degrading, and for which measures must be taken in order to save the object for future generations.

3.2 Research topics

3.2.1 Research or development

What is research, what is development, what is design evaluation in a project of this kind. Are there any new findings to be expected in the project.
All of these questions have been raised by ourselves and others in connection with the establishment of the project.

As an example let me start with a topic that has come up early in the project: What will be the consequences for the archeological layers that normally will be surrounding a ruin, when we build a protective building over the ruin and therefore also cover the archeological layers.
If no measures are taken, the humidity of the archeological layers will be changed. Does the change matter at all, is it disastrous, should the normal condition be sustained. There is no immediate answer to these questions.

My point is to show that there are important research activities connected with the Carebuild project.

3.2.2 The service life concept

Eternal preservation is the aim of a conservator's work in connection with our cultural heritage. However, the problem of service life of an object is equally relevant for a cultural heritage object, as it is for any other object of our built environment. Extensions of service life will always be a question of maintenance and other preserving costs.

For a protection building project both the service life of the protected object, and the service life of the new building must be considered.

To this end, we have found it adequate to apply the methodology for Prediction of Service Life developed by RILEM/CIB, see Fig. 5.

How far we may be able to go in applying this methodology for all of the problems that are at hand, remains to be proved. However, it is our intention to be able to predict the service life of the ruin at Hamar for specified conditions, and as a consequence secure that these conditions can be met by the protection building.

In general, however, the answer to the question of what to do for the preservation of a particular object may range from:

i) No actions are taken, i.e. the object will degrade over time in its environment

to

ii) A permanent, well conditioned protection building should be built if the object shall be saved for future generations.

3.3 Extent of the project

The development of the protection building at Hamar will be the basic case of the research project.

However, we hope that when the project is brought further, we may cooperate with another country, for instance Italy, where the effects of air pollution may be much stronger than they are at Hamar, and in Norway in general.

One of the aims of the research project is to develop principles and systems for architectural solutions for protection buildings.

One principle, that was represented in the second prize winner in the architectural competition for the Hamar building, is a reconstruction of the old building form by a glass building, see Fig. 6 and 7.

Another example is a prospect for a protective shell for the Column of Marcus Aurelius in Rome, see Fig. 8 and 9.

A project, worthy of mentioning, is a museum that has been built over ruins of three Roman houses at Chur, Switzerland, designed by Peter Zumthor, see Fig. 10.

4.0 CONCLUSION

Preservation of our cultural heritage in the form of ruins, monuments and historical buildings will require extensive contributions in the future, both scientifically as well as financially.

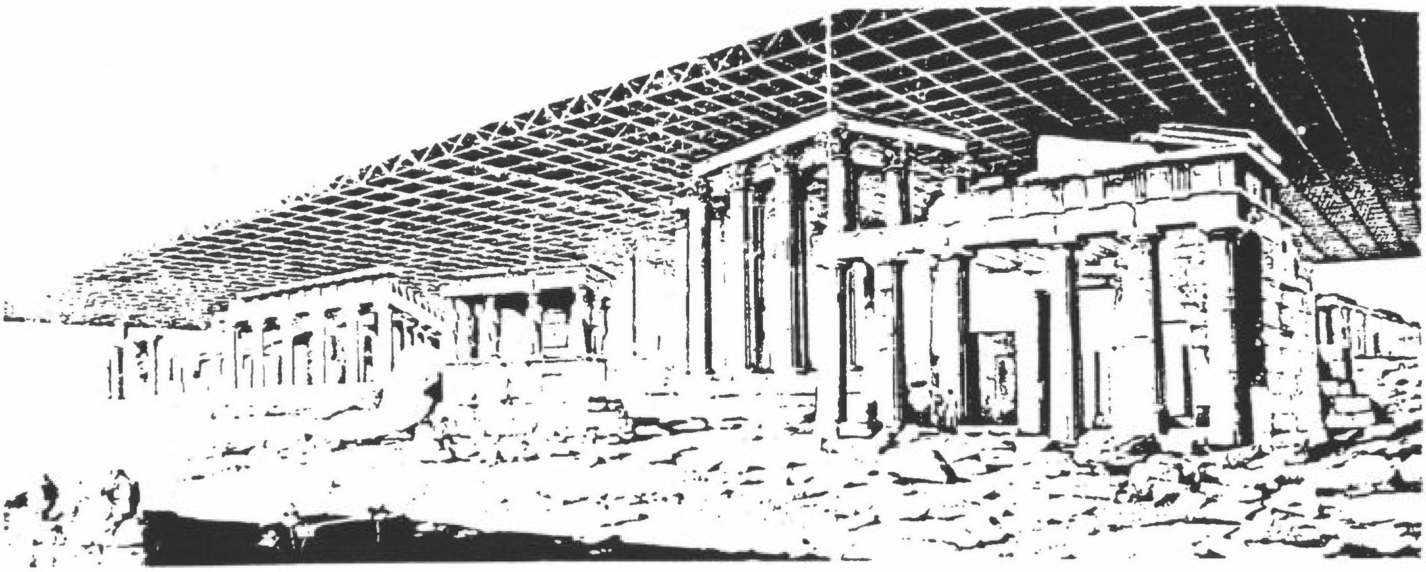
If no such efforts are made, a considerable part of our cultural heritage may be lost altogether over a fairly short time.

St. Marcus Basilika i Venezia
Bygget 1530

1930

1970

Fig. 1



Förslag till skyddstak över Akropolis, Aten, Grekland.

Videografisk bild. (Universitetet i Turin.)

Fig. 2

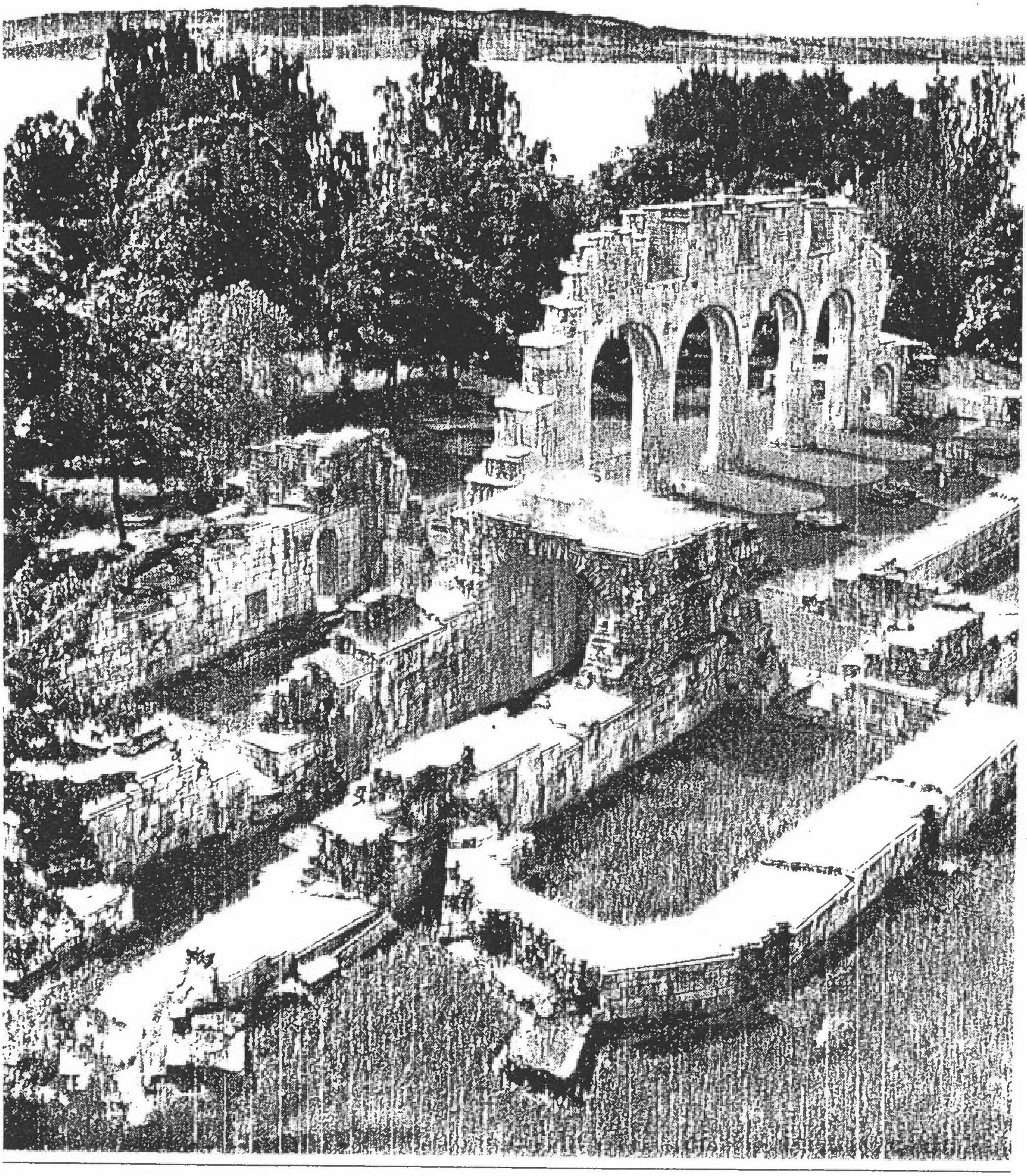


Fig. 3 A

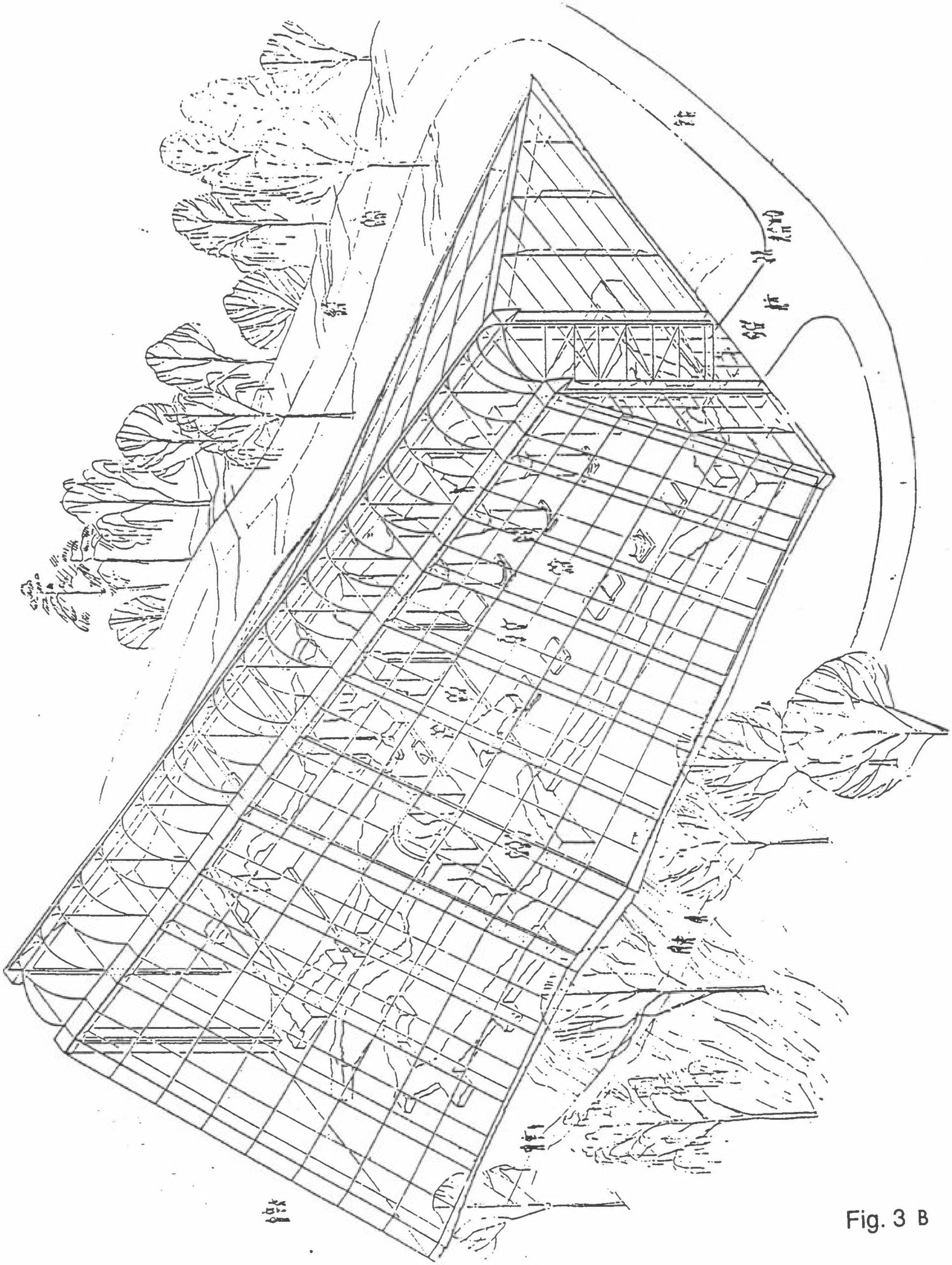
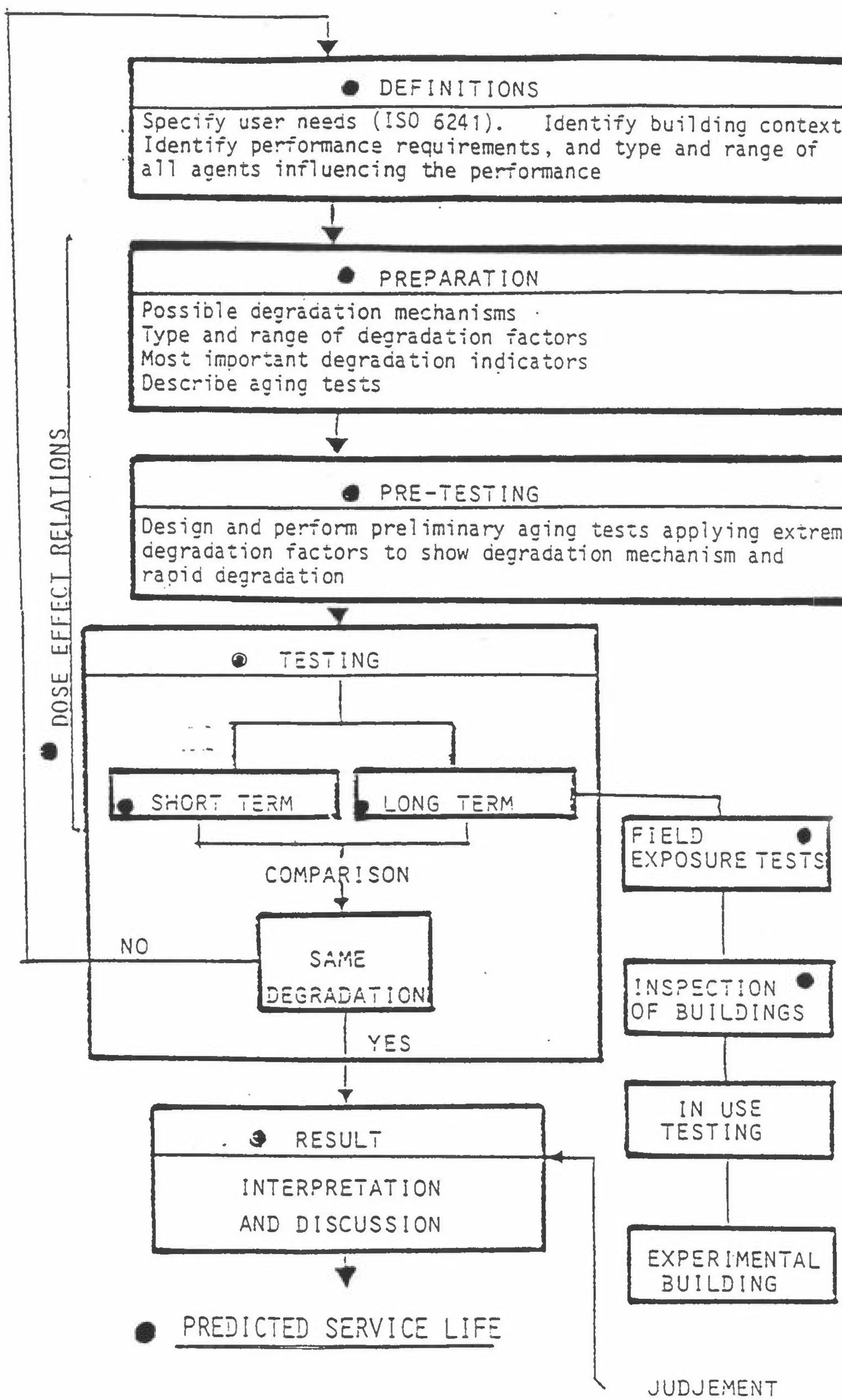


Fig. 3 B

Project Profile

EU 446	
Title:	EUROCARE-CAREBUILD Envelope Buildings for historic buildings, monuments, stone ruins, etc.
Announced at:	Rome 1990
Participants:	Norway: Riksantikvaren / Dr. techn. Kristoffer Apeland / Hydro Aluminium A/S / NILU / Lund og Slatto Arkitekter A/S / Norsk Viftefabrikk A/S / Scan-Gobain Norge A/S Sweden: Lund Institute of Technology
Main contact:	Professor Kristoffer Apeland Tel. +47 2 46 50 80
Estimated cost:	1 MECU
Time scale:	4 years

Fig. 4



The Service Life Prediction Methodology

Fig. 5

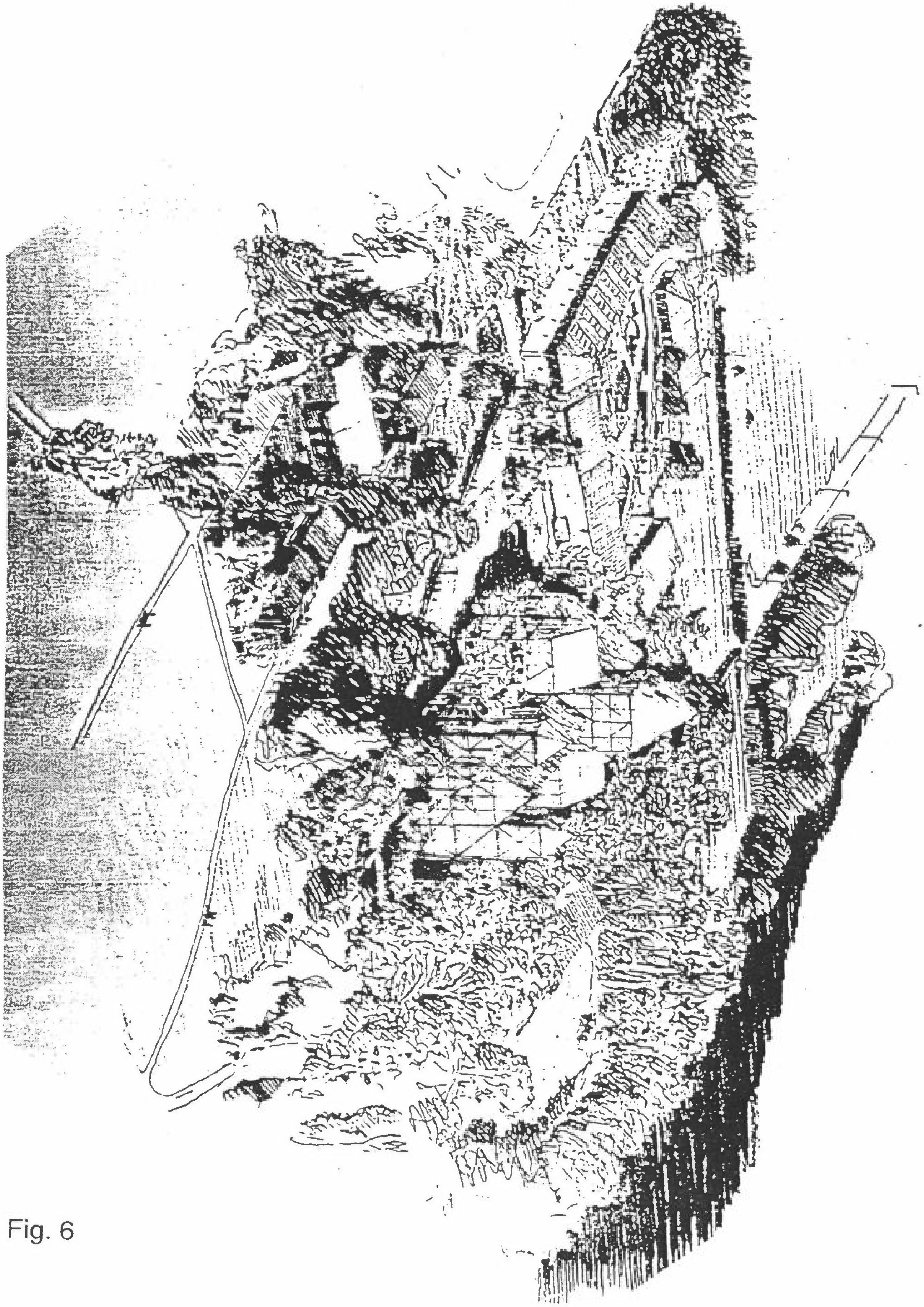


Fig. 6

aksonometrisk perspektiv

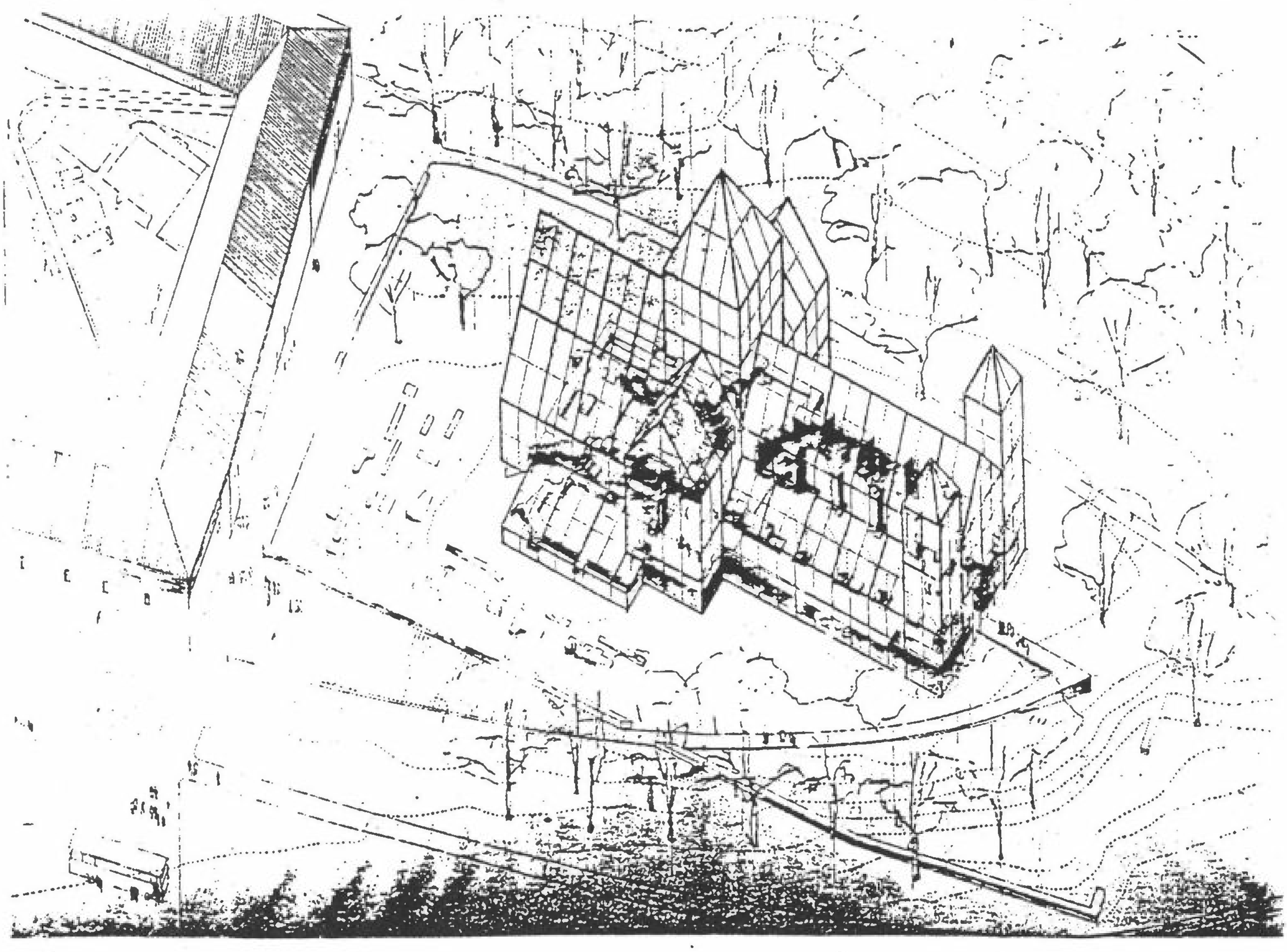


Fig. 7

In this issue

A mixed number such as this one includes by definition very varied contributions. However, the questions that museum professionals are asking themselves today and the achievements that crown their aspirations come together in such a way as to allow us to perceive a unity of intent within the diversity.

One of the criteria that guided the choice of articles, which were in certain cases prepared some time ago and in others deal with new programmes yet to be implemented, was the following: The important and difficult task for museums of ensuring that the cultural heritage is presented in such a way as to throw light on the way we live today.

This number therefore begins with a project that is somewhat daring in both its architectural and its conservation aspects. Italy has not only been 'blessed with the gift of beauty' but also with the spirit of invention as the article reveals. 'The Museum as a Medium of Cross-cultural Communication' takes us inside a museum that illustrates past and present life in the Far East. Moving from one article to another we discover many different subjects: the conservation of water-logged wood, itineraries for visitors to a theatrical museum, interpreting works of art, the concept and nature of museology, computer techniques in the world of art and inventorying cultural property. The variety of topics bears witness to the vitality that abounds in museums all over the world.

In 1987 *Museum* will address specific themes: permanent exhibitions, training for museologists and the role of museums in developing and safeguarding arts and crafts.

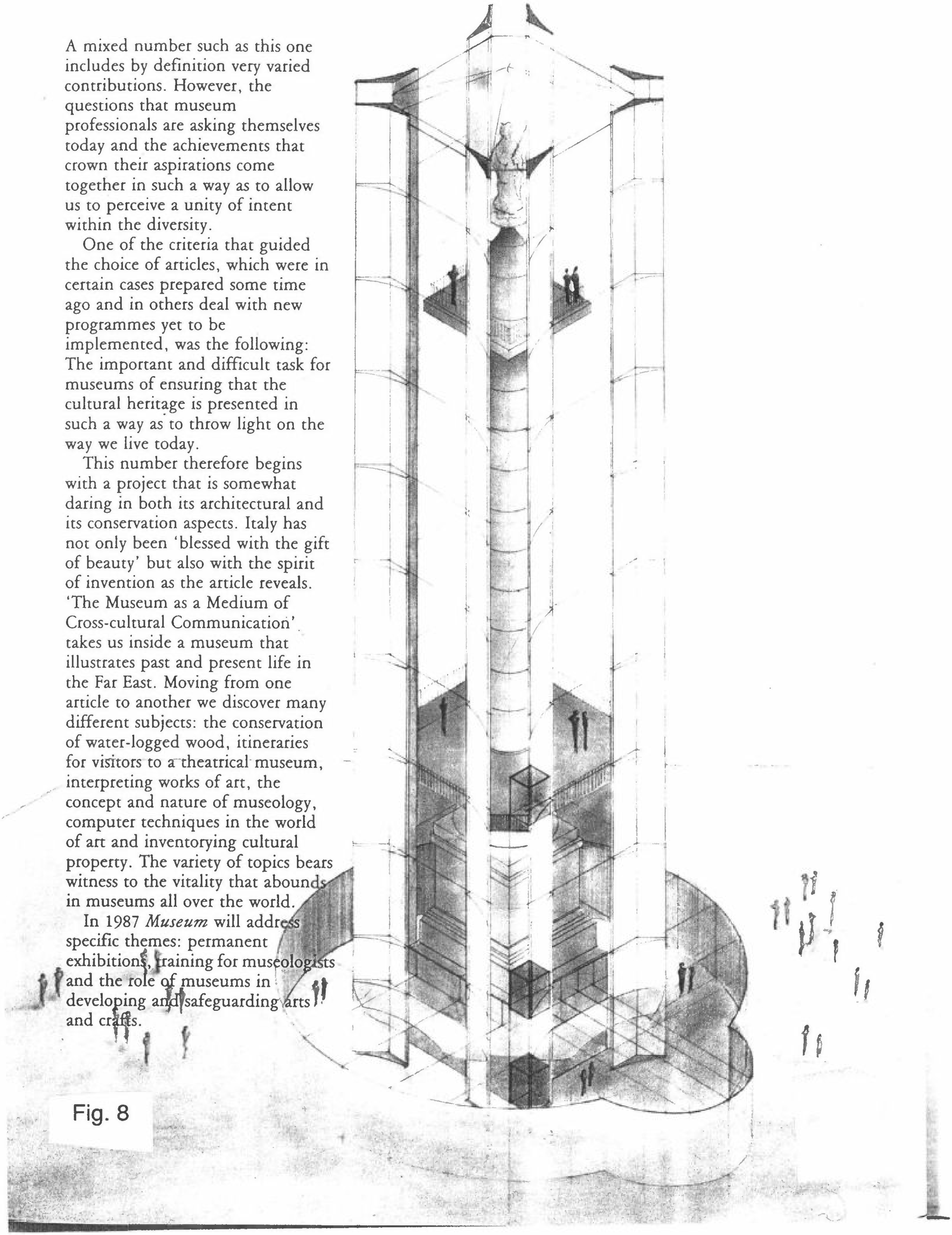
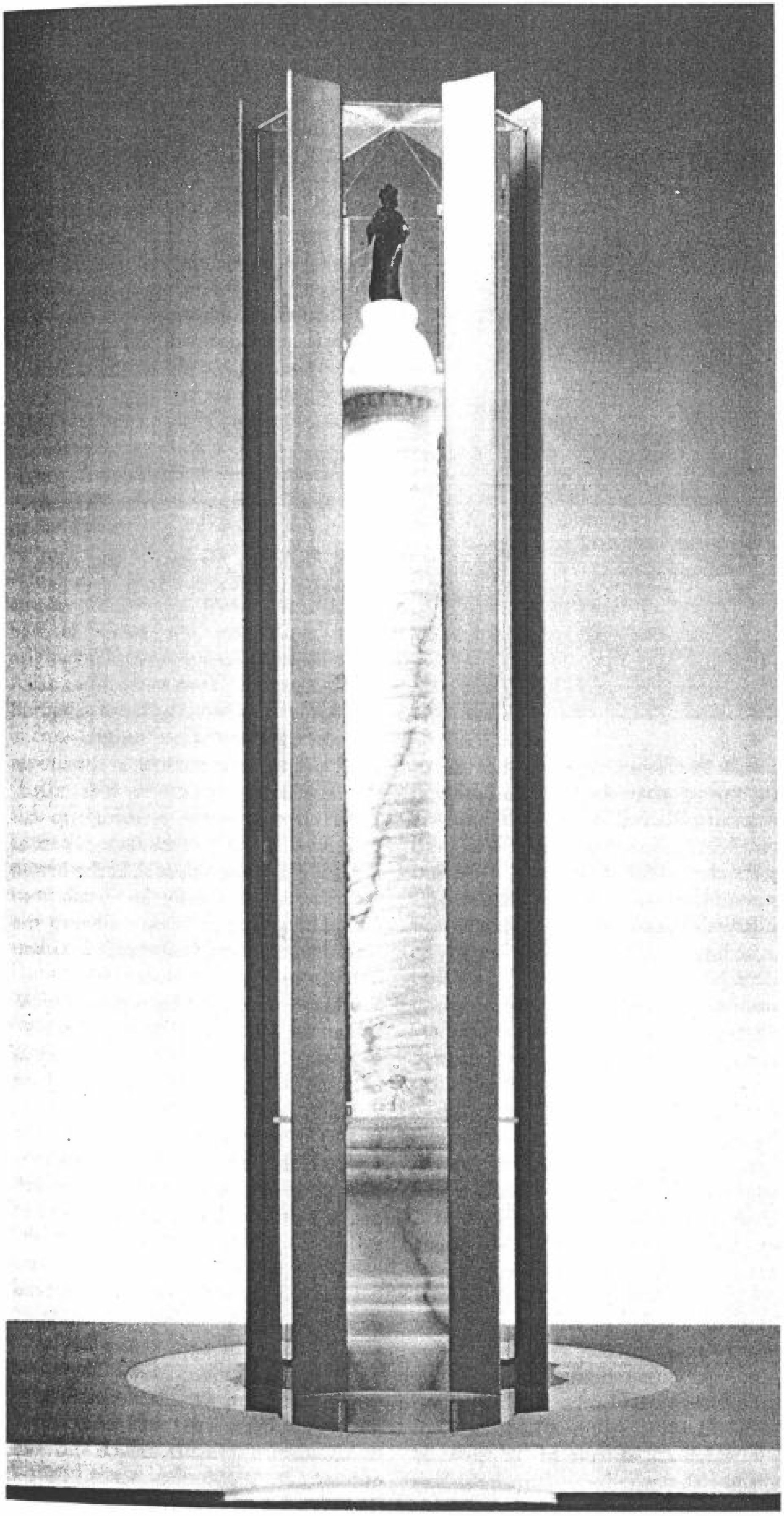


Fig. 8

4, 5, 6
Model of the protective shell designed for the Column of Marcus Aurelius.



6

Fig. 9

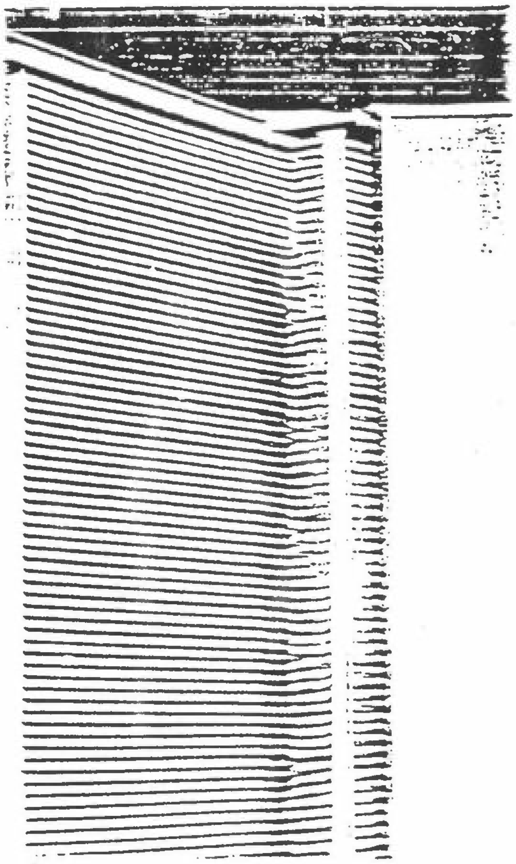
the general installations that are of fundamental importance for the smooth operation of the whole construction; it will in fact be necessary to monitor the air-conditioning inside the shell to ensure that the air entering it is cleansed of the harmful gases present in the atmosphere, and also to monitor temperature and moisture content, which must be maintained at levels compatible with optimum conservation requirements.

The study also provided for the equipment necessary for the cleaning, inside and outside, of the anti-reflecting panes of glass forming the walls of the new structure.

The guiding principle behind the project has been the desire to spread knowledge of the works of the past by bringing them into a cultural circuit that can be appreciated in the present. In the space obtained by excavating around the base of the column, it is planned to accommodate several museum rooms displaying the documentary material on the history of the column and drawing attention to its artistic merits. The public will be able to enter the museum directly from the Piazza. Each detail of the figures on the reliefs is, moreover, to be photographed by a television camera, which will follow the spiral, turn by turn, all the way up the shaft, and the long story, unrolled to form a continuous strip, will be legible as though told in writing.

With the reliefs thus recorded it will be possible, with the aid of a system of monitors, to follow the progress of the restoration work or of some of its specific phases. It will also be possible, by means of computerized systems, to monitor the restoration treatment. A digital system of computerization will enable the photographs stored to be retrieved and shown on television screens to visitors.

[*Translated from Italian*]



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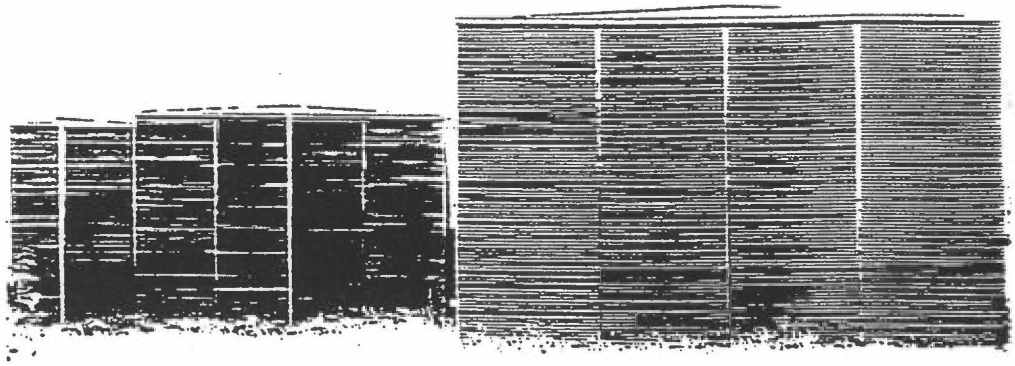

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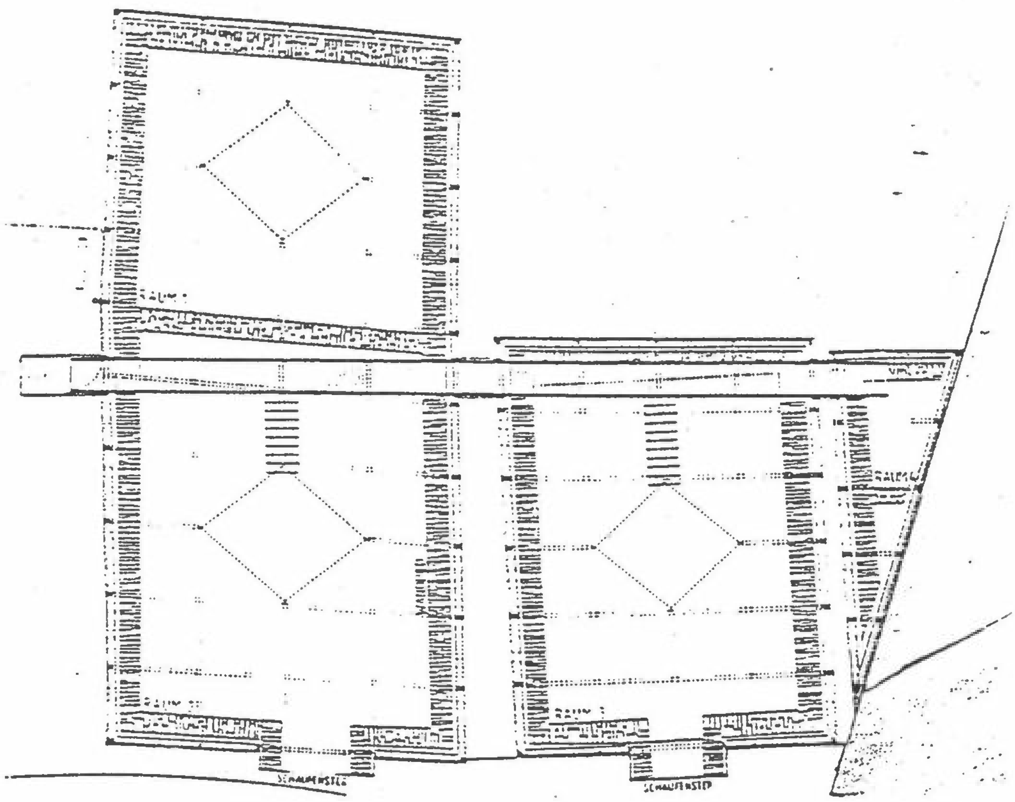

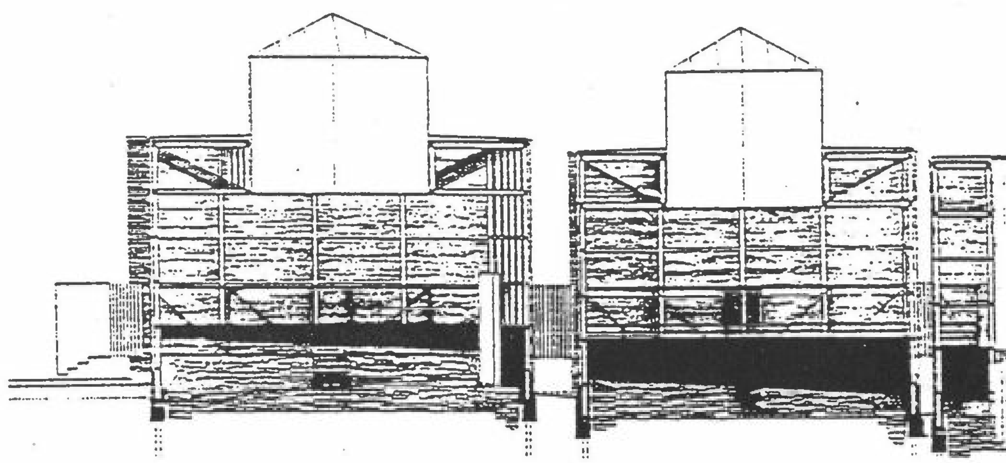

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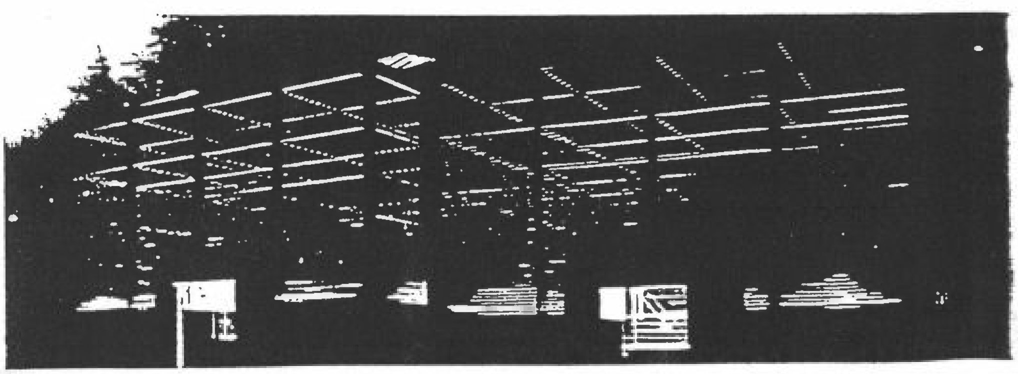


11

8
Close-up where corner of shelter meets acute-angled end of triangular shelter over incompletely excavated house shows the poetry of very direct yet delicate construction
9
A set of timber sheds almost like tea-cosies
10
A raised walkway that connects the sheds like a kebab skewer
11

Fig. 10

APPENDIX 4.11

Arch. Anders Tjønneland:
Architectural process of the envelop building

EUREKA-SEMINAR, HAMAR/LILLEHAMMER - 91
Kåseri med dias/overhead på Hedmarksmuseet - 03.10.91

This project is an example of fighting the Environmental Degradition of Historic buildings by its most extreme, namely by errecting an envelope building for protection of the historic object.

In 1987 our firm, Lund & Slaatto, won the architectural competition with a proposal for an envelope building for the remains of the Hamar Cathedral. The name of the entry was "Poetry of Reason". As an important part of the Eurocare project No 446, "CAREBUILD", the construction of the envelope building is planned to take place in 1992-93.

In addition to solving the very functional problems of establishing acceptable physical conditions for the ruin, the main features of the architectural idea is to create:

1. An economic volume enclosing and surrounding the ruin which has a very asymmetrical shape

2. To minimise the necessary precautions to establish the foundations

3. To minimise the structure by using strong lightweight materials

4. To find the optimal ballance between the wanted transparency and the need for climate control by eventually using glass sheets with reflective surface layer

5. To give a symbolic expression of the historic dimension and time dimension by twisting the outer walls from the position of the presumed historic vault in the former cathedral to the coordinates of the surrounding now-beeing buildings.

(1) The enclosed photo of the modell illustrates how the varying angles of the longitudinal walls in the vertical section fits the asymmetrical shape of the ruin

(2) The main girder beam in the vault position is carried only by two columns in front of the main entrance and two columns at the back side of the former cathedral. To help supporting the main beam there are two stiff arches near the middle and corresponding with the former traverse aisle of the ruin. With this construction there is no need for supports and foundations inside the ruin. This makes the necessary archeological excavations ahead of the construction work a little easier.

The excavation work by the foundations started this summer, and will be completed during the summer '92.

(3.1) The main construction was originally planned to be painted steel with aluminium glass profiles. At the moment we are also working with alternative solutions using aluminium also in the carrying parts. The fasination about the aluminium alternative is that natural aluminium without anodizing or paint will last for years to come with no need for maintenance.

(3.2) At the moment we are studying two alternative ways of supporting the glass skin. 1: With accentuated primary beams corresponding with dimensions in the former cathedral's constructive structure. 2: More neutral alternative with diagonal beams.

(4) The outer skin is planned to solely consist of glass material. Until recently we were working on solutions using rectangular twisted panes.

At the moment we are exploring the possibilities by using triangular panes with flat surface which added together in facettes forms the twisted main form of the surface.

To achieve maximum transparency we intend to use large panes in large formats and also want the very glass material to have maximum transparency with practically no colour and no reflexions. This of course opposes the need for climate control in the outer skin, and our task is to find a reasonable point of balance between transparency and reflections.

(5) The enclosed photo of the modell illustrates the attempt to symbolize the time dimension with the twisted and asymmetric main shape of the envelope building.

The main shape secondly serves the purpose of liberating the construction from association to any existing type of building for a special purpose. The construction creates its own identity, namely to serve as the Envelope Building for the Hamar Cathedral.

03.10.91
LUND & SLAATTO ARKITEKTER AS

Anders Tjønneland

APPENDIX 4.12

Siv.ing. Harald Ibenholt:
The history of Hamar cathedral

THE HISTORY OF HAMAR CATHEDRAL

1152-1300

The history of the cathedral begins the 21. of July 1152, when the english cardinal Nicolaus Brekspear arrived Norway. His task was to organize the church in Norway. Unntill then the Norwegian church had been a province under Lund in Sweden.

The cardinal's visit lead to the position of an archbishop in Trondheim and the foundation of the diocese in Hamar. The diocese needed a cathedral. The building work has probably started few years after the cardinal's visit and we believe it continued till around 1200.

The cathedral was built in a local limestone. The construction is typical for medieval churches. The walls are made of two skins of dresses stones with a lime mortar and rubble filling between.

It was a romanesque basilika. With aisles on both sides of a central nave, separated by archades. The choir with a round apsis. Two towers in the western front and a central tower. The roof made of timber. From the beginning only the lower aisles and the chapels in the choir had vaults in masonry.

1300-1537

After approximately 100 years, around 1300, the choir was rebuilt. The round apsis was teared down and the choir prolonged and built after gothic style. The sentral tower was reinforced and made higher. Since the choir now was vaulted buttresses were built round the choir on the outside. The nave was probably vaulted too, in masonry of red sandstone.

1537-1584

By the reformation in 1537 the diocese in Hamar was placed under Oslo, and the church lost its function. Money and workers for maintenance disappeared. The cathedral decayed. The king in Denmark and the local authorities in Oslo wrote letters to each other for 30 years where they discussed whether the church should be teared down or not.

The roof and all other wooden constructions burned down in 1567. But the church could still be saved. Some more letters were written. Works was done: they almost succeed to give the church a new roof. But then, in 1584 the correspondance stops and so does the work.

The cathedral was overgiven, 400 years ago.

1584-1850

A local cronicle tells us:
After 100 years of crumbling, the western front falls down in 1670 and the large central tower collapses 20 years later.

Beside exposure of the weather, the church building suffered from stone robbing. It was used as a stone quarry. Large amounts of stone were taken from the church and used as building material in at least five other churches in the district. The stones that were too irregular and material from the core were burnt for lime production.

1850-1988

During the 19. century there is a growing interest to take care of the ruin and to clear up and excavate the area.

In the 1880's some work is beeing done. The weakest part is reinforced and new stones are cut to protect the core round the window openings in the upper part of the southern wall.

The conservation works continues in our century. Craks in the stones and joints between them are filled. In the beginning with lime mortar, but gradually cement is used for this purpose.

In the end of the 1930's the top of the walls are covered with cement, new stones are added to weaker part of the ruin. The whole ruin is sprayed with hot linseed oil to reduce the penetration of water.

In spite of the maintenance the last decades the condition becomes worse. The water is sucked in in all cracks in the stones and joints and freezes.

In 1985 the columns in the southern wall are so damaged that is was a threat to the stability of the wall. A temporary green tent was put up to protect it from rain and wind.

1988

The central office of historic monuments and sites and this museum invites norwegian architects in a competition to design an envelope building to protect the ruin.

Harald Ibenholt

APPENDIX 5

The workshops

APPENDIX 5.1

Mr. Paul Caluwaerts,
Mr. Kim Ruberg, and
Mr. Markku Warras

What is EUREKA? What is in it for you?
(abstract)

Launched in 1985, EUREKA has changed the face of R & D cooperation within Europe. It is an innovative tool helping Europe to master and exploit the technologies which will prove decisive in the race for competitiveness.

EUREKA : EUROPE'S INTERFACE WITH THE FUTURE

EUREKA's members are:

• Austria, Belgium, Denmark, Federal Republic of Germany, Finland, France, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and Turkey.

• the European Communities represented by the Commission.

Its aim is to stimulate cross-border cooperation in order to heighten Europe's productivity and competitiveness on the world market.

It interacts with companies and research institutes in EUREKA member countries, which pool their efforts in the development of leading-edge technology.

Its action sweep covers all scientific and technological fields. Special emphasis is, however, placed upon :

1. Energy Technology
2. Medecine and Biotechnology
3. Communications
4. Information Technology
5. Transport
6. New Materials
7. Robotics and Production Automation
8. Lasers
9. Environment

EUREKA IS YOUR INITIATIVE

«Bottom-up» is EUREKA's ground rule. Participants have full responsibility for defining and implementing their scientific and technological cooperation projects. They are their own judges of the best course towards new markets for Europe.

Whatever your role - manager or researcher - and whatever your operating environment - company or applied research laboratory - it is up to you to take the initiative.

EUREKA provides the structure harnessing your dynamism. It is open to all projects with two or more partners from different member countries.

WHAT CAN EUREKA OFFER ?

1. Networking resources

• You have a project proposal, but no partners ?

• You are already involved in a project, but it demands specific skills, necessitating a further partner search ?

• You do not have a specific proposal, but would like to enhance your technological know-how within a European framework ?

The EUREKA National Coordinator for your country can put you in touch with the right people throughout Europe. You can also consult the EUREKA database, which lists more than 300 cooperation projects.

2. A meeting of minds: supportive measures

- Your project is in urgent need of new joint industrial standards?
- It faces technical obstacles to trade?
- It is hampered by barriers to public procurement?

EUREKA offers a forum for direct dialogue between participants and Governments or European authorities. You can put your case and state your requirements to those who have the authority to act.

3. Access to public and private funding

Participants are expected to raise the funding required for the implementation of their projects. However, Governments of EUREKA member countries can decide to provide financial backing for projects. In such an event, they set the level of funding and eligibility conditions.

EUREKA can act as a contact point for participants seeking access to private funding.

4. The hallmark of professionalism

If your project receives the EUREKA seal of approval, it can wear the EUREKA label - an internationally recognised hallmark of professionalism.

EUREKA CRITERIA

In order to become a EUREKA project, your venture must:

- involve at least two partners from different EUREKA countries;
- use leading-edge technology;
- aim at securing a significant technological advance in the product, process or service concerned.

GETTING YOUR EUREKA PROJECT ON THE ROAD

Step 1: proposal blueprint

You must:

- find partners;
- prepare a proposal together;
- negociate a cooperation agreement with your partners;
- organize the financing of the project.

Step 2: submit your proposal to your EUREKA national Project Coordinator

National Project Coordinators are responsible for proposal assessment at national and international level.

Step 3: your proposal is «circulated» around the EUREKA network

Once your proposal has been approved by the relevant two or more National Coordinators, it is «circulated» around the network for 45 days so that other potential partners can express their interest or any pertinent remarks be made.

Step 4: your proposal becomes a EUREKA Project

Once the first three stages have been completed, your project is ready to be announced by the Ministerial Conference.

EUREKA: A FLEXIBLE DECENTRALISED STRUCTURE

National Project Coordinators

They are your interface with the EUREKA organisation and the depositaries of your proposals. They form a link with the relevant national authorities and are in close contact with their counterparts in the other EUREKA member countries, particularly with those processing the proposal files submitted by your partners. They monitor the progress of projects after their launch.

EUREKA Secretariat

The Secretariat is a small support unit in Brussels. It gathers and distributes information on projects, facilitates contacts between partners and promotes the EUREKA concept in conjunction with national authorities.

High level group

This Group is made up of High Representatives appointed by Governments. It formulates general EUREKA policy for approval by the Ministerial Conference. It also monitors the implementation of ministerial decisions.

Ministerial Conference

The Ministerial Conference is the political body of EUREKA and is responsible for furthering the Initiative and its aims. It is composed of Ministers from the nineteen EUREKA member countries and of a member of the Commission of the European Communities. It meets a minimum of once a year, when it announces the new EUREKA projects.

THE EUREKA DATABASE: INFORMATION AT THE TOUCH OF A BUTTON

The EUREKA database contains a wealth of information on announced or proposed projects. It can divulge the R & D fields covered, technological goals, the implementation schedule of projects, budget, participants' names and contact addresses. It is a contact tool for potential industrial and scientific partners.

The information contained in the EUREKA database can be:

• supplied on request by National Project Coordinators or by the EUREKA Secretariat in Brussels (see below for addresses).

• accessed directly

- via the ECHO (European Commission Host Organization) host computer in Luxembourg. For this you must have a standard terminal and be linked to ECHO via the X25 data network (international address +270 448 112) or via the international telephone network (+352 43 64 28). Password: EUREKA.
- via the TELETEL network in France using a Minitel terminal.

Accessible on the French Transpac network (Code 3615) or via an international line (+33 36 43 15 15). Select EUROBASE service.

APPENDIX 5.2

Mr. Jonathan W. Martin

Service life prediction from accelerated aging test results using reliability theory and life testing analysis
(abstract)

SERVICE LIFE PREDICTION FROM ACCELERATED AGING TEST RESULTS USING RELIABILITY THEORY AND LIFE TESTING ANALYSIS

JONATHAN W. MARTIN

CENTER FOR BUILDING TECHNOLOGY
NATIONAL BUREAU OF STANDARDS
GAITHERSBURG, MD 20899

ABSTRACT

The prediction of the service life of a building product is needed for making life cycle cost decisions, for determining the risks and liabilities in marketing a product, and for helping to identify the causes of a product's failure. Accurate estimates of the service life for building products, however, have traditionally been difficult to obtain. The most timely source for obtaining service life estimates for a building product is through the use of accelerated aging tests. Unfortunately, most accelerated aging tests for building materials are not capable of providing quantitative estimates of a product's service life since they were only designed to screen out bad products or to make qualitative comparisons between the service lives of different products. To rectify this situation, accelerated aging test procedures used in high technology industries were applied to building products. The emphasis in these procedures is in the mathematical analysis of the life data. One of the more successful mathematical procedures is reliability theory and life testing analysis. In this paper, the basic format of this analysis procedure is outlined and several applications are presented in which these techniques were applied to predicting the service lives of different building materials and products. The results of these analyses are very promising and it is concluded that reliability theory and life testing analysis techniques should be readily adaptable for predicting the service lives of a wide range of building products and materials.

APPENDIX 5.3

EU 454 EUROCARE DATA

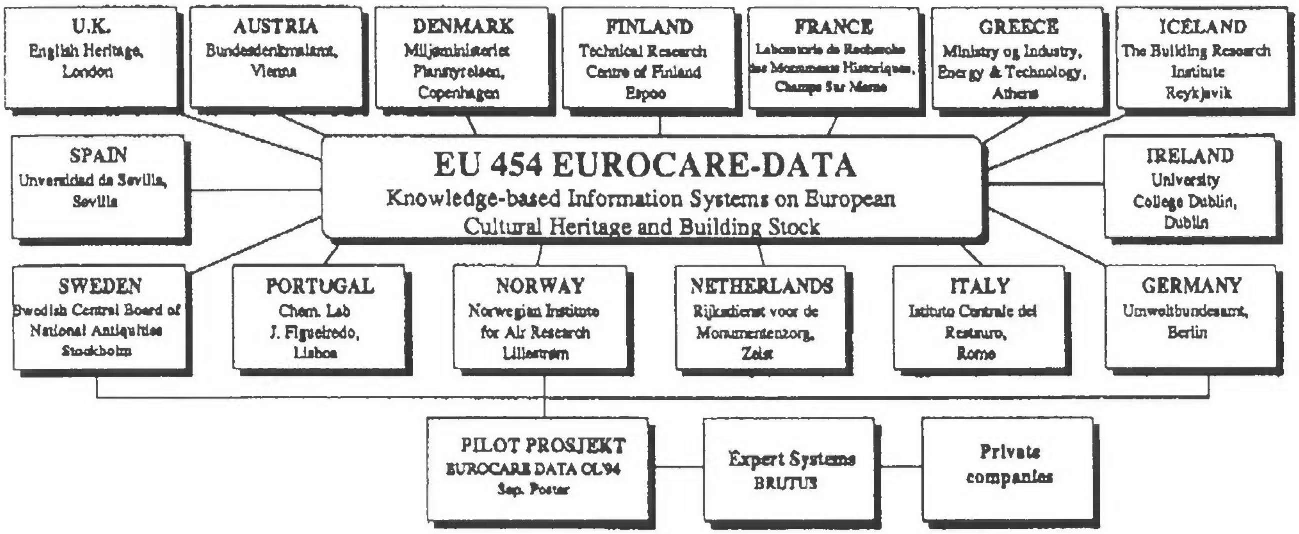
EU 454 EUROCARE DATA

EU 454 EUROCARE DATA, Knowledge-based information systems on European cultural heritage and building stock.

Aims:

Establishing an integrated information management system EUROCARE DATA for European countries, which should help increase the Service Life of the built environment, make conservation of these environment easier and cut maintenance cost (Yearly Life Cycle Cost).

Participants



Results obtained

- German MONUFAKT system as a "mother"-stystem
- National network organization established between Germany, Sweden and Norway (see separate poster). Other countries invited to join.
- Formal connection with Council of Europe "Documentation Group".
- Expert system for diagnosis and reparation of concrete structures are being developed (BRUTUS-project, see separate poster).

Plans for:

1991:

- Conclusion of planning, organization and funding of "EUROCARE DATA OL 94" (see separate poster).
- Elaboration of national reports

1992/1993:

- Data system development
- Data definition and aquisition

Performed activities

- Seminars and workshops in connection with EUROCARE Board meeting since 1989.
- Proposals for funding to CEC/STEP-program 1990-1992.
- Elaboration of national status reports.
  1. Are the activities in accordance with your project plans? No.
  2. Which are the problems? Lack of national network organization and funding. Needs of supportive measures in terms of planning, communication and networking.

APPENDIX 6

Poster exhibition

EUROCARE

EUREKA PROJECT EU 140

POSTER - EXHIBITION

PP = project proposal
* = abstract was presented in the conference papers

		Presented by
A:	**ORGANIZATIONS AND RESEARCH PROGRAMMES**	
1.	EUREKA	Ruberg
2.	STEP CT 90-0107	Cooper
3.	STEP CT 90-0100 THE EFFECTS OF AIR POLLUTANTS ON THE ACCELERATED AGEING OF CELLULOSE CONTAINING MATERIALS	Havermans
4.*	STEP CT 90-010 GRANITIC MATERIALS AND HISTORICAL MONUMENTS	Vicente
5.*	STEP PL 900512 CRITERIA FOR STABILITY OF ARCHAEOLOGICAL	Saaby
6.*	STEP CT 90-015 .... CORRELATION BETWEEN NATURAL AND ARTIFICIAL AGEING OF TANNED LEATHER	Saaby
7.	CONDITION ASSESSMENT OF HISTORIC BUILDING FACADES, STEP, PP	Lewis
8.*	CIB/RILEM	Sjöström
9.	FRENCH-GERMAN RESEARCH PROGRAMME	Philippon
10.	ECE ICP ON EFFECTS ON MATERIALS	Kucera
11.	NBS-MK	Haagenrud
12.	NTNF	Søgnen
13.	NTNF	Høst
14.	MINISTRY OF ENVIRONMENT	Ofstad
B:	**INFORMATION DATABASES - SYSTEMS**	
1.*	EU 454 EUROCARE-DATA	Haagenrud
2.	EUROCARE-DATA SWEDEN	Näslund
3.	EUROCARE-DATA GERMANY, MONUFAKT	Fitz
4.*	EUROCARE-DATA NORWAY, OL-94	Korsæth

5.*		EUROCARE-DATA NORWAY, SEFRAK	Wester
6.*		EUROCARE-DATA NORWAY, GAB	Rygh
7.*		EUROCARE-DATA NORWAY, FORUT	Blankvoll
8.*	EU 598	EUROCARE REFRAN	Baldi/ Carlucci
9.		EUROCARE REFRAN/EUROCARE CENTRE	Rosvall/ Lagerqvist

C: MONITORING & CONTROL METHODS

1.*	EU 615	EUROCARE WETCORR	Engdal/Støre
2.*	EU 640	EUROCARE WETDRY-DEP	Sjöström
3.		EUROCARE WETDRY-DEP, NILU	Henriksen
4.*	EC-50	ACOUSTICS, PP	Storemyr
5.*	EC-25	EUROCARE AIMS (Air infiltration in museums and historic buildings), PP	Holmberg
6.*	EC-47	RADARDCARE (Radarcare in restoration and for archaeological investigations), PP	By
7.*	EC-54	PHOTOCHEM UV (Photochemical dosimeters for measurements of ultraviolet solar radiation), PP	Sjöström
8.*	EC-53	PHOTOGRAM (Measurement of deformation by use of photogrammetical methods), PP	Sjöström
9.*	EC-43	SERVLIFE (Control system for durability and service life of building products), PP	Sneck
10.		Depth of Weathering determined by C and O Isotopes: A new Application of the Laser Microprobe, PP	Åberg

D: BUILDING MATERIALS

1.	EU 341	EUROCARE FOUNDATION	Pawlak
2.*	EU 455	EUROCARE PROWOOD	Heimdal
3.		EUROCARE PROWOOD, NILU	Henriksen
4.		EUROCARE PROWOOD, MYCOTEAM	Holøs
5.		EUROCARE PROWOOD, SIB	Jernberg
6.*		EUROCARE PROWOOD, SP	Samuelsson

7.		EUROCARE PROWOOD, UNIVERSITY OF BERGEN	-
8.		EUROCARE PROWOOD, SWEDISH UNIVERSITY OF AGRICULTURAL SCIENCES	-
9.*	EU 664	EUROCARE CON-COAT	Olafsson
10.*	EC-45	EUROLIME (Development and manufacturing of lime for preservation of monuments), PP	Althaus/ Patzak
11.*		EUROLIME, NORWAY, PP	Waldum/ Ibenholt
12.*	EC-48	ENACCOUNT (Energy and environmental influence by the use of building materials), PP	Fossdal/ Høidalen
13.*	EC-51	ELKINET (Elkinet ahead-cathodic protection of concrete), PP	Kubberød
14.*	EC-52	TRANSICE (Atmospheric ice on transmission line insulators), PP	-
15.*	EU 401	EUROCARE CONCRETE	-
16.	EC-55	CONLIFE (durability rehabilitation and service life of concrete structures), PP	Danielsen

E: CULTURAL HERITAGE

1.*	EU 390	EUROCARE LAST	Mathews
2.	EU 446	EUROCARE CAREBUILD	Apeland/ Tjønneland
3.	EU 488	EUROCARE FRESCO	Patzak
4.*	EU 489	EUROCARE BIODECAY	Busse
5.*	EU 490	EUROCARE NONNBERG	Koller
6.	EU 491	EUROCARE PARZ	Koller
7.*	EU 492	EUROCARE WALLPAINT	Koller
8.	EU 496	EUROCARE EUROMARBLE	Simon
9.*	EC-42	MED-GLASS (Weathering of medieval glass), PP	Schreiner
10.*	EC-41	NDA-ART (Non destructive analysis of objects of art and archaeology), PP	Schreiner
11.*	EC-46	PAPERMEC (Methods to improve the mechanical properties of degraded paper), PP	Timmler-Doornekamp

12.*EC-49	NORHER (Norwegian Heritage), PP	Sulheim
13.*EU 595	EUROLITH	Oger/Tripette
14. EU 316	EUROCARE COPAL	Mach
15.*EU 396	EUROCARE PROMOS	-

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ABSTRACT
The 1st EUROCARE Market Place Conference took place at Lillehammer in Norway from 1st to 4th October 1991. The aims of the conference were to bring together those engaged on conservation, restoration and maintenance in order to report on existing projects and promote new ones within EUROCARE, as well as addressing the CEC's STEP and BRITE/EURAM programmes. The conference attracted about 120 participants from 14 European countries and the USA. 72 companies and research organizations were represented.

* Kategorier: Åpen - kan bestilles fra NILU A
Må bestilles gjennom oppdragsgiver B
Kan ikke utleveres C